BANARAS HINDU UNIVERSITY

B.Sc. (Hons.) Courses

Offered by

FACULTY OF SCIENCE

CONTENTS

FACULTY OF SCIENCE

Ordinances governing B. Sc. (Hons.) Degree Programme
(Effective from 2009-10)

Under the powers conferred by Section 4A of the Banaras Hindu University Act 1915, as amended and under the provision of Section 18 of this Act, the University hereby institutes the six semester programme of the B. Sc. (Hons.) Degree and makes the following ordinances governing admission, courses of study, examination and other matters relating to B. Sc. (Hons.) Degree under the Faculty of Science of the Banaras Hindu University. The programme shall run at the Faculty of Science and Mahila Maha Vidyalaya (MMV).

B. Sc. (Hons.) Degree
I Structure

1. B. Sc. (Hons.) Degree shall be awarded to candidates on successful completion of a six semester programme of study.

2. Admission, studies, examinations, continuance from semester to semester, promotion and declaration of results for the B. Sc. (Hons.) Degree are given in the following ordinances.

3. Candidates shall choose a combination of three main subjects from the list given below (Table 2), which he/ she shall study in semesters Ist, IInd, IIIrd and IVth.

4. Apart from the combination of three subjects, a student shall also study an ancillary subject in each Semester from Semester I to V (Tables 5 & 6).

5. A student shall also study compulsory courses during Semesters Ist to IVth (Tables 1 & 5).

6. The student may choose, if he/ she so desires, one or both the optional courses of English (English I and II) in semesters V and VI.

7. In the third year, i.e., Semesters Vth and VIth, a student shall offer an honours subject out of the three main subjects of his/her combination of three subjects studied in the First and Second years. Apart from the honours subject, the student shall also be required to complete a Project/Field study/Elective course in Semester VI.

8. The credits of each of the three main subjects shall be 6 in the first year and in the second year, while ancillary subject in each semester (Semester I to V) shall have 3 Credits. The compulsory courses in each semester (Semester I to IV) shall have 1 Credit each. The 'Project/Field study/Elective' shall carry 4 Credits (Table 4).

The lists of Main Subjects, Ancillary Subjects and Compulsory courses along with their Credits are given below in Tables 1 to 6.

Table 1: List of Main subjects, Ancillary subjects and Compulsory courses.

Main Subjects	Ancillary Subjects	Compulsory Courses
Botany	Biology	Environmental Studies
Chemistry	Physics	English
Computer Science	Statistics	History of Science in Ancient India**
Geography	Chemistry	
Geology	Computer Science	Philosophy of Science**
Home Science	Elements of Earth Science	Science Communication**
*Industrial Microbiology	Mathematics	Ethics in Science**
Mathematics		English I+
Physics		English II+
Psychology		
Statistics		
Zoology		

Vocational subject; not available for honours.

***Any two of these shall be taught in Semester III and IV .*

+*Optional English courses, the student may study them, if he/she so desires.*

Table 2: List of subject combinations available in Faculty of Science

S.N.	Mathematics Group	S.N.	Biology Group
1.	Physics, Maths, Chemistry	1.	Botany, Zoology, Chemistry
2.	Physics, Maths, Computer Science.	2.	Botany, Chemistry, Industrial Microbiology
3.	Physics, Maths, Statistics	3.	Botany, Geology, Chemistry
4.	Physics, Maths, Geology	4.	Geology, Geography, Chemistry
5.	Physics, Maths, Geography	5.	Zoology, Chemistry, Psychology
6.	Statistics, Maths, Computer. Sci.		

Table 3: List of subject combinations available in MMV.

S. No.	Mathematics Group	S. No.	Biology Group
1.	Physics, Maths, Chemistry	1.	Botany, Zoology, Chemistry
2.	Physics, Maths, Statistics	2.	Botany, Home Sc., Chemistry
3.	Physics, Maths, Geography	3.	Zoology, Chemistry, Psychology
4.	Physics, Maths, Computer Sc.		
5	Statisitcs, Maths, Computer Sc.		

Table 4: Pattern of Credit distribution.

Semester	Main Subject	Ancillary Course	Compulsory Course	Total Credits
I	18 (3×6)	3	1	22
II	18 (3×6)	3	1	22
III	18 (3×6)	3	1	22
IV	18 (3×6)	3	1	22
V	18 (one sub.)	3	0	21
VI	22 (one sub.)*	0	0	22
			Total Credits	131

*including 4 credits project/elective/field study.

Note: *English I and English II shall have one credit each. However, these credits will not be considered in computation of SGPA and CGPA.*

Table 5: Description of Ancillary subjects and Compulsory courses for Mathematics and Biology groups.

Stream : Biology	Stream: Mathematics	Both streams
Ancillary	Ancillary	Compulsory
Sem. I Physics Sem. II Maths/Elements of Earth Science*	Biology-I Biology-II	Environmental Studies English
Sem. III Statistics I Sem. IV Computer Science	See Table 6	Any one of *Science Communication; Ethics in Science* Any one of *Philosophy of Science, History of Science in Ancient India*
Sem. V Statistics II Sem.VI Project**/**Elective/ Field study		English I+ English II+

*Elements of Earth Science not allowed for subject combinations 3 & 4 of Science Faculty listed in Table 2.

** Alternative courses: Science Communication; Ethics in Science.

+Optional English language courses

Table 6: Description of Ancillary subjects for Mathematics stream (Semester III-V) and Project/Elective/Field Study in VI Semester.

S.No.	Combination	Sem. III	Sem. IV	Sem. V	Sem. VI
1.	Physics+Maths+Chem.	Stat. I	Comp.Sci.	Stat. II	Project/ Elective/ Field study
2.	Physics+Maths+Com.Sc.	Stat. I	Chemistry	Stat. II	
3.	Physics+Maths+Stat.	Chem.	Comp.Sci.	Earth Sc.	
4.	Physics+Maths+Geology	Stat. I	Comp.Sci.	Stat. II	
5.	Physics+Maths+Geog.	Stat. I	Comp.Sci.	Stat. II	
6.	Statistics+Maths+Com.Sc.	Chem.	Physics	Earth Sc.	

II.   Entrance Requirements

1. A candidate shall be eligible for appearing in the Under-graduate Entrance Test (U.E.T.) leading to admission to B. Sc. (Hons.) Semester I, if he/she has passed the following:

Admission to 3-Year B. Sc. (Hons.) <u>Maths Group</u>	10+2 or equivalent examination with a minimum of 50% marks in the aggregate in Science subjects with Physics, Mathematics plus one of the following: Chemistry, Statistics, Geology, Computer Science, Geography, and Informatics Practices.
Admission to 3-Year B. Sc. (Hons.) <u>Biology Group</u>	10+2 or equivalent examination with a minimum of 50% marks in the aggregate in Science subjects with Physics, Chemistry plus any one of the following: Biology, Geology and Geography.

2. Applicants should not be more than 22 years of age on July 1st of the year of seeking admission.

III.   Admission Procedure

1. Admission in B. Sc. (Hons.) Semester I programme of study shall be made on merit in the UET.
2. Science Faculty/MMV shall have an Admission Committee for B.Sc. (Hons.) undergraduate admission, constituted under statute 18 (xxiii) by the Academic Council and consisting of the Dean/Principal and two senior- most members of the teaching staff of the Faculty/MMV (Science Stream). Admission shall be made in accordance with these ordinances and the rules made thereunder.
3. Admission cannot, however, be claimed by any candidate as a matter of right. The admission or re-admission of a candidate shall be entirely at the discretion of the

Admission Committee which may refuse to admit any student without assigning any reason there for.

4. On his/her selection for admission to the B. Sc. (Hons.) Semester I programme, the candidate shall, within the time fixed by the Dean/Principal, deposit the fees prescribed for the programme. If the candidate fails to deposit fees within the stipulated time, his/her selection shall automatically stand cancelled. Such a candidate shall not be admitted to the concerned programme unless a fresh order of selection and extension of date for payment of fees is issued by the Dean/Principal of the Faculty/College concerned.

IV. Admission of Foreign Nationals

Applications of foreign nationals nominated by the Government of India under scholarship schemes and self-financing Foreign Nationals shall be entertained for the aforesaid programmes. They shall not be subject to the Entrance Test provided they have passed the equivalent qualifying examinations and satisfy the minimum eligibility requirements with relaxation in maximum age for admission.

Reservation to the extent of 15% of the quota of seats in a subject combination, on supernumerary basis, for Foreign Nationals shall be made for admission to each of the various aforementioned subject combinations available in the Faculty/MMV provided the applications are routed through the office of International Students Advisor, BHU.

The International Students Advisor shall get examined the eligibility etc. of each applicant and shall issue the eligibility letter to the concerned foreign national, if found eligible. Further details of the process etc. shall be available from the office of the International Students Advisor, BHU, Varanasi, India.

V. Reservation/Weightages

1. 15% Seats shall be reserved for Scheduled Caste and 7.5% for Scheduled Tribe candidates in each subject combination. Admission against these seats shall be made provided the candidate has passed the qualifying examination and appeared in the Entrance Test. The vacant seats reserved for SC/ST candidates, if any, shall be filled as per Government of India Rules. **Appearance in the Undergraduate Entrance Test is mandatory for admission**.

2. 5% supernumerary seats shall be reserved for the sons/ daughters of permanent employees (including those on probation) of the University currently in service or were in service during the academic session immediately preceding the one (session) for which the Entrance Test is held, provided the candidate fulfils the minimum eligibility requirements and qualifies in the UET. BHU employees' sons/daughter's category applicants shall be required to submit the certificate of the employee ward only in the prescribed format duly signed and issued by the Dy. Registrar (Administration) if called for admission.

3. 3% seats shall be reserved for PC (Physically Challenged) candidates (visually impaired 1% + hearing impaired 1% + orthopedically handicapped 1%) provided they fulfill the minimum eligibility requirements and qualify in the UET. They shall have to submit a PC certificate issued by the district CMO at the time of submitting the application. Candidates who claim for PC category shall be considered under this

category on an approval from the University Medical Board only at the time of admission.

VI.   Attendance

(a)   A student is required to have full, i.e., 100%, attendance and condonation upto 30% can be considered for specific cogent reasons. Out of this 30%, only 10% condonation will be permitted without taking any application from the student. Rest 20% condonation may be given by the Dean/Principal MMV. Further, a student shall be deemed to have minimum percentage of attendance only if, apart from the above, he/she has attended at least 50% of the classes in each subject also. The cogent reasons for condonation are given below.

(i)   Participation in NCC/NSC/NSS Camps duly supported by certificate.

(ii)   Participation in University or College Team Games or Interstate or   Inter-University tournaments, duly supported by certificate from the Secretary of the University Sports Board or President of the College Athletic Association concerned.

(iii) Participation in Educational Excursions, which form a part of teaching in any subject conducted on working days duly certified by the Dean/Principal, MMV.

(iv)   University Deputation for Youth Festival duly certified by the Dean/Principal, MMV.

(v)   Prolonged illness duly certified by the Medical Officer or the Superintendent, S.S. Hospital, Banaras Hindu University or any other Registered Medical Practitioner, provided such certificate is submitted to the Dean, Faculty of Science/Principal, MMV in time.

(vi) **No relaxation beyond 30% shall be considered in any case.**

(b)   The attendance of a newly admitted candidate shall be counted from the date of his/her admission, or date of beginning of classes which ever is later, while in the case of promoted candidates, attendance shall be counted from the date on which respective class begins. However in case of promotion after declaration of results of supplementary examination (if any), the attendance will be counted from the date of admission in the respective case.

(c)   There shall be an Attendance Monitoring Committee in the Faculty/MMV under the Chairmanship of the Dean/Principal.

VII.   Scheme of B.Sc. (Hons.) Programme

The details corresponding to schemes of courses in different subjects and laboratory exercises are given under respective subjects in B.Sc. (Hons.) syllabus.

VIII.   Scale of Tuition and other fees

All regular candidates of B.Sc. (Hons.) shall pay the following fees (in Rs.) per Academic year:

Tuition Fee	150.00
Faculty/Institute Development Fund	200.00
Lab Fee & Development Fund*	170.00
Academic Assessment#	200.00
Library Fee & Development Fund*	100.00
Computer & Internet Facility	100.00
Student Health Welfare	280.00
Extra Curriculum Activity Fund	170.00
Border's/Delegacy Union Fee	10.00
Student's Union Fee+	10.00
Student's Welfare Fund	100.00
Total	**1490.00**
Admission	50.00
Enrolment	50.00
Identity Card & Passbook	26.00
Alumni Activity Fund	50.00
Degree Charges	100.00
Training & Placement	100.00
Library Caution Money	500.00
Total	**876.00**
Grand Total	**2366.00**

*Lab Fee Rs. 20 + Development Fund Rs. 150 = Rs. 170 per subject; Existing Lab Fee Rs. 10 per subject

#Per University Examination

+No Students Union Fee will be realized till the Students Union remains suspended.

Hostel Fee	Indian Nationals	Foreign Nationals
Hostel Rent*	160.00	300.00
Fan Fee	100.00	100.00
HDMF	2000.00	2400.00
Mess Caution Money	800.00	1000.00
Fan Caution Money	1000.00	1000.00
Hostel Annual Maintenance Fee	50.00	50.00
Hostel Establishment Charges	0.00	100.00
Hostel Development Charges	0.00	500.00
I.H. Annual Maintenance Fund	0.00	2400.00
Total	**4110.00**	**7850.00**

* Rs. 500/- will be charged from four Hostellers (viz. Triveni, Sardar Patel, Atreya and Sukanya) separately.

Note: *The above fees may be revised by the Academic Council from time to time.*

IX.   System of Examination

1. The examinations of B.Sc. (Hons.) programme in the Faculty of Science/MMV shall be conducted in six semesters ordinarily in December/May or on such dates as may be fixed by the Dean.

2. The academic performance of a candidate shall be evaluated in respect of the courses of study prescribed for each semester through the examinations held for respective semesters.

3. **The credit system:**

   B.Sc. (Hons.) programme shall have a specified number of credits. These credits describe the weightages of various courses of the programme. The number of credits along with grade points that the student has satisfactorily completed measures the performance of the student. Satisfactory progress of a student is subject to his/ her maintaining a minimum Cumulative Grade Point Average (CGPA), as well as minimum grades in different courses of the programme. A certain number of credits as specified in the syllabus must be earned by the student to qualify for the degree. Description of credit distribution for main subjects, ancillary and compulsory courses are already shown in Table 4.

(A) Assignment of credits:

Credits of a course shall be assigned in the following manner:

(a) For all theory (Lecture) courses, one credit shall be assigned for one one-hour lecture per week in a semester.

(b) Each laboratory hour per week in a semester shall be assigned half credit.

(c) Credits shall be in whole numbers. As far as possible, each theory course shall be minimum of 3 Credits, while each laboratory course shall be of minimum 2 credits.

B) **The Performance of a candidate in a semester or upto a semester shall be measured by SGPA and CGPA, details of which are given below:**

SGPA :   Semester Grade Point Average.

CGPA : Cumulative Grade Point Average.

Calculation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

$$(i).\quad SGPA = \frac{\sum_{i=1}^{n} C_i.P_i}{\sum_{i=1}^{n} C_i}$$

where,

C_i = Number of credits assigned for the ith course of a semester for which SGPA is to be calculated.

P_i = Grade point earned in the ith course.

i =1, ------- n, represent the number of courses in which a student is registered in the concerned semester.

Note: *For calculation of SGPA and CGPA, credits of compulsory and optional courses shall not be taken into account.*

$$(ii).\quad CGPA = \frac{\sum_{j=1}^{m} C_j.P_j}{\sum_{j=1}^{m} C_j}$$

where,

C_j = Number of credits assigned for the jth course, up to the semester for which CGPA is to be calculated.

P_j =   Grade point earned in j^{th} course.

j = 1, ------- m; represent the number of courses in which a student was registered up to the semester for which CGPA is to be calculated.

(C) <u>Grading System:</u> The grading system, as detailed hereunder in **Table 1** shall be applicable for each course:

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Table - 1

Award of Grades Based on Absolute Marks

(If the number of candidates in the paper is less than 20)

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Marks Range (Out of 100)	Grade	Grade Point
90 -100	S	10
80 - 89	A	9
70 - 79	B	8
60 - 69	C	7
50 - 59	D	6
40 - 49	E	5
Passed with Grace	P	4
00 - 39	F	0
Non-appearance in examination (Incomplete)	I	0
Incomplete Project / Dissertation / Training	X	0

<u>Explanation:</u>

Latter grades **S, A, B, C, D, E and P** in a course mean that the candidate has passed that course.

The F grade denotes poor performance, i.e., failing in the course. A student has to appear at subsequent examination(s), if provided under the ordinances in all courses in which he/she obtains "F" grade, until a passing grade is obtained.

The I Grade: The "I" Grade is awarded, when a student does not appear in the examination of course/courses. This shall be treated as "F" Grade.

The X Grade: An "X" Grade is awarded to a student if he/she does not complete Project/Dissertation/Training. This will be converted to a regular grade on the completion of the Project/Dissertation/Training Work and its evaluation. The "X" Grade shall be treated as "F" Grade.

C. <u>Grace Rule:</u> Tabulators shall award grace marks as per the following guidelines:

(1). A student who fails in not more than 3 theory courses by total marks of not more than ½ the number of total theory courses of the semester (any) fraction is rounded off to the next higher number), shall be awarded grade "P" (in place of grade "F") of Grade Point 4 in the concerned courses.

(2). Grace mark will not be awarded for making up shortfall in minimum SGPA/CGPA or improving the grade.

X. Confidential Clause

Examination System:

Each theory/practical/seminar/field work/project work/dissertation course shall be of 100 marks. For evaluation, the overall structure of the distribution of marks in a course shall be such that 30 marks are allotted to various assessments during the semester, while 70 marks shall be allotted for the end semester examinations.

(A). The scheme of assessment during the semester (for 30 marks):

(i)   The assessment (sessional) in theory courses shall comprise a class test of 1 hour duration for 20 marks and 10 marks for regularity/ assignment/viva/quiz/or any other similar test.

The 30 marks of sessional for courses of Laboratory exercises shall be based on completion of the laboratory exercises in due course of time/keeping up of practical record book/punctuality in the class/viva to the practicals/ any other relevant judgment.

(ii). At the discretion of the concerned Head/Coordinator, a student who could not appear in the internal test(s) already conducted on account of some cogent reasons, such as late admission, illness, etc., may be allowed to appear in the internal assignment/test held for such a student.

(iii). The class tests shall be conducted by the teacher (or group of teachers) teaching the course and the marks shall be displayed on the Notice Board.

(iv). All Heads/Coordinators shall ensure that all internal assessment marks of sessional are sent to Controller of Examination prior to the commencement of End Semester examination.

(v). There shall not be any sessional marks for courses, which involve Seminar/Field work/Project Work/Dissertation.

(vi). Sessional marks of a course shall be carried over for failed students in the course

(B). End Semester Examination and evaluation (for 70 marks):

(I)   The question papers shall be set and the answer-scripts shall be evaluated by the teachers of the concerned courses. If there are more than one teacher teaching the course, the question paper shall ordinarily be set and evaluated by a teacher of the group, appointed by the Board of Examiners.

(II) The End Semester examination answer-scripts shall be shown to the students after evaluation by the concerned teachers within 7 days of the last examination for the semester. Thereafter, within a week, all the answer books along with the statement of marks shall be sent to the Office of the Controller of Examinations for declaration of the results.

(III) In case of any objection by a student in the evaluation, the same shall be looked after by a panel of two senior faculty members, to be nominated by the Dean, whose decision shall be final.

(IV) Question papers for a course may be set separately for the different combinations involving the same course. The teacher(s), who teach the concerned combination involving a course shall set the question paper and evaluate the answer-scripts.

(V) Wherever there are more than one examiner for different combinations involving the same course, moderation shall be done by the Moderation Board to ensure the same level of difficulty for all the different question papers set for the same course.

(VI) In cases of practical examination and project evaluation, external examiner may be appointed if and where considered necessary.

(VII) **There shall be no provision for re-evaluation**.

(VIII) Compulsory and optional courses shall not be evaluated. However, the prescribed minimum attendance in these courses shall be necessary.

Admit Card (for End Semester Examination):

A candidate may not be admitted into examination room unless he/she produces his/her admit card to the officer conducting the examination or satisfies such officer that it shall be subsequently produced.

The Controller of Examinations may, if satisfied that an examinee's admit card has been lost or destroyed, grant duplicate admit card on payment of a further fee of Rs. 10/-

XI: Promotion Rules and Supplementary Examination

There shall be no supplementary examination for Ist, IInd, IIIrd and IVth semesters. However, there shall be a provision of supplementary examination for Vth and VIth semesters after declaration of the result of VIth Semester. Students failing in courses of Vth and VIth semesters may appear in supplementary examination(s) or subsequent main examination(s).

(A) *First Semester Course & Examination:*

The candidates who have taken admission in B.Sc. (Hons.) programme First Semester in a session can be put in the following two categories on the basis of their attendance in the Semester:

I. (i) Those who have put in the required minimum percentage of attendance for appearing in the First Semester Examination and filled up the examination form in time for appearing at the First Semester Examination.

(ii) Those who did not put in the required minimum percentage of attendance for appearing at the First Semester Examination or did not fill up examination form in time for appearing at the First Semester Examination.

Candidates under Category I(i) are eligible for appearing at the examination of First Semester, while *candidates under Category. I(ii)* are not allowed to appear at the examination of the Semester. However, category *I(ii)* candidates are allowed to reappear at the Undergraduate Entrance Test (UET) of subsequent year(s) for seeking admission afresh. This implies that **no readmission is permissible to those who do not put in the required percentage of attendance for taking the examination or did not submit the examination form in time.**

II.   After appearing at the Examination of the First Semester the candidates can be put in the following categories in the context of declaration of the results of the First Semester Examination:

(i)   **Passed,** i.e., those who have passed in all courses of the examination of the Semester.

(ii)   **Promoted,** i.e., those who have not passed in all the courses of the Semester.

(iii) **Minimum passing grade** shall be Grade 'E' for each course. However, candidates with grade 'P' in a course shall also be considered as passed in that course.

(iv)   **Promotion to Second Semester**: All students who have put in the minimum percentage of attendance in Semester I and filled up the examination form in time shall be promoted to the Semester II.

(B) *Second Semester Course & Examination:*

As in the Ist Semester, in the IInd and subsequent Semesters, all the candidates who have put in the minimum percentage of attendance for appearing at the Examination and have filled in the examination form in time for appearing at the End Semester Examination shall be allowed to appear at the respective examinations. However, students who have not put in the minimum percentage of attendance or did not fill up the examination form in time in a Semester shall be allowed to take re-admission in that Semester **(except in the First Semester where re-admission is not permitted)**.

(C) *Declaration of results after II Semester (based on the results of I and II Semester Examinations):*

After declaration of results of the I & II Semesters, a candidate can be put in the following two categories:

(i) **Passed:** A candidate who has passed in examinations of all the courses of Ist and IInd Semesters.

(ii) **Promoted:** A student, who does not pass in all the courses of either 1st or 2nd semester or both, shall be promoted to the 3rd semester if he/she has obtained at least 4.0 CGPA. All such students shall have the option to clear the courses, in which they had failed, in the subsequent available examination(s) of the concerned semester as ex-students.

(iii) **Failed:** A candidate who has failed in one or more courses or failed to appear at any of the examinations of Ist and IInd Semesters taken together, and he/she has obtained less than 4.0 CGPA shall be treated as failed.

(D) *Promotion to Third Semester:*

(i)   A candidate who comes under the category **'Passed or Promoted'** is eligible to be promoted to third Semester if otherwise eligible.

(ii)   Failed candidates shall not be promoted to the IIIrd Semester. However, they shall be promoted to the third semester when they become eligible to come under the category of either 'Passed' or 'Promoted' as explained above after passing the Failed papers in the subsequent available examinations as ex-students.

(E) *Promotion to Fourth Semester:*

All students who have put in the minimum percentage of attendance in IIIrd Semester and filled in the examination form in time shall be promoted to IVth Semester.

(F) *Declaration of Results after IVth Semester (based on the results of Ist, IInd, IIIrd & IVth Semester Examinations):*

After declaration of results of III & IV Semesters, a candidate can be put in the following two categories:

(i) **Passed:** A candidate who has passed in all the courses of Examinations of Ist, IInd, IIIrd & IVth Semesters.

(ii) **Promoted:** A student, who does not pass in one or more courses of 1st, 2nd, 3rd or 4th semesters or all of them, shall be promoted to the 5th semester if he/she has obtained at least 4.0 CGPA. All such students shall have the option to clear the courses, in which they had failed, in the subsequent available examination(s) of the concerned semester as ex-students.

(iii) **Failed:** A candidate who has failed in any course or failed to appear at any examination of the courses of Ist, IInd, IIIrd or IVth Semesters and obtained less than 4.0 CGPA.

(G) *Promotion to the Fifth Semester:*

A student, who passes all courses (items) of Semester I, II, III, & IV is eligible to be promoted to the V Semester if otherwise eligible. Further, a student who has not passed all the courses of Semester I, II, III or IV can be promoted to the V Semester if he/she has obtained at least 4.0 CGPA. All such students shall have the option to clear the courses in which they had failed, in the subsequent available examination(s) of the concerned semester as ex-students.

Failed candidates shall not be promoted to the Vth Semester. However, they shall be promoted to the Vth semester when they become eligible to come under the category of either 'Passed' or 'Promoted', as explained above, after passing the Failed papers in the subsequent available examinations as ex-students.

Allotment of Honours subjects:

Candidates who have passed in all Examinations of courses of I, II, III & IV Semesters, or who have been promoted to V Semester shall submit their applications for allotment of Honours subject in the beginning of the V Semester to the Dean, Faculty of Science/Principal, MMV. Allotment of Honours subject in Semester V shall be done on the basis of merit, choice and availability of seats in the Honours subject.

The merit shall be calculated as the sum of (i) the CGPA at the end of Semester IV and (ii) the weighted average of grades of the courses in the subject of Honours in four Semesters where weights shall be the credits for the concerned courses. Further, the honours subject shall be first allotted to those candidates who belong to the category 'passed' after the declaration of result of End Semester Examination of IV Semester. The candidates who are not in the 'passed' category, but have been promoted to Semester V shall be the next to be allotted the Honours subject in Semester V.

(H) *Promotion to Sixth Semester:*

All students who have put in the minimum percentage of attendance in V Semester and filled in the examination form in time shall be promoted to VI Semester.

(I) *Declaration of Results after VI Semester (based on results of I, II, III, IV, V & VI Semester Examinations):*

After declaration of results of Fifth and Sixth Semesters, a candidate can be put in the following two categories:

(i) **Passed:** A candidate who has passed in all the courses (including Project/Elective/Field study) of I, II, III, IV, V & VI Semesters and obtained at least CGPA of 5.0.

(ii) **Failed:** All those students who have not "Passed" shall be categorized as "Failed".

Such failed students may clear their failed courses in subsequent examinations as ex-students. There shall be a provision of supplementary examinations for V and VI Semesters after declaration of results of VI Semester. Students failing in courses of V and VI Semesters may appear in the supplementary examination or subsequent main examination(s).

A student who has failed in a course shall get two more chances to clear this course subject to the maximum duration for passing the course. Further, each candidate shall have to clear all the courses within the maximum period of 6 years from the date of his/her latest admission.

(J) *Declaration of Division:*

A candidate who has passed in all the papers/ courses of I, II, III, IV, V & VI Semesters of the 3-year B.Sc. (Hons.) programmes taken together shall be declared as **'Passed'**. Such passed candidates may be awarded with the division according to the following criteria:

(i) First Division with distinction	:	CGPA 8.5 and above
(ii) First Division	:	CGPA 6.5 and above, but below 8.5
(iii) Second Division	:	CGPA 5.0 and above, but below 6.5

Note: The SGPA and CGPA shall be computed upto 2 places of decimals (truncated at the second place).

The conversion formula for converting CGPA to the corresponding Percentage of Marks will be as follow:

$$X = 10 Y - 4.5$$

where, X = Percentage of Marks

Y = CGPA

Further Clarifications:

(a) A student has to clear the whole B.Sc. (Hons.) programme in *NOT MORE THAN SIX YEARS* from the latest admission to the First Semester of the programme. Even after that if a student fails, he/she shall have to leave the programme.

(b) A student who is promoted to a higher semester or readmitted to a semester due to shortage of attendance shall be required to study the same syllabus as being taught in that year.

Syllabus:

The syllabus for the main subjects shall be framed by the Department concerned. However, the syllabi of ancillary and compulsory courses, etc. shall be framed by an ad-hoc Board of Studies constituted for the purpose.

XII: Ranking to the candidates

Ranking shall be given to only those candidates who pass all the courses of the programme in one attempt.

Notwithstanding any provision in the ordinances to the contrary, the following category of examinee is also eligible for ranking:

The student who, having been duly admitted to a regular examination of the course, was unable to take that examination in full or in part due to some disruption of examination, and took the next following examination of that course and passed the course.

The marks obtained by him/her at the examination shall be considered as the basis for the University Ranking, Scholarships and other distinctions.

In order to get the benefit of this provision, the student should claim that he/she is eligible for this benefit and get a decision in writing after proving his/her eligibility there for.

XIII: Re-admission to the Programme/semester

A student who does not put in at least the minimum percentage of attendance required in the 1st semester shall not be promoted to the higher semesters. However, such students can take fresh admission in the programme after appearing in the UET and being eligible for admission in the course on the basis of result of the UET.

All such students of higher, i.e., 2nd, 3rd, 4th, 5th or 6th, semesters who have not put in the required minimum percentage of attendance or not filled in the examination form in time shall have the option to be re-admitted in the concerned semester available in the subsequent year(s). No student who has been promoted to the 2nd or higher semester and continues to be a student shall be allowed to reappear in the UET for taking fresh admission in the programme.

XIV: **Break in the Course**

Any student taking admission in B.Sc. (Hons.) Degree programme of the Faculty/ MMV shall not be allowed to pursue any other full time programme/ course in the Faculty or elsewhere in the entire period of the programme meaning thereby that if a student leaves the programme after passing some of the semesters/ courses and takes up a full-time programme/ course elsewhere, then he/she shall not be allowed to continue the programme further in the Faculty.

Definition

1. A 'Regular Student' is one who has pursued a regular course of study and obtained prescribed attendance mentioned in the ordinances and is eligible to appear in the examination.

2. 'Ex-student' means one who has studied in the Faculty/MMV for at least one semester preceding the date of the examination and has filled up the examination form but failed or has failed to appear in the examination, though otherwise eligible.

Note: *Academic calendar for the odd and even semesters shall be notified at the beginning of every academic year.*

B. Sc. (HONS.) BOTANY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Botany

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Semester-I

Course Code	Title	Credits
BOB101	Cryptogams	4
BOB102	Lab. work based on Course BOB101	2
	Total	**6**

Semester-II

Course Code	Title	Credits
BOB201	Microbiology, Plant Pathology, Cytology and Genetics	4
BOB202	Lab. work based on Course BOB201	2
	Total	**6**

Semester-III

Course Code	Title	Credits
BOB301	Phanerogams	4
BOB302	Lab. work based on Course BOB301	2
	Total	**6**

Semester-IV

Course Code	Title	Credits
BOB401	Ecology, Physiology and Biochemistry	4
BOB402	Lab. work based on Course BOB401	2
	Total	**6**

Semester-V

Course Code	Title	Credits
BOB501	Comparative studies of Cryptogams	4
BOB502	Comparative studies of Phanerogams	4
BOB503	Plant Ecology	4
BOB504	Lab. work based on Course BOB501	2
BOB505	Lab. work based on Course BOB502	2
BOB506	Lab. work based on Course BOB503	2
	Total	**18**

Semester-VI

Course Code	Title	Credits

BOB601	Plant Metabolism, Biochemistry and Biotechnology	4
BOB602	Microbiology and Plant Pathology	4
BOB603	Cytogenetics and Evolutionary Processes	4
BOB604	Lab. work based on Course BOB601	2
BOB605	Lab. work based on Course BOB602	2
BOB606	Lab. work based on Course BOB603	2
BOB607	Field Study*	4
	Total	**22**
	Grand Total	**64**

*Subject to sanction of leave of absence on duty/duty leave to the accompanying teachers

B.SC. (HONS.) BOTANY
SEMESTER I

BOB101: CRYPTOGAMS   **Credits: 4**

General classification of Cryptogams; study of structure, reproduction and life history of the following representative forms included in various groups

Section A: Algae
1. Main characteristics of Chlorophyceae, Xanthophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae
2. Chlorophyceae: *Volvox, Oedogonium, Draparnaldiopsis*
3. Xanthophyceae: *Vaucheria*
4. Phaeophyceae: *Ectocarpus, Sargassum*
5. Rhodophyceae: *Polysiphonia*
6. Cyanophyceae: *Nostoc, Scytonema*

Section B: Fungi
1. General characteristics of Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina
2. Mastigomycotina: *Saprolegnia, Albugo*
3. Zygomycotina: *Rhizopus*
4. Ascomycotina: *Peziza*
5. Basidiomycotina: *Agaricus, Puccinia*
6. Deuteromycotina: *Alternaria, Cercospora*

Section C: Bryophytes
1. General characteristics of Hepaticopsida, Anthocerotopsida and Bryopsida
2. Hepaticopsida: *Marchantia*

3. Anthocerotopsida: *Anthoceros*

4. Bryopsida: *Funaria*

Section D: Pteridophytes

1. Important characteristics of Psilophyta, Lycophyta, Sphenophyta and Filicophyta; Various types of steles

2. Lycophyta: *Selaginella*

3. Sphenophyta: *Equisetum*

4. Filicophyta: *Pteris*

BOB102: Lab. work based on Course BOB101   **Credits: 2**

SEMESTER II

BOB201: MICROBIOLOGY, PLANT PATHOLOGY, CYTOLOGY and GENETICS   Credits: 4

Section A: Microbiology and Plant Pathology

1. History and scope of Microbiology

2. Position of microorganisms in the living world; morphological, metabolic and molecular criteria for the classification of bacteria (scheme not required)

3. Structure of a bacterial cell: capsule and slime, flagella, cell wall, cell membrane, chromosome, plasmid and endospore

4. Structure of bacteriophages belonging to 'T' series

5. Lysogenic and lytic cycles

6. A brief account of genetic recombination in bacteria (transformation, conjugation and transduction)

7. Role of microorganisms in cycling of carbon and nitrogen.

8. Microorganisms and the production of alcoholic beverages, antibiotics and single cell protein

9. General symptoms of viral, bacterial and fungal diseases of plants.

10. The study of the following plant diseases: Tobacco mosaic, citrus canker, late blight of potato, powdery mildew of pea, loose smut of wheat, covered smut of barley and wilt of pigeon pea

Section B: Cytology and Genetics

1. Ultrastructure of plant cell: Nucleus, cytoskeleton

2. Cell cycle: Interphase nucleus: euchromatin and heterochromatin, mitosis, meiosis; genetic significance of meiosis

3. Basic tenets of cytogenetics: Terminologies: Cytology, genetics, cytogenetics, cell and cell theory, germplasm theory, genotype-phenotype concept

4. Mendel's laws of inheritance: Law of dominance, law of segregation, law of independent assortment, deviations from Mendel's laws (Neo-Mendelism)

5. Interaction of genes: Intragenic and intergenic interactions, incomplete dominance, lethal genes, complementary genes, supplementary genes, inhibitory genes, duplicate genes, epistatic genes

6. Linkage and crossing over: Interrelationships and importance, crossing over and meiosis, cytological basis of crossing over, crossing over and linkage maps, linkage groups, interference

7. Sex determination: Bases of sex determination, chromosome theory of sex determination, sex determination in plants

8. Theories of organic evolution: Theory of inheritance of acquired characters (Lamarckism), theory of natural selection (Darwinism), de Vries Mutation theory, synthetic theory

BOB202   Lab. work based on Course BOB201   **Credits: 2**

SEMESTER III

BOB301: PHANEROGAMS   Credits: 4

Gymnosperms:

(a) Classification (Sporne)   (b)   Morphology, anatomy,   reproduction and economic importance of:

   Cycas, Pinus, Ephedra

Angiosperms:

(a) Taxonomy:

   1. Bentham and Hooker's system of classification: Principles, outline, merits and demerits
   2. Distinguishing characteristics of the following families and their economic importance: Ranunculaceae, Papaveraceae, Rosaceae, Myrtaceae, Apiaceae, Cucurbitaceae, Rubiaceae, Asclepiadaceae, Apocynaceae, Acanthaceae, Solanaceae, Lamiaceae, Amaranthaceae,   Poaceae
   3. Brief account of Plant collection and herbarium techniques and important herbaria of world

(b) Anatomy of stems and roots with special reference to plants showing anomalies:

   Stem: *Nyctanthes, Bignonia, Strychnos, Boerhaavia, Laptadenia, Dracaena,* and root: *Vanda*

 (c) Embryology - General Account

   1. Microsporangium and Microsporogenesis
   2. Megasporangium and Megasporogenesis
   3. Male gametophyte
   4. Female gametophyte (monosporic, bisporic and tetrasporic embryosac)
   5. Double fertilization
   6. Endosperm (Different modes of development, functions of endosperm)
   7. Embryogeny: (Classification, development of any typical dicot and monocot embryo)

BOB302   Lab. work based on Course BOB301   **Credits: 2**

SEMESTER IV

BOB401: ECOLOGY, PHYSIOLOGY and BIOCHEMISTRY   Credits: 4

Section A: Ecology

1. Introduction to ecology
2. Environment: Abiotic and biotic environment; plant adaptations in response to water, temperature and light
3. Population ecology: Population characteristics; ecotypes and ecads
4. Community ecology: Community characteristics; frequency, density, cover, IVI; life forms and biological spectrum
5. Ecosystem ecology: Ecosystem structure (abiotic and biotic components, food chain, food web, ecological pyramids); ecosystem function (energy flow, biogeochemical cycles of carbon and phosphorus)
6. Ecological succession: Types and pattern
7. Biogeographical regions of India

Section B: Physiology and Biochemistry

1. Water relation of plants: Water potential, water absorption, loss of water
2. Cell Membrane: Structure, transport/Ion transport
3. Transport of solutes: Sugar translocation
4. Mineral nutrition of plants: Role of micro-and macronutrients, deficiency symptoms of nutrients
5. Photosynthesis: Structure of chloroplast, absorption of light, transfer of light energy, electron transport, photophosphorylation, C_3, C_4 and CAM pathways of carbon fixation, photorespiration
6. Respiration: Structure of mitochondria, glycolysis, TCA cycle, electron transport, oxidative phosphorylation
7. Nitrogen metabolism: Forms of nitrogen, assimilation of nitrate
8. Protein Synthesis: Types of RNA, transcription, translation
9. Enzymes: Classification, nomenclature, mechanism of action (binding to substrate, lowering of activation energy), factors controlling enzyme activity
10. Plant growth hormones: Physiological role of auxins, gibberellins, cytokinins, abscisic acid and ethylene
11. Phytochrome: Structure and function

BOB402:   Lab. work based on Course BOB401   **Credits: 2**

SEMESTER V

BOB501: COMPARATIVE STUDIES OF CRYPTOGAMS   Credits: 4

Section A: Algae

1. Classification (Fritsch's system) of algae and general characteristics of major classes
2. Pigmentation and storage products
3. Thallus organization and evolutionary tendencies
4. Reproduction and life history types with reference to Chlorophyceae, Phaeophyceae, Rhodophyceae and Cyanophyceae
5. Economic importance of algae

Section B: Fungi

1. General features of fungi and their classification (Ainsworth's system)
2. Structure, reproduction and life cycle of representative classes of fungi
3. Types of fungal spores and mode of their liberation
4. Evolutionary trends in fungi
5. Economic importance of fungi

Section C: Bryophytes

1. General features and classification of Bryophyta (Smith's system)
2. Life histories of bryophytes with reference to *Cyathodium, Pellia, Notothylus, Sphagnum* and *Polytrichum*
3. General account of evolution of sporophyte

Section D: Pteridophytes

1. General features and contemporary system of classification of Pteridophyta
2. Stelar evolution in Pteridophyta
3. Evolutionary tendencies in sporangia
4. Life histories of *Psilotum, Isoetes, Adiantum, Ophioglossum, Marselia*

BOB502: COMPARATIVE STUDIES OF PHANEROGAMS
Credits: 4

Section A: Gymnosperm

1. Classification of Gymnosperms and general account of morphology and reproduction of the following: Cycadales (*Zamia),* Ginkgoales (*Ginkgo*), Coniferales (*Biota*) and Gnetales (*Gnetum*)
2. General account of *Williamsonia* and *Pentaxylon*
3. Phylogenetic trends in Gymnosperms
4. Distribution of living Gymnosperms in India

Section B: Angiosperm

1. Classification of Angiosperms (Takhtajan) and general account of numerical and chemotaxonomy

2. Distinguishing characters of the following families and their economic importance: Annonaceae, Rutaceae, Meliaceae, Asteraceae, Convolvulaceae, Scrophulariaceae, Verbenaceae, Polygonaceae, Euphorbiaceae, Moraceae, Zingiberaceae, Liliaceae, Cyperaceae

3. Embryology: General account of polyembryony, apomixis and experimental embryology with reference to anther and embryo culture

BOB503: PLANT ECOLOGY
Credits: 4

1. Population: Patterns and concepts, population growth, mechanisms of population differentiation
2. Community: Community characteristics and their analyses, species diversity, niche
3. Ecosystem: Concept, components and organisation; primary productivity and
   its measurement; energy flow; nutrient cycling within ecosystems (C, N and P)
4. Mechanisms of ecological succession; concept of climax
5. Environmental pollution: Water Pollution: Sources and kinds, impact of pollution on aquatic ecosystems, eutrophication of water bodies; Air Pollution: Sources and kinds, impact of air pollution on plants; acid rain, causes and effects; Soil Pollution: Sources and kinds, impact on plants and ecosystems
6. Ecotoxicology: Concept of toxicity and its ecological implications, important toxicants; dose response relationship; role of ecological factors in modifying toxicity, biomagnification

BOB504: Lab. work based on Course BOB501
Credits: 2
BOB505: Lab. work based on Course BOB502
Credits: 2
BOB506: Lab. work based on Course BOB503
Credits: 2

SEMESTER VI

BOB601: PLANT METATBOLISM, BIOCHEMISTRY and BIOTECHNOLOGY   **Credits: 4**

1. Biosynthesis of carbon compounds: Sucrose, Starch, Cellulose, Lipids
2. Sulphur and phosphorus metabolism: Activation and assimilation of sulphur, energy-rich phosphorus compounds; ATP synthesis
3. Nitrogen metabolism: Biological nitrogen fixation: The enzyme nitrogenase, substrate for nitrogenase, mechanism; Nitrate metabolism: Uptake and reduction into ammonia, ammonia assimilation
4. Nucleic acids: Structure and properties of different forms of DNA and RNA, DNA replication
5. Protein structure and synthesis: Basic aspects of protein conformation, protein synthesis-transcription (mRNA processing), translation (activation of amino acids, initiation, elongation, termination & release of peptides), post-translational modification of proteins
6. Enzymes: Mechanism of enzyme action, coenzymes, allosteric enzyme, isozymes

7. Biosynthesis and mode of action of: Auxins, Gibberellins, Cytokinins, Abscisic acid, Ethylene

8. Biotechnological tools and techniques: Cloning vectors, recombinant DNA techniques, transgenic plant production

BOB602: MICROBIOLOGY and PLANT PATHOLOGY   Credits: 4

Section A Microbiology:

1. Introduction and scope of Microbiology
2. General account of: *Methanococcus*, *Halobacterium*, *Agrobacterium*, *Mycoplasma* and *Thermoplasma*
3. Growth of microorganisms in batch culture
4. General account of structure and replication of viruses with special reference to cyanophage LPP1, TMV and retroviruses
5. Mechanisms of transformation, conjugation and transduction in bacteria
6. Fermentation technology for production of lactic and acetic acid
7. Role of microorganisms in degradation of aromatic hydrocarbons
8. Nitrogen fixation by free-living and symbiotic microorganisms; ammonification; nitrification and denitrification
9. Role of microorganisms in genetic engineering

Section B Plant Pathology:

1. History and scope of plant pathology
2. Modes of infection and physiology of parasitism
3. Mechanisms of host - pathogen interactions
4. Transmission and spread of plant diseases
5. Methods of plant disease control
6. Causal organism, symptoms, disease cycle and control measures of the following plant diseases: Green ear disease of bajra, downy mildew of crucifers, powdery mildew of sheesham, rusts of pea and linseed, smut of bajra, wilt of tomato, bacterial blight of rice, mosaic of sugarcane and little leaf of brinjal

BOB603: CYTOGENETICS and EVOLUTIONARY PROCESSES   Credits: 4

1. Chromosome structure: Physical architecture, chemical composition, ultrastructural organisation
2. Chromosome structural aberrations: Deletion, duplication, inversion, translocation, origin, cytological and genetical consequences, permanent translocation heterozygosity
3. Genomic variations: Aneuploidy: monosomics, trisomics, nullisomics, polyploidy: autopolyploidy, allopolyploidy, segmental allopolyploidy, autoallopolyploidy, sources and consequences of chromosomal anomalies

4. Evolution of karyotype and its importance: Concept and components of karyotype, trends of karyotype evolution, karyotype in systematics and evolution of species

5. Mapping of genes on chromosomes: Physical and Genetic maps, deletion mapping, linkage analysis, somatic cell fusion, *In situ* hybridization

6. Multiple alleles and multiple factors: multiple allelism, ABO and Rh blood groups in man, eye colour in *Drosophila,* self sterility in plants, quantitative inheritance, kernel colour in wheat, skin colour in human beings, enhancer and suppresser genes

7. Non-Mendelian inheritance and organellar genetics: Maternal influence, coiling in snail shells, plastid inheritance in *Mirabilis jalapa*, petites in fungi, kappa particles in *Paramecium*, sex factor in bacteria

8. Mutation and mutagens: Types of mutation, molecular basis of mutation, physical and chemical mutagens and mechanism of their action

9. Hybridization and its role in evolution: Heterosis, theories of hybrid vigour, evolutionary significance

BOB604:	Lab. work based on Course BOB601	**Credits: 2**
BOB605:	Lab. work based on Course BOB602	**Credits: 2**
BOB606:	Lab. work based on Course BOB603	**Credits: 2**

| **BOB607:** | **FIELD STUDY** | **Credits: 4** |

B. Sc. (HONS.) CHEMISTRY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Chemistry

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Paper		Credits	Total Credits
Semester-I			
CHB-101: Section A - Structure and Bonding Section B - Organic Chemistry- I		4	
CHB-102: Chemistry Practical-I Section A: Quantitative Analysis (Physical & Volumetric) Section B: Qualitative Analysis (Organic & Inorganic)		2	**6**
Semester-II			
CHB-201: Section A - Inorganic Chemistry-I Section B - Physical Chemistry-I		4	
CHB-202: Chemistry Practical-II Section A: Quantitative Analysis (Physical & Volumetric) Section B: Qualitative Analysis (Inorganic)		2	**6**
Semester-III			
CHB-301: Section A - Organic Chemistry-II Section B - Physical Chemistry-II		4	
CHB-03A: Basic Aspects of Chemistry (for PMS & SMK groups only)		3*	
CHB-302: Chemistry Practical-III Section (A): Quantitative Analysis (Physical & Volumetric) Section (B): Qualitative Organic Analysis		2	**6**
Semester-IV			
CHB-401: Section A - Inorganic Chemistry-II Section B - Selected topics in Chemistry		4	
CHB-03A: Basic Aspects of Chemistry (for PMK group)		3*	
CHB-402: Chemistry Practical-IV Section (A): Quantitative Analysis (Physical & Volumetric) Section (B): Preparations (Organic & Inorganic)		2	**6**
Semester-V			
CHB-501: Analytical Chemistry-I		3	
CHB-502: Inorganic Chemistry-III		3	
CHB-503: Organic Chemistry-III		3	
CHB-504: Physical Chemistry-III		3	
CHB-505: Inorganic Chemistry Practical		2	
CHB-506: Organic Chemistry Practical		2	
CHB-507: Physical Chemistry Practical		2	**18**
Semester-VI			
CHB-601: Analytical Chemistry-II		3	
CHB-602: Inorganic Chemistry-IV		3	
CHB-603: Organic Chemistry-IV		3	
CHB-604: Physical Chemistry-IV		3	
CHB-605: Inorganic Chemistry Practical		2	
CHB-606: Organic Chemistry Practical		2	
CHB-607: Physical Chemistry Practical		2	
CHB-608: Elective Paper - Section-A: Atomic and Molecular Structure *Section-B: Application of Spectroscopic Techniques*		4	**22**
	Total		**64**

Semester- I
CHB-101

Credits: 4

Section (A): Structure and Bonding
1 **Atomic Structure:** Schrodinger wave equation; H atom; Radial and angular wave functions: quantum numbers and concept of orbitals; Slater orbitals.
2 **Chemical Bonding**: VB and MO approach of H_2 molecule; MO treatment of homonuclear and heteronuclear (CO & NO) diatomic molecules; Concept of HOMO and LUMO. VSEPR theory; Structure of simple molecules and ions of main group elements
3 **Ionic Solids:** Close packing, Radius ratio rule and crystal coordination number. Examples of MX and MX2 type ionic solids (NaCl and TiO_2)
4 **Metallic Bonding**: theories of bonding in metals; Free electron, VB and Band theories.
5 **Weak Interactions**: Hydrogen bonding and van der Waal's interactions

Section (B): Organic Chemistry-I
1 **Concepts:** Atomic orbitals, hybridization, orbital representation of methane, ethane, ethyne and benzene. Polarity of bonds: Inductive, resonance and steric effects hyperconjugation, and their influence on acidity and basicity of organic compounds.
2 **Hydrocarbons:** Akanes: Chlorination of methane, Alkenes: Addition reactions (Electrophilic and Free radical), Hydration, hydroxylation, hydroboration, epoxidation and ozonolysis. Alkynes: Reduction, Electrophilic addition, acidity and metal acetylides. Conjugated and isolated Dienes: 1,2- verses 1,4-addition. Diels - Alder reaction.
3 **Alkyl Halides:** Nucleophilic substitution: SN^1, SN^2 mechanisms; Eliminations reactions: E1and E 2 mechanisms, Elimination versus substitution reactions; energy profile diagrams-transition states (general considerations). Grignard reagents: Preparation and synthetic applications.
4 **Alcohols:** Comparative study of substitution, dehydration, oxidation, and esterification of primary, secondary and tertiary alcohols.
5 **Stereochemistry:** Fischer, Saw-horse and Newman projection formulae, Chirality-optical activity, enantiomersim and diasteroisomerism involving one and two chiral centres. Configuration; D/L, erythrose, threose and R/S nomenclatures. Geometrical isomerism and E/Z nomenclatures. Conformations of n-butane.
6 *Active methylene compounds:* Preparation and synthetic applications of ethyl acetoacetate and diethyl malonate, Tautomerism.

Books Recommended
For Section-A
1. *Basic Inorganic Chemistry,* **F. A Cotton, G. Wilkinson**, **and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Concise Inorganic Chemistry,* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.

For Section-B
   1. *Organic Chemistry,* **Paula Y. Bruice**, 2nd Edition, Prentice-Hall, International Edition (1998).
   2. *Organic Chemistry,* **I. L. Finar,** Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
   3. *Organic Chemistry,* **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
   4. Organic Chemistry, Paula Y. Bruice, 2nd Edition, Prentice-Hall, International Edition (1998).
   5. Organic Chemistry, I. L. Finar, Vol. I, 6th Edition (1973), ELBS and Longman Ltd., New Delhi.
   6. Organic Chemistry, R. T. Morrison and R. N. Boyd, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
   7. Organic Chemistry, J. Clayden, N. Greeves, S. Warren, and E. Wothers, , Oxford Univ. Press, Oxford (2001).

Section-A: *Quantitative Analysis (Physical and Volumetric)*

1. Kinetics of First Order reaction.
2. Redox titration: (a) Iodometry (b) $Fe2^+$ / $K_2Cr_2O_7$

Section-B: *Qualitative Analysis (Organic and Inorganic):*

1. Detection of elements (X, N, S)
2. Detection of functional groups: PhOH, -COOH, C=O, -CHO, Ar-NH$_2$, Ar-NO$_2$, -CONH$_2$
3. *Qualitative Inorganic Mixture Analysis:* Anions and interfering anions.

Note: Experiments may be added/deleted subject to availability of time and facilities.

Semester- II

CHB-201

Credits : 4

Section (A) - Inorganic Chemistry-I

1. **Periodic trends and properties**: Size, Ionization Energy, Electron Affinity, Electronegativity, Lattice and Hydration Energies, Use of redox potential and reaction feasibility

2. **Chemistry of *s* and *p*-block elements**: Alkali and alkaline earth metals: Hydrides and Complexation tendencies.Structural features of hydrides, halides, oxides and oxyacids

3. **Chemistry of *d*-block elements**: Salient features, characteristic properties of 3*d*-elements with reference to oxidation states, colour, magnetic behaviour, and complex formation tendency.

Section (B) – Physical Chemistry-I

1. *Gaseous State***:** Kinetic theory of gases, ideal gas laws based on kinetic theory. Collision in a gas- mean free path, collision diameter, collision number. Behaviour of real gases - the van der Waal's equation. Critical phenomena - critical constants of a gas and their determination, the van der Waals equation and critical state, Principle of corresponding states.

2. *Liquid State***:** Surface tension of liquids - capillary action, experimental determination of surface tension, temperature effect on surface tension. Viscosity of liquids, experimental determination of viscosity coefficient, its variation with temperature.

3. *Thermodynamics:* First Law of thermodynamics and internal energy, state and state functions, sign convention for heat and work, nature of work, path dependence of heat and work. Enthalpy, heat changes at constant volume and constant pressure, heat capacities (C_V, C_P) and their relationship for ideal gases.
    Thermodynamic quantities (*w, q, ΔU, ΔH*) for isothermal and adiabatic reversible expansion of ideal gases and their comparison.

    Change in internal energy (*ΔU*) and enthalpy (*ΔH*) of chemical reactions, relation between ΔU and ΔH, variation of heat of reaction with temperature (Kirchhoff's equation).

4. *Electrochemistry***:** Arrhenius theory of electrolytic dissociation, Hydrolysis of salts, hydrolysis constant, buffer solutions, indicators and theory of acid-base indicators.
    Migration of ions: transference number and its determination by Hittorf methods. Conductance of

electrolyte solutions, molar conductance of electrolyte and its splitting into ionic molar conductance, Kohlrausch law of independent migration of ions, ionic mobility. Application of conductance measurements: determination of degree of dissociation and dissociation constant of weak electrolytes/acids, solubility of sparingly soluble salts, and Conductometric titrations.

5. *Nuclear Chemistry*:   Nucleus and its classification, nuclear forces, nuclear binding energy, stability of nucleus. Radioactivity: Radioactive elements, general characteristics of radioactive decay, decay kinetics (decay constant, half life, mean life period), units of radioactivity.

Books Recommended

For Section-A

1. *Basic Inorganic Chemistry,* **F. A Cotton, G. Wilkinson**, **and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.
2. *Concise Inorganic Chemistry,* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.

For section-B

1. *Physical Chemistry*, P. Atkins and J. De Paul, 8th Edition (2006), International Student Edition, Oxford University Press.
2. *Physical Chemistry,* P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.
3. *Principles of Physical Chemistry,* B. R. Puri, L. R. Sharma, and M. S. Pathania**,** 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
4. *Physical Chemistry,* K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999)

CHB-202	Credits: 2

Section-A: *Quantitative Analysis (Physical and Volumetric)*

1. Determination of water equivalent of a calorimeter (cooling curve).
1. Heat of neutralization (strong acid-strong base).
2. Heat of dissociation of weak acid.
3. Heat of solution (NH_4NO_3, $CaCl_2$).
4. Basicity of an acid by thermochemical method.

Section-B: *Qualitative Inorganic Analysis*

Qualitative Inorganic Mixture Analysis: Not containing more than 4 ions and one interfering anion

Note: Experiments may be added/deleted subject to availability of time and facilities.

CHB-301

Credits : 4

Section (A):Organic Chemistry-II

1. **Aromaticity:** Aromaticity and Huckel rule - A general concept. Molecular orbital picture of benzene.

2. **Aromatic Electrophilic Substitution:** Mechanism of nitration, halogenation, sulphonation, and Friedel-Crafts (alkylationa and acylation) reactions. Effects of substituents on orientation and reactivity.

3. **Aryl Halogen Compounds:** Chlorobenzene, electrophilic and nucleophilic aromatic substitutions; side chain chlorination of toluene, DDT and BHC.

4. **Chemistry of Carbonyl compounds:** Preparations and reactions: addition and condensation reactions; Cannizzaro, Perkin, aldol, benzoin, haloform, oxidation and reduction reactions. Important reactions of acids, HVZ reaction, Relative reactivity of acid chlorides, acid anhydrides, amides and esters. Comparative acidity of carboxylic and sulphonic acids.

6. **Phenols:** General methods of preparation and reactions. Reimer-Tiemann and Kolbe reactions. Relative acidity of phenol, alcohol and carboxylic acid.

7. **Nitrogen Containing compounds:** Nitronbenzene and reduction products. Comparative basicity of aliphatic and aromatic amines. **Diazonium Salts**: Preparation and synthetic applications.

Section (B): Physical Chemistry-II

1. *Thermodynamics:* Second Law of Thermodynamics, Carnot cycle, entropy, entropy changes in reversible and irreversible processes and of universe, physical concept of entropy, entropy changes of an ideal gas in different processes, entropy of an ideal gas, entropy changes in mixture of gases. Joule-Thomson effect, Joule-Thomson coefficient of real (van der Waal) gases, inversion temperature.

   Free energy and its concept, Gibbs and Helmholtz free energies and their relationship, variation of free energy with temperature and pressure. Free energy and equilibrium constant. Maxwell's relations, Gibbs-Helmholtz equations, its application for the determination of ΔG, ΔH, ΔS of a reversible cell reaction. Criteria for reversible and irreversible processes based on entropy and free energy.

   Partial molal quantities, chemical potential, the Gibbs-Duhem equation, determination of partial molal quantities, variation of chemical potential with temperature and pressure, chemical potential in case of a system of ideal gases.

2. *Phase Equilibria***:** Thermodynamics of phase transition-Clapeyron-Clausius equation and its applications. Phase rule, phase, component, degree of freedom, thermodynamic derivation of phase rule, phase diagrams of one-component system (water), two component systems (phenol-water, lead-silver). The distribution law, applications to cases of dissociation and association of solutes in one of the phases, solvent extraction, equilibrium constant from distribution coefficient ($KI + I_2 = KI_3$).

3. *Electrochemical Cells***:** Reactions in reversible cells, free energy and *emf* of reversible cell. Single electrode potential (Nernst equation), its measurement and sign convention. Standard electrode potential. *Emf* of reversible cell from electrode potentials. Types of reversible

electrode, reference electrodes. Applications of emf measurements: determination of ionic activities, pH, and equilibrium constant. Potentiometric titration. Concentration cells with and without transference. Liquid junction potential and its elimination.

4. *Chemical Kinetics*: Order and molecularity of chemical reactions, pseudo order. Kinetic law for second order reactions, determination of the rate constant and order of reaction from kinetic data. Effect of temperature on rate of reaction: collision theory of rates of bimolecular reactions and its comparison with Arrheninus equation.

Complex reactions: Reversible (first order in both directions), concurrent, consecutive reactions. Unimolecular gas reactions (Lindmann theory), steady-state approximations, theory of absolute reaction rate and its thermodynamic formulation.

Books Recommended
For Section-A

1. *Organic Chemistry,* **Paula Y. Bruice**, 2nd Edition, Prentice-Hall, International Edition (1998)
2. *Organic Chemistry",* **R. T. Morrison and R. N. Boyd**, 6th Edition (1992), Prentice-Hall of India (P) Ltd., New Delhi.
3. *Organic Chemistry,* **I. L. Finar,** [Vol. I, 6th Edition (1973), Reprinted in 1980 & Vol. II, 5th Edition (1975), Reprinted in1996], ELBS and Longman Ltd., New Delhi.
4. *Organic Chemistry***, L.G. Wade Jr.***, 5th Edition (2001) Prentie Hall International INC. USA.*
5. *Organic Chemistry,* **J. Clayden, N. Greeves, S. Warren,** and **E. Wothers**, , Oxford Univ. Press, Oxford (2001).

For Section-B

1. *Physical Chemistry,* P. C. Rakshit**,** 5th Edition (1985), 4th Reprint (1997), Sarat Book House, Calcutta.
2. *Principles of Physical Chemistry,* B. R. Puri, L. R. Sharma, and M. S. Pathania**,** 37th Edition (1998), Shoban Lal Nagin Chand & Co., Jalandhar.
3. *Physical Chemistry,* K. J. Laidler and J. M. Meiser, 3rd Edition, Houghton Mifflin Comp., New York, International Edition (1999).

CHB-302	**Credits: 2**

Section-A: *Quantitative Analysis (Physical and Volumetric)*

1. Critical Solution Temperature.
2. Effect of impurity on Critical Solution Temperature.
3. Distribution of solute in two immiscible solvents (without association).
4. Distribution of solute in two immiscible solvents (with association in one solvent).
5. Determination of pH of a given buffer.

Section-B: *Qualitative Organic Analysis*

Identification of simple organic compounds (derivatives not included)

Note: Experiments may be added/deleted subject to availability of time and facilities.

Semester IV

CHB-401

Section (A): Inorganic Chemistry-II

1. **Acids and bases**: Bronsted-Lowry, Lux-Flood, Solvent System and Lewis concepts of acids and bases. Factors affecting strengths of Lewis acids and bases. HSAB theory and applications

2. **Non-aqueous solvents:** Physical properties of a solvent for functioning as an effective reaction medium, types of solvents and their general characteristics. Liq. NH_3 as a non- queous solvent

3. **Coordination compounds:** Nomenclature, Werner's theory. Isomerism. Sidgwick'sEAN concept and Valence Bond Theory. Stereochemistry of coordination compounds with coordination no. 4, 5 and 6.

4. **Lanthanides:** Comparative study of lanthanide elements with respect to electronic configuration atomic and ionic radii, oxidation state and complex formation, lanthanide contraction. Separation of lanthanides. Application of lanthanide complexes.

Section (B): Selected Topics in Chemistry

1. **Energy devices:** Batteries; Fuel cells, Solar cells, Biomass as renewable energy resources.

2. **Corrosion:** Causes of metallic corrosion, types of corrosion, measurements of corrosion by weight loss method, prevention (electrochemical and inhibitor).

3. **Green Chemistry:** Principles and concept of green chemistry, atom economic and non-economic reactions, reducing toxicity, a few examples of environmental friendly reactions and reaction media.

4. **Photoisomerization:** Rotation about C-C and C=C bonds, Structure of Rhodospin, Mechanism of vision.

5. **Bioenergetics:** Gibbs and Helmholtz energies with special emphasis on biological applications: study of energy transformations in living systems (bioenergetics): standard state in biochemistry, ATP-the currency of energy, Glycolysis, limitation of applicability of thermodynamics in biology.

Books Recommended
For Section-A

1. *Recent Aspects in Inorganic Chemistry*, R.C. Agarwal, Kitab Mahal
2. *Inorganic Chemistry,* J.E. Huheey, E.A. Keiter and R.L. Keiter.
3. *Basic Inorganic Chemistry,* F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.

For Section-B

1. *Physical Chemistry for the Chemical and Biological Sciences,* Raymond Chang; University Science Book, California (2000).

2. *New Trends in Green Chemistry*, V.K. Ahluwalia, M. Kidwai, Anamaya Publication, New Delhi (2004)

3. *Physical Chemistry for the Chemical and Biological Sciences,* Raymond Chang; University Science Book, California (2000).

4. *New Trends in Green Chemistry*, V.K. Ahluwalia, M. Kidwai, Anamaya Publication, New Delhi (2004)

5. *Green Chemistry: Environmentally Benign Reactions***,** V. K. Ahluwalia, 2007

6. *Modern Molecular Photochemistry,* N. J. Turro, University Science Books, Sausalito California (1991).

7. *Green Chemistry: An Introductory Text,* Mike Lancester, RSC Paperback, Edn. (2002)

CHB-402   **Credits: 2**

Section-A: *Quantitative Analysis (Physical and Volumetric)*

1. Coagulation of a sol.
2. Determination of Surface Tension of liquids.
3. Determination of viscosity coefficients of liquids.
4. Complexometric titrations**:** Zn^{2+}, Mg^{2+}, Ca^{2+}, Fe^{2+} with EDTA; Hardness of water.
5. Iodimetric titration.

Section-B: *Preparations* (Organic and Inorganic)

1. Preparation of Organic Compounds:
   (i) m-dinitrobenzene, (ii) Acetanilide, (iii) Bromoacetanilide, (iv) Oxidation of primary alcohols-Benzoic acid from benzylacohol, (v) azo dye

2. *Preparation of Inorganic Compounds:*

   (i) Potassium trioxalato chromate (III); (ii) $CoHg(SCN)_4$; (iii) Cu(I) thiourea complex
   (iv) Bis (2, 4-pentanedionate) zinc hydrate; (v) Double salts (Chrome alum/ Mohr's salt)

Note: Experiments may be added/deleted subject to availability of time and facilities.

Semester V

CHB-501: Analytical Chemistry-I

Credits : 3

1. **Stastical Evaluation:** Determinant and indeterminant errors, Normal error curve, Accuracy and Precision, Relative and standard deviation, Methods for minimizing errors, Criteria for rejection of observation, Significant figures and computation rules, Error propagation.

2. **Precipitation:** Desirable properties of gravimetric precipitates, Formation of gravimetric precipitates, Conditions for quantitative precipitations, Contamination in precipitates, Method for removal of impurities in precipitates, Steps involved in quantitative

precipitation, Organic precipitants (oxine, dithizone, α-nitroso-(naphthol, cupferon, dimethyl glyoxime) in chemical analysis.

3. **Analytical Reagents:** Theoretical and practical aspects of the use of EDTA, cerate, iodate, bromate, chloramine-T, Karl Fischer and periodate reagents in chemical analysis.

4. **Environmental Pollution:** Terminology used in environmental chemistry, Atmospheric pollution, Source of air pollution, Global warming, Ozone-hole, Auto exhaust emissions and it's prevention, Air quality parameters, Acid rains, Industrial and domestic effluents, Treatment plants, Flouresis, Arsenic, Mercury and Methylisocynate(MIC) poisonings, Current environmental issues in the national context and remedial measures.

<u>**Books Recommended:**</u>

1. 'Modern Methods of Chemical Analysis', R.L. Pecscock, L.D. Shields, T. Cairns, and I.C. Mc William, 2nd Edition (197 6), John Willey, New York.
2. 'Basic Concepts of Analytical Chemistry', S.M.Khopkar, 2nd edition (1998), New Age International Publications, New Delhi.
3. ' Analytical Chemistry', G.D. Christian, John Willey & sons, New York (200 1)
4. 'Environmental Chemistry', A.K. De, 3rd edition (1994), Willey Eastern, New Delhi.

CHB-502: Inorganic Chemistry-III

Credits : 3

1. ***Theories of Metal-Ligand bonding:*** Limitations of valence bond theory; Crystal-field theory and crystal-field splitting in octahedral, tetrahedral and square planar complexes. Jahn-Teller Distortion. Factors affecting the crystal-field splitting.

2. ***Thermodynamic and Kinetic aspects of Metal Complexes:*** A brief outline of thermodynamic and kinetic stabilities of metal complexes and factors affecting the stability. Substitution reactions of square-planar complexes – Trans effect

3. ***Chemistry of Second and Third Transition Series:*** A general comparative treatment of 4d and 5d elements with their 3d analogues in respect of ionic radii, oxidation states, magnetic behaviour and electronic spectral properties

4. ***Organometallic Chemistry:*** Definition, nomenclature and classification of organometallic compounds.Preparation, properties, bonding and applications of alkyl and aryls of Li, Al, Hg, Sn, Ti. A brief account of metal-ethylenic complexes and homogeneous hydrogenation

<u>**Books Recommended**</u>

1. *"Concise Inorganic Chemistry",* J. D. Lee, 5th Edition (1996), Chapman & Hall, London.
2. "Inorganic Chemistry", J.E. Huheey, E.A. Keiter and R.L. Keiter.
3. *"Modern Inorganic Chemistry",* R. C. Aggarwal, 1st Edition (1987), Kitab Mahal, Allahabad.
4. *"Basic Inorganic Chemistry",* F. A Cotton, G. Wilkinson, and Paul L. Gaus, 3rd Edition (1995), John Wiley & Sons, New York.
5. *"Inorganic Chemistry",* A. G. Sharpe, 3rd International Student Edition (1999), ELBS / Longman, U.K.
6. *"Inorganic Chemistry",* D. F. Shriver and P. W. Atkins, 3rd Edition (1999), ELBS, London.

CHB-503: Organic Chemistry-III

Credits : 3

1. **Alicyclic Compounds:** Cycloalkanes, general synthesis, Bayer's strain Theory. Cyclohexane-chair and boat conformations, axial and equatorial bonds, conformation of mono substituted cyclohexanes.

2. **Poly nuclear Hydrocarbons:** Alternant and non-alternant hydrocarbons. Chemistry of naphthalene.

3. **Reactive intermediates and related Rearrangement reactions**: Generation, stability and reactivity of *Free radicals* (Anti Markovnikov's, Birch Reduction, Bouveault-Blanc reduction, oxidation of phenol by metal ions); *Carbocations* (Pinacol-Pinacolone, Wagner-Meerwein Rearrangement, Baeyer-Villiger oxidation, Hydroperoxide reaction and Beckmann.) and *Carbanions (*Robinson Anuulation and Michael Addition); *Carbenes* and *Nitrenes* (Hofmann, Curtius reactions). Ylides: Sulphur ylides, phosphorous ylides, Michaelis-Arbuzov phosphonate synthesis, Witting reactions, Mitsunobu reaction.

4. **Isotope Effect in a Reaction:** Isotopic substitution in a molecule, primary and secondary kinetic isotope effects, solvent isotopic effect and their importance in mechanistic studies.

5. **Stereochemistry:** Concept of Chirality; symmetry element, symmetry operations. Enantiomers, diastereomers, racemates, racemisation, resolution, Pro-chirality, pro-stereoisomerism with suitable examples of one and two chiral centers. Regioselective, chemoselective and stereoselective reactions. Asymmetric induction, Cram's Rule: Addition of nucleophile to carbonyl function; Aldol condensation (*achiral-achiral*). Wilkinson's hydrogenation.

6. **Photochemistry:** Principles of photochemistry, photochemical reactions of carbonyl compounds and olefins.

7. **Heterocyclic Compounds:** Synthesis and chemistry of furan, pyrrole, pyridine, Indole and Quinoline

  7.
 8. **Books Recommended**
   1. *Organic Chemistry,* **I. L. Finar,** Vol. I and II, 5th Edition (1975), Reprinted in1996, ELBS and Longman Ltd., New Delhi.
   2. *Stereochemistry of Organic Compounds*, **D. Nasipuri**, 2nd Edition (1994), Wiley Eastern Ltd., New Delhi
   3. *Stereochemistry of Organic Compounds,* **E.L. Eliel, S.H. Wilen and Mander**, , Wiley Interscience, New York (2004).
   4. *Organic Chemistry,* **J. Clayden, N. Greeves, S. Warren, and E. Wothers**, Oxford Univ. Press, Oxford (2001).

   5. *A Guide Book to Mechanism in Organic Chemistry*, **Peter Sykes**, 6th Edition (1997), Orient Longman Ltd., New Delhi.
   6. *Organic Chemistry*, **R.T. Morrison and R.N. Boyd**, 6th Edition (2003), Prentice- Hall of India, New Delhi.
   7. *Heterocyclic Chemistry: Syntheses, Reactions and Mechanisms*, **R.K. Bansal**, 3rd Edition (1999), New Age International, Publisher, New Delhi.
   8. Photochemistry *and Pericyclic Reactions,* **Jagdamba Singh and Jaya Singh** *2nd edition.* New Age International (P) Ltd. Publishers, New Delhi

CHB-504: Physical Chemistry III

Credits : 3

1. *Solid State*: Crystal lattices, space lattice, unit cell, crystal systems, law of rational indices, Miller indices, crystals and x-rays (the Braggs equation). Crystal structure of NaCl, graphite, and diamond. Types of crystal (molecular, covalent, metallic, ionic). Imperfection in crystals: point defect-Schottky and Frankel defects.

2. *Surface and Photochemistry*: Gibbs Adsorption isotherm. Multi layer adsorption-BET equation (no derivation) and its application to surface area measurement. Heterogeneous catalysis (surface reactions): kinetics of unimolecular surface reactions- inhibition and activation energy. Nature of surface. Kinetics of enzymatic reactions: Michaelis-Menten equation, effect of temperature and pH.
Law of photochemical equivalence, quantum efficiency, reasons for low and high quantum efficiency. Kinetics of photochemical reaction (H2+Br2=HBr), photostationary state, Chemical actinometers (uranyl oxalate)

3. *Thermodynamics of Solutions:* Chemical potential of a mixure of ideal gases. Chemical potential of real gases and fugacity, activity and activity coefficient (concept and physical significance), reference and standard states. Variation of fugacity with temperature and pressure, Lewis-Randall rule, thermodynamic functions of mixing (ΔG_{mix}, ΔS_{mix}, ΔV_{mix}, ΔH_{mix}), ideal solutions and their characteristic properties, Duhem-Margules equation and its application, Henry and Raoult's laws. Thermodynamics of colligative properties: Freezing point depression, elevation of boiling point, osmotic pressure. van't Hoff equation. Measurement of osmotic pressure and determination of molecular weight of macromolecules.

4. **Electrochemistry:** Theory of strong electrolytes: - Qualitative idea of Debye-Huckel theory of ion-ion interactions, Debye-Huckel limiting law for activity coefficient of ions in electrolyte solution (derivation not required), its modification for concentrated solutions. Debye-Huckel-Onsager (D-H-O) theory of electrolytic conductance: qualitative idea of electrophoretic and relaxation effects, D-H-O equation for conductance of electrolyte solutions, effect of high frequency and high field on conductance.

5. **Nuclear and Radiation Chemistry:** Nuclear reactions: Bethe notation, types of nuclear reactions (n, p, α, d and γ), conservation of quantities (mass-energy and linear momentum) in nuclear reactions, reaction cross-section, compound nucleus theory and nuclear reactions. Nuclear fission: the process, fragments, mass distribution, and fission energy. Nuclear reactor: the natural uranium reactor, classification of reactors, breeder reactor. Nuclear fusion and stellar energy.

Radiation chemistry: Elementary ideas of radiation chemistry, radiolysis of water and aqueous solutions, unit of radiation chemical yield (G-value), radiation dosimetry (Fricke's dosimeter), units of radiation energy (Rad, Gray, Rontgen, RBE, Rcm, Sievert).

Books Recommended

1. *Physical Chemistry,* P. C. Rakshit, 5th Edition (1988), 4th Reprint (1997), Sarat Book House, Calcutta.

2. *Physical Chemistry,* K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.

3. *Physical Chemistry,* I. N. Levine, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.

4. *Essentials of Nuclear Chemistry* H. J. Arnikar, 4th Edition (1995), New Age International (p) Ltd., Wiley Eastern Ltd., New Delhi.

CHB-505: Inorganic Chemistry Practical   Credits: 2

1.   Chromatographic separation of metal ions.

2.   Gravimetric estimation of Cations/Anions.

CHB-506: Organic Chemistry Practical   Credits: 2

1.   Systematic identification of organic compounds (monofunctional and bi-functional) and preparation of their derivatives.

CHB-507: Physical Chemistry Practical   Credits: 2

1.   Viscosity-composition curve for a binary liquid mixture.
2.   Surface tension-composition curve for a binary liquid mixture.
3.   Determination of indicator constant - colorimetry.
4.   Determination of pH of a given solution using glass electrode.
5.   Beer's Law - Determination of concentration of solution by colorimetry.
6.   Order of reaction of I_2 / Acetone / H^+.
7.   Equilibrium constant of methyl acetate hydrolysis reaction

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Note : Experiments may be added/deleted subject to availability of time and facilities.

Semester VI

CHB-601: Analytical Chemistry-II   Credits : 3

1.   **Solvent Extraction:** Distribution law, Single extraction, Multiple extraction, Craig concept of counter-current distribution, Important solvent systems: chelate extraction, synergic extraction, extraction by solvation, ion-pair extraction
2.   **Chromatography:** Classification of chromatographic methods, General principle and application of adsorption, partition, ion exchange, thin layer, and paper chromatography.
3.   **Radio-Analytical Methods:** Elementary theory, Isotope dilution and Neutron activation methods and applications.
4.   **Spectrophotometry:** Beer's law and it's application, Nomenclature and units, General instrumentations for spectrophotometry, Spectrophotometric determinations of one Component (iron, chromoium, manganese, nickel, titanium and phosphorus) and two components (overlapping and non overlapping) systems, Spectrophotometric determination of dissociation constants of indicator, Photometric errors and RINGBOM-AYRES plots.

Book Recommended:

1.   Principles of Instrumental Analysis, D.A. Skoog, F.J.Holler and T.A. Nieman, , 5th edition (l998), Horcourt Brace & Company, Florida.
2.   Analytical Chemistry, G.D. Christian, John Willey & sons, New York (200 1).
3.   Instrumental Methods of Analysis', H.H. Willard, L.L. Merritt, and J.A.Dean, 6th edition(l986), CBS Publishers & Distributors, Shahdara, Delhi.

4.	Modem Methods of Chemical Analysis, R.L. Pecscock, L.D. Shields, T .Cairns, and I.C. Mc William, 2nd edition(l976), John Willey, New York.

CHB-602: Inorganic Chemistry-IV   **Credits : 3**

1. *Magnetic Properties of Transition Metal Complexes***:** Types of magnetic behaviour, methods of determining magnetic susceptibility, L-S and J-J coupling, orbital contribution to magnetic moments. Correlation of magnetic moment data and stereochemistry of Co(II) and Ni(II) complexes; anomalous magnetic moments.

2. *Electronic Spectra of Transition Metal Complexes*: Types of electronic transitions, selection rule for dd transitions, spectroscopic ground states. Explanation of electronic spectra on the basis of Orgel energy level diagrams for d1, d4, d6 and d9 states.

3. *Chemistry of f-block Elements***:** Comparative study of actinide elements with respect to electronic configuration, atomic and ionic radii, oxidation states and complex formation; occurrence and principles of separation. General features and chemistry of actinides, principles of separation of Np, Pu and Am from U. Trans-Uranium elements.

4. **Bioinorganic Chemistry**: Essential and trace element in biological process, oxygen transport with reference to haemoglobin; synthetic models of O_2 carrieres., Biological role of alkali metals ions. Vitamin B-12

Books Recommended

1.	*Concise Inorganic Chemistry,* **J. D. Lee**, 5th Edition (1996), Chapman & Hall, London.
2.	Inorganic Chemistry, **J.E. Huheey, E.A. Keiter and R.L. Keiter**.
3.	*Modern Inorganic Chemistry,* **R. C. Aggarwal**, 1st Edition (1987), Kitab Mahal, Allahabad.
4.	*Basic Inorganic Chemistry,* **F. A Cotton, G. Wilkinson**, **and Paul L. Gaus**, 3rd Edition (1995), John Wiley & Sons, New York.
5.	*Inorganic Chemistry,* **A. G. Sharpe**, 3rd International Student Edition (1999), ELBS / Longman,U.K.
6.	*Inorganic Chemistry,* **D. F. Shriver and P. W. Atkins**, 3rd Edition (1999), ELBS, London

CHB-603 : Organic Chemistry-IV   *Credits : 3*

1. **Peptide Chemistry:** Amino acids-preparative methods, physical properties, dipolar nature, chemical reactions and configuration. *Peptides:* peptide linkage, peptide synthesis and structure of poly peptides. *Proteins:* General characteristics and secondary structure.

2. **Drugs:** Preparations, and uses of following: (i) Antipyretics and Analgesics: Aspirin, Paracetamol, Phenylbutazone. (ii) Sulpha Drugs: Sulphanilamide, sulphapyridine, sulphathiazole. (iii) *Antimalarials:* Chloroquine, Primaquine. (iv) *Antibiotics:* Chloroamphenicol.

3. **Carbohydrates:** Characteristic reactions of aldoses and ketoses. Glucose-structure (Open and Cyclic), Fructose (only reactions), Mutarotations, Sucrose, starch and cellulose (Structureal aspects only).

4. **Polymers:** Types of polymers and polymerization process: Addition, stereo controlled, step growth polymerizations. Radical, ionic and coordination mechanisms of polymerization. Synthesis and applications of following polymers: (i) Specialty Polymers: Conducting & Electroluminescent (Organic light emitting diodes), liquid crystals (ii) Natural and synthetic rubber (iii) Synthetic Fibers: Polyester, Polyamides (iv) Foaming Agent: Plasticizers (v) biodegradable polymers.

6. **Terpenes:** Occurrence, isolation, classification. Isoprene rule. Structure and synthesis of Citral and Geraniol.

7. **Dyes:** synthesis of malachite green, fluorescein. Synthesis and structure of Indigotin.

Books Recommended
1. *Organic Chemistry*, **I. L. Finar**, Vol. II, 5th Edition (1975) Reprinted in 1996, ELBS and Longman Ltd, New Delhi
2. *Organic Polymer Chemistry,* K. J. Saunders, 2nd Edition (1988), Chapman & Hall, London
3. Introduction to Synthetic Polymers, **Ian M. Campbell**, 2nd Edition (2000), Oxford University Press, USA
4. *Principles of Polymer Science*, **P. Bahadur and N.V. Sastry**, Narosa, New Delhi (2002).
5. *Principles of Medicinal Chemistry,* **W. O. Foye**, , 3rd Edition (1989), Lea & Febiger/ Varghese Publishing House, Bombay.
6. *Medicinal Chemistry,* **A. Kar**. Wiley Eastern Ltd., New Delhi (1993).

CHB-604: Physical Chemistry-IV **Credits: 4**

1. Quantum Mechanics of Simple Systems*: Schrödinger's wave equation. Eigen functions and Eigen values and quantum mechanical operators. Expectation value of a physical quantity. Orthogonality of wave functions. The particle in a one dimensional box problem and its solutions. Particle in a three dimensional box. Degeneracy. Rigid rotor and Harmonic Oscillator.*

*2. Molecular Spectroscopy***:** Region of electromagnetic spectrum. Emission and absorption spectra. Transition probabilities and selection rules. Width and intensity of spectral transitions Pure rotational spectra. Diatomic molecules-Rigid rotor & non-rigid rotors. Vibrational, rotational spectra of diatomic molecules. Harmonic oscillator-rigid rotor approximation. Anharmonicity effect. Normal modes of vibration. Infrared spectra of linear and bent AB_2 molecules. Electronic spectra of diatomic molecules. Vibrational structure. Franck-Condon principle.

*3. Nuclear Magnetic Resonance Spectroscopy***:** Nuclear Magnetic Resonance spectroscopy. Chemical shifts. Spin-spin splittings. Relaxation times.

*4. Molecular Statistics***:** The Boltzmann distribution. Maxwell distribution law for distribution of molecular speeds. The Maxwell-Boltzmann distribution law for the distribution of molecular energies. The partition functions. Thermodynamic quantities from partition functions. The Sackur-Tetrode equation for molar entropy of monatomic gases. Rotational and vibrational partition functions. The characteristic temperature. The calculation of Gibbs free energy changes and equilibrium constant in terms of partition functions.

Books Recommended

1. *Physical Chemistry,* K. J. Laidler and J. M. Meiser, 3rd Edition (International Edition, 1999), Houghton Mifflin Co., New York.
2. *Physical Chemistry,* I. N. Levine, 4th Edition (International Edition, 1995), Mc Graw-Hill Inc., New York.

3. *Physical Chemistry - A Molecular Approach,* D. A. Mc Quarrie and J. D. Simon, South Asian Edition (1998), University Science Books, Sausalito CA, by Viva Books, New Delhi.
4. *Fundamentals of Molecular Spectroscopy*, C. N. Banwell and E. M. McCash, 4th Ed., Tata McGraw-Hill Publishing Company Ltd., New Delhi.

CHB-605: Inorganic Chemistry Practical   **Credits : 2**
1. Preparation of coordination compounds.
2. Spectral and magnetic characterization of compounds

CHB-606: Organic Chemistry Practical   **Credits : 2**
1. Preparation of the following compounds:
   Suphanilic acid, dibenzal acetone, methyl orange, aspirin, m-dinitrobenzene from benzene, synthesis of azlactone, phthalimide,
2. Identification of organic functional groups by I.R. spectroscopy.

CHB-607: Practical Physical Chemistry   **Credits : 2**
1. Dissociation constants of weak acid, base.
2. Conductometric titration: acid-base.
3. Potentiometric titration: acid-base.
4. Kinetics of catalytic decomposition of H_2O_2.
5. Kinetics of acid-catalysed hydrolysis of sugar (chemical method).
6. Determination of relative strengths of two acids by studying the kinetics of acid-catalysed ester hydrolysis.
7. Kinetics of enzymatic reaction (starch-amylase system).

Note : Experiments may be added/deleted subject to availability of time and facilities.

CHB-608: Elective Paper   *Credits : 4*

A.   Atomic and Molecular Structure

(1)   Atomic Structure: The Schrödinger wave mechanics. The hydrogen atom. Atomic orbitals. Variation theorem. The He-atom, electron spin. Pauli Exclusion principle.

(2)   Molecular Symmetry: Symmetry elements and operations. Point groups. Symmetry species of H_2O molecule

(3)   Molecular Structure: Hydrogen molecule ion. MO approach. Diatomic MOs. VB approach. Hybridization

B.   Application of Spectroscopic Techniques

(1)   Infrared Spectroscopy: Working and experimental considerations in spectral recording; Characteristic group frequencies; carbonyl frequencies; effect of structure: aldehydes, ketones; esters, amides, acid anhydrides, carboxylics acids, acid chlorides; effect of conjugation; cyclization; ambi-dentate ligands and metal carbonyls.

(2)   Ultraviolet and Visible Spectroscopy: Basic working principle and measurement technique; σ-σ*, π-π*, n-σ* and n-π* transitions, dienes and conjugated poly-enes; Woodward-Fieser rules; spectra of transition metal complexes (*d-d* transitions)

(3)   Mass Spectrometry: EI and CI techniques; isotope patterns, molecular ion,   fragmentation

patterns. Mass spectra of simple compounds: (i) 2-hexane by β- fragmentation and (ii) 4-n-butyltoluene by benzylic fission and McLafferty rearrangement.

(4) NMR Spectroscopy: Working principle and method of measurement; factors influencing chemical shift, spin-spin splitting, PMR spectra of simple compounds of (i) benzyl alcohol (δ values) and (ii) ethyl bromide (δ and J values). CMR spectra of simple compounds and their interpretation (2-butanol, benzene, pyridine) .

Books Recommended:

For Atomic and Molecular Structure

1. Physical Chemistry by G.M. Barrow, 5th Ed., Special Indian edition, 2007

2. Physical Chemistry by P.W. Atkins and J. De Paula, 8th Ed., Oxford University Press, 2006

For Spectroscopic Techniques and applications

1.   W. Kemp, *Organic Spectroscopy*, 3rd Ed., (1991), Macmillan, London

2. J. R. Dyer, *Application of Absorption Spectroscopy of Organic Compounds*, Prentice Hall, New Delhi (1978).

3. D. H. Williams and I. F. Fleming, *Spectroscopic Methods in Organic Chemistry,* 4th Ed., (1988), Tata-McGraw Hill, New Delhi.

4. R. S. Drago, *Physical Methods in Inorganic Chemistry,* 1st Ed., (1971), Affiliated East-West Press, New Delhi

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Department of Computer Science

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

SEMESTER I		
Course Code	*Course Title*	*Credits*
CSB101	Introduction to Computer Programming through C	4
CSB102	*Lab. Exercises based on course CSB101*	2
	Total	*6*
SEMESTER II		
CSB201	Digital Logic and Circuits	4
CSB202	*PC Software Lab*	2
	Total	*6*
SEMESTER III		
CSB301	Computer Organization and Architecture	4
CSB302	*Lab. Exercises based on course CSB301*	2
	Total	*6*
SEMESTER IV		
CSB401	Numerical Computing	4
CSB402	*Lab. Exercises based on course CSB401*	2
	Total	*6*
SEMESTER V		
CSB501	Object Oriented Programming using C++	3
CSB502	Net Centric Computing	3
CSB503	Discrete Mathematical Structures	4
CSB504	Operating System Concepts	4
CSB505	*Lab. Exercises based on course CSB501*	2
CSB506	*Lab. Exercises based on course CSB502*	2
	Total	*18*
SEMESTER VI		
CSB601	Database Management Systems	4
CSB602	Data and File Structures	4

CSB603(A-B)	Any one of the following Major Elective Course I:
	    CSB603A: System Analysis and Design
	    CSB603B: E-Commerce
		3

CSB604(A-C)	Any one of the following Major Elective Course II:
	    CSB604A: Graph Theory and Combinatorics
	    CSB604B: Digital Signal Processing
	    CSB604C: Operation Research
		3

CSB605	*Lab. Exercises based on course CSB601*	2
CSB606	*Lab. Exercises based on course CSB602*	2
CSB607	*Project*	4
	Total	*22*
	Grand Total	*64*

B.Sc. (Hons.) Computer Science-   SEMESTER I

CSB101	**Introduction to Computer Programming through C**	*Credits: 4*

Basic Programming Concepts: Introduction to the basic ideas of problem solving and programming using principles of top-down modular design, Flowcharts, Abstraction Mechanisms, Stepwise Refinement.

Syntactic Elements of a Language, General Syntactic Criterion, Formal Definition of Syntax, Semantics, Storage Management, Static Storage Management, Stack-Based Storage Management, Heap Storage Management, Operating and Programming Environment.

Introduction to Programming Language C: Data Types, Instruction and its Types, Storage Classes, Operators and Hierarchy of Operations, Expressions in C, Control   and   Repetitive   Statements, break, continue,   Functions: User Defined Functions and Library Functions, Local and Global Variables, Parameter Passing, Pointers, Arrays, Strings, C Preprocessors, Structures, Input and Output in C, C-Library.

Introduction to the Major Programming Paradigms: Imperative Language, Object Oriented Languages, Functional Languages, Logic Languages, Parallel Languages etc.

Suggested Readings:
1. R. Sethi, Programming Languages: concepts and constructs, Addison-Wesley, 1996.
2. T.W. Pratt, Programming Languages, McGraw Hills.
3. C. Ghezzi & M. Jazayeri, Programming Languages Concepts, John Wiley.
4. M. Marcotty & H.F. Ledgard, Programming Language Landscape, Galgotia Publication.
5. B.W. Kernighan and D.M.Ritchie, the C Programming Language, PHI.
6. R.C. Hutchinson and S.B. Just, Programming using the C   Language, McGraw-Hill.
7. B.S. Gottfried, Schaum's Outline of Theory and Problems of   Programming with C, McGraw-Hill.
8. H. Schildt, C Made Easy, Osborne McGraw-Hill.
9. Y. Kanetkar, Let Us C, BPB Publications.

CSB102	*Lab. Exercises based on course CSB101*	*Credits: 2*

This practical paper will consist of programming exercises based on course CSB101.

CSB201	**Digital Logic and Circuits**	*Credits: 4*

Number System: Binary, Octal, and Hexadecimal; Fixed and Floating Point Number Representations, Complements, Binary Arithmetic: Addition, Subtraction, Multiplication and Division, Binary Codes.

Boolean algebra and Logic Gates: Introduction to Boolean algebra, laws of Boolean algebra, logic gates, universal logic gates, POS and SOP notations, Canonical logic forms. Logic families:

Simplification of Boolean Functions: Laws of Boolean algebra and K-Maps, Tabulation Method.

Combinational Circuits: Design Procedure of Combinational Circuits, Adders, Subtractors, Code Converters, Magnitude Comparator, Encoder, Decoder, Multiplexer, Demultiplexer, ROM, PLAs, PALs.

Sequential Circuits: Flip-Flops: SR, D, JK, T, Master/Slave F/F, Clocked F/F, Edge-trigerred F/F, Excitation Tables; Registers, Counters: synchronous and asynchronous, Shift Registers, RAM.

Logic Families: TTL, ECL, E^2L, CMOS, Characteristics of different logic families.

Suggested Readings:
1. M. M. Mano, Digital Logic and Computer Design, PHI.
2. M.M.Mano, Computer System Architecture, PHI.
3. M.M.Mano, Digital Design, Pearson Education.
4. M. M. Mano and C. R. Kime, Logic and Computer Design Fundamentals," 3rd ed., Prentice Hall, 2004.
5. Virendra Kumar, Digital Electronics : Theory and Experiments, New Age Publication.
6. Malvino, Leach, Digital Principles and Applications, McGraw-Hill.
7. V. Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, PHI, 2006.
8. Thomas C. Bartee, Digital Computer Fundamentals, McGraw-Hill.
9. B. Streetman, Integrated Digital Circuits, PHI

CSB202	*PC Software Lab*	*Credits: 2*

MS-Office Package: MS Word, MS-Excel, MS-Powerpoint, MS Access and Latex.

Suggested Readings:
1. Jennifer Ackerman Kettell, Guy Hart-Davis, Curt Simmons, Microsoft Office 2003 : the complete reference, McGraw-Hill/Osborne, 2003.
2. Laurie Ann Ulrich, NetLibrary, Inc., Sams teach yourself Microsoft Office 2000 in 21 days, Sams publishing, 1999.
3. Gini Courter; Annette Marquis, Mastering Office XP for business professionals, SYBEX, 2003.

B.Sc. (Hons.) Computer Science-   SEMESTER III

CSB301	Computer Organization and Architecture	Credits: 4

Basic Organization : Von Neumann Machine (IAS Computer), Operational flow chart (Fetch, Execute), Instruction Cycle, Organization of Central Processing Unit, Hardwired & micro programmed control unit, Single Organization, General Register Organization, Stack Organization, Addressing modes.

Memory Organization : Memory Hierarchy, Main memory (RAM/ROM chips), Auxiliary memory, Associative memory, Cache memory, Virtual Memory, Memory Management Hardware, hit/miss ratio, magnetic disk and its performance, magnetic Tape etc.

I/O Organization : Peripheral devices, I/O interface, Modes of Transfer, Priority Interrupt, Direct Memory Access, Input-Output Processor, and Serial Communication. I/O Controllers, Asynchronous data transfer, Strobe Control, Handshaking.

Instruction Formats, Op Codes Mnemonics, Data Transfer, Arithmetic, Branch, Loop, Logical , Shift and Rotate Instructions, String Instructions and Text Processing.

Stacks, Calls, Returns, Near and Far Procedures, Interrupts and Their Routines, Directives, Pseudo-ops, Macros and Conditional Machine Instructions, Disk File Handling, Input and Output Instructions, Device Drivers.

Suggested Readings:
1. Y.C. Liu and G.A. Gibson : Microcomputer System – 8086/8088 Family (P.Hall)
2. P. Abel : IBM PC Assembly Language Programming (PHI)
3. M. Thorn : Programming the 8086/8088 (Benjamin)
4. J.P. Hayes, Computer Architecture and Organization, 3rd ed., McGraw Hill.
5. M. M. Mano, Computer System Architecture, PHI.
6. M. M. Mano, Digital Logic and Computer Design (PHI).
7. V. Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, PHI, 2006.
8. William Stallings, Computer Organization And Architecture: Designing For Performance, Prentice Hall, 2005.

CSB302	*Lab. Exercises based on course CSB301*	Credits: 2

Hands on experiments in Digital Logic Design and programming exercises based on course CSB-301: Computer Organization and Architecture.

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CSB401	Numerical Computing	*Credits: 4*

Note : Emphasis is on computational methods

Errors in Computer Arithmetic, Normalization.

Bisection, Falsiposition and Newton-Raphson methods for solution of nonlinear equations. Errors in the solutions, Convergence of Solutions.

Gauss, Gauss-Siedel and Iterative methods for system of linear   equations. Ill conditioned system, Pivotal Condensation, Matrix   Inversion, Eigen-values, Eigen-vector, Diagonalization of Real Symmetric Matrix by Jacobi's Method.

Introduction to Finite Differences.
Polynomial Interpolation using Newton's and Lagrange's formulae.

Numerical Differentiation. Numerical Integration : Trapezoidal Rule, Simpson's Rule, Weddle's Rule, Gauss Quadrature Formula. Error in numerical Integration.

Numerical   Solution   of   differential Equations: Picards Method, Taylor's Series Method, Euler's Method, Modified Euler's Method, Runge-Kutta Method, Predictor-Corrector Method.

Suggested Readings:
1. V. Rajaraman, Computer Oriented Numerical Methods, PHI.
2. F.Acton, Numerical Methods that Work, Harper and Row.
3. S.D.Conte and C.D.Boor, Elementary Numerical Analysis, McGraw Hill.
4. SS Shastri, "Introductory Methods of Numerical Analysis", PHI.
5. C. F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Addision Wesley.

CSB402	*Lab. Exercises based on course CSB401*	*Credits: 2*

This practical paper will consists of programming exercises based on course CSB-401: Numerical Computing.

CSB501	Object Oriented Programming using C++	Credits: 3

OOAD and OOP, Object Oriented Programming paradigm and design; General Concepts: Object, Class, Data Abstraction and Encapsulation, Inheritance, Polymorphism, Dynamic Binding, Message Passing; Benefits of OOP.

Object oriented Programming using C++: Data Types, Operators, Classes and Objects, Constructors and Destructors, Operator Overloading, Type Conversions, Inheritance, Pointers, Virtual Functions, Polymorphism, Stream I/O in C++, File Processing, Templates, Standard Template Library, Program defined exceptions, Events; Introduction to Class Wizard, Application Wizard and MFC.

Suggested Readings:

(1)   B. Stroustrup, The C++ Programming Language, Addison-Wesley.

(2)   E. Balagurusamy, Object oriented Programming with C++, 2/ed, TMH.

(3)   G. Booch, Object Oriented Analysis and Design, Addison-Wesley.

(4)   Rumbagh et al, Object Oriented Modeling, PHI.

(5)   Dietel , H. M. and P. J. Dietel. C++ How to Program, 2ed. Prentice Hall, 1998.

(6)   Bhushan Trivedi, Programming with ANSI C++, Oxford University Press, 2007.

CSB502	Net Centric Computing	Credits: 3

Data Communication and Networking: Background and history of networking and the Internet, Network architectures, Network standards and standardization bodies, The ISO 7-layer reference model in general and its instantiation in TCP/IP; Circuit switching and packet switching, Streams and datagrams;

Physical layer networking concepts (theoretical basis, transmission media, standards);

Data link layer concepts (framing, error control, flow control, protocols);

Internetworking and routing (routing algorithms, internetworking, congestion control);

Transport layer services (connection establishment, performance issues).

Applications, Protocols at the application layer; Domain names and name services, Issues for Internet service providers (ISPs), Network Security, Overview of the issues of network management, Quality of service issues: performance, failure recovery.

Building Web Applications: Web technologies: Server-side programs, Common gateway interface (CGI) programs, Client-side scripts, The applet concept; Characteristics of web servers: Handling permissions, File management, Capabilities of common server architectures, Role of client computers; Nature of the client-server relationship, Web protocols, Support tools for web site creation and web management, Developing Internet information servers, Publishing information and applications

Suggested Readings:

1. Comer, Douglas E. Computer Networks and Internets with Applications, 3/e PrenticeHall 2001.

2. Peterson & Davie *Computer Networks 2nd ed.*Morgan Kaufman 2000.

3.   Stallings, William *Data & Computer Communications 7th ed.* Prentice-Hall 2003.

4. Tanenbaum, Andrew *Computer Networks* 4th ed. Prentice-Hall 2002.

CSB503	Discrete Mathematical Structures	Credits: 4

Sets , Relations & Functions : Property of binary relations, equivalence, compatibility, partial ordering relations, hasse diagram, functions, inverse functions, composition of functions, recursive functions.

Mathematical Logic : Logic operators, Truth tables, Theory of inference and deduction, mathematical calculus , predicate calculus, predicates and quantifiers.

Groups & Subgroups : Group axioms, Monoids , semigroups, Isomorphism, homomorphism , automorphism.

Lattices & Boolean Algebra : Truth values and truth tables, the algebra of propositional functions, boolean algebra of truth values.

Combinatorics & Recurrence Relations : Permutation, Combination, Principle of Inclusion and Exclusion, Recurrence Relations, Generating Functions

Graph theory : Basic Concepts of Graphs and Trees, Adjacency and Incidence   Matrices, Spanning Tree, Transitive Closure, Shortest Path, Planar Graphs, Graph Coloring, Eularian and Hamiltonian graphs, Applications of Graph Theoretic Concepts to Computer Science.

Suggested Readings:

1. J.P. Trembley and R.P.Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill.
2. Dornhoff and Hohn, Applied Modern Algebra, McMillan.
3. N. Deo, Graph Theory with Applications to Engineering and   Computer Science, PHI.
4. R. Johnsonbaugh, Discrete Mathematics, Pearson Education, 2001.
5. R. P. Grimaldi, Discrete and Combinatorial Mathematics, Pearson Education, 1999.
6. C.L. Liu, Elements of Discrete Mathematics, McGraw-Hill.
7. Rosen, Discrete Mathematics, Tata McGraw Hill.

CSB504	Operating System Concepts	Credits: 4

Introduction: Definition, Design Goals, Evolution; Concept of User, job and Resources; Batch processing, Multi-programming, Time sharing; Structure and Functions of Operating System.

Process Management: Process states, State Transitions, Process Control Structure,   Context Switching, Process Scheduling, Threads.

Memory Management: Address Binding, Dynamic Loading and Linking Concepts, Logical and Physical Addresses, Contiguous Allocation, Fragmentation, Paging, Segmentation, Combined Systems, Virtual Memory, Demand Paging, Page fault, Page replacement algorithms, Global Vs Local Allocation, Thrashing, Working Set Model, Paging.

Concurrent Processes: Process Interaction, Shared Data and Critical Section, Mutual Exclusion, Busy form of waiting, Lock and unlock primitives, Synchronization, Classical Problems of Synchronization, Semaphores, Monitors, Conditional Critical Regions, System Deadlock, Wait for Graph, Deadlock Handling Techniques: Prevention, Avoidance, Detection and Recovery.

File and Secondary Storage Management: File Attributes, File Types, File Access Methods, Directory Structure, File System Organization and Mounting, Allocation Methods, Free Space management; Disk Structure, Logical and Physical View, Disk Head Scheduling, Formatting, Swap Management.

Protection & Security.

UNIX/ LINUX and WINDOWS as example systems.

Suggested Readings:

1. Silberschatz and Galvin, Operating System Concepts 6/ed, Addison Wesley.
2. William Stalling, Operating Systems: Internals and Design Principles 5/ed, PHI.
3. Tanenbaum, Modern operating Systems, PHI.
4. J Bach, The Design of UNIX Operating System, Pearson Education.
5. Vijay Mukhi, The C Odessy, BPB.
6. Peterson and Silberschatz, Operating System Concepts, Addison Wesley.
7. P. B. Hansen, Operating System Principles, PHI.
8. K. Christian, The UNIX Operating System, John Wiley.
9. A. N. Haberman, Introduction to Operating System Design, Galgotia.
10. Manuals of DOS, UNIX and Netware.

CSB505	*Lab. Exercises based on course CSB501*	Credits: 2

This practical paper would carry the exercises based on course CSB501: C++ programming.

CSB506	*Lab. Exercises based on course CSB502*	Credits: 2

Laboratory experiments should involve data collection and synthesis, empirical modeling, protocol analysis at the source code level, network packet monitoring, software construction, and evaluation of alternative design models, Web designing.

B.Sc. (Hons.) Computer Science-   SEMESTER VI

CSB601	**Database Management Systems**	Credits: 4

Database Systems, View of Data Models, Database Languages, DBMS Architecture, Database Users and Data Independence.

ER Modeling, relation types, role and Structural Constraints, Extended ER Modeling Features, Design of an ER Database Schema, Reduction of ER Schema to Tables. Relational Model: Relational Model Concepts, Relational Algebra, Relational Calculus.

Introduction to SQL: SQL data types and literals, Types of SQL commands, SQL operators, Tables, views and indexes, Queries and sub queries, Aggregate functions, Cursors in SQL.

Relational Database Design: Functional and multi-valued Dependencies, Desirable Properties of Decomposition, Normalization up to 5 NF.

Concept and Design of Object Oriented Database.

Selected Database Issues: Security, Transaction Management, Basic Algorithms to Query Processing and Query Optimization, Concurrency Control, Recovery Techniques.

Case Study: Oracle/MS-SQL.

Suggested Readings:
1. C.J.Date, An Introduction to Database Systems, Vol I & II, Addison Wesley.
2. Korth Silberschatz, Data Base System Concepts, 4th ed., McGraw Hill.
3. J.D.Ullman, Principles of Database Systems, Golgotha, New Delhi.
4. Wiederhold, Database Design, McGraw Hill.
5. R. Elmasri, and S.B. Navathe, Fundamentals of Database Systems, Pearson Education Asia.
6. Raghu Ramakrishnan, Database Management Systems, McGraw-Hill Education.

CSB602	Data and File Structures	Credits: 4

Basic Data Structures : Arrays, Linked Lists, Stack, Queue, Dequeue, Tree, Heap, Hashing, Hash Table and Collision resolution, Representation of Graphs and Applications. Basic algorithms for Creation, Manipulation and Applications of Data Structures. Algorithm Complexity and Time-Space trade-off.

Internal Sorting Algorithms : Selection, Bubble, Insertion, Heap, Quick Sort. External Sorting Algorithms: Merge Sort.

File Structures: Primary File Organization: Sequential, Direct, Indexed Sequential, Multi-list File Organization, Inverted Files.

Suggested Readings:
1. Lipshutz, Data Structure, McGraw Hill.
2. Standish, Data Structure, Addison-Wesley.
3. B. Salzberg, File Structures - An Analytic Approach, Prentice-Hall.
4. A.L. Tharp, File Organization and Processing, John Wiley and Sons.
5. A. M. Tennenbaum, Y. Langsam and M. J. Augenstein, Data Structures using C, PHI, 1996.
6. S. Lipschutz, Data Structure, Schaum Series.

7. D. E. Knuth, Fundamental Algorithms, Narosa Publication.
8. N. Wirth, Algorithms+Data Structures= Program, Prentice Hall.
9. Robert Lafore, Data Structures and Algorithms in Java, Sams.
10. Sahni S, data Structures, Algorithms and Applications in C++ , Mc Graw- Hill, 2002.

CSB603A	System Analysis and Design	Credits: 3

Introduction to System, Software development life cycle, specification, analysis, design, implementation and testing.

Modular top-down analysis, design and testing, Project Feasibility, System Requirements Analysis, Fact Finding Techniques, Data Flow Diagram, Data Dictionary, Decision Tree, Decision Tables, Structured English, Systems Proposal.

System Design, CASE tools for system analysis and design, data modeling and process modeling (data flow diagrams, entity relationship diagrams), traditional and prototyping approaches, Object-Oriented Analysis and Modeling, design and development of relational database systems. I/O design, input validation and user interface design (GUI).

Suggested Readings:
1. Elias M. Awad, Systems Analysis and Design, McGraw-Hill Professional.
2. Jeffery L. Whitten, Lonnie D. Bentley and Kevin C. Dittman, Systems Analysis and Design Methods, McGraw-Hill.
3. Kenneth E. Kendall, Systems Analysis and Design, Pearson Education.
4. Valacich Joseph S., George Joey F., Hoffer Jeffrey A, Essentials Of Systems Analysis And Design, Prentice Hall of India.
5. V. Rajaraman, "System Analysis and Design", Prentice Hall.
6. J.A. Sern, "Analysis & Design of Information System", McGraw Hill.

CSB603B	E-Commerce	Credits: 3

Introduction, Definition, Objectives, Advantages and disadvantages, Forces driving E-Commerce, Traditional commerce Vs. E-Commerce, E-Commerce opportunities for industries, Growth of E-Commerce.

E-Commerce Models: Business to consumer, Business to Business, Consumer to Consumer, other models – Brokerage Model, Aggregator Model, Info-mediary Model, Community Model and value chain Model.

Electronic Payment Systems: Special features required in payment systems, Types of E-payment systems, E-Cash, E-cheque, credit card, Smart Card, Electronic Purses.
E-Marketing, E-Customer Relationship Management, E-Supply Chain Management.

Security Issues in E-Commerce: Security risk of E-Commerce, Types of threats, Security tools and risk management approach. Cyber laws, Business Ethics, IT Acts.

Suggested Readings:

1. Bharat Bhaskar, Electronic Commerce – Frameroork Technologies and Applications, Tata McGraw Hill.
2. Ravi Kalakota & A.B. Whinston, Frontiers of Electronic Commerce, Pearson Education.
3. Ravi Kalakota & A.B. Whinston, Electronic Commerce – A Manager's Guide, Pearson Education.
4. Agarwala Kamlesh, N and Agarwala Deeksha, Business on the Net_Introduction to the E-Com., Macmillan India.
5. P. T. Joseph, E-Commerce: A Managerial Perspective, PHI, 2002.

CSB604A	Graph Theory and Combinatorics	Credits: 3

Graph Theory: Basic definitions, Trees, cycles, bipartite graphs and other basic concepts. Matchings in bipartite graphs; Hall's theorem and its variants. Euler circuits and Hamilton cycles. Turan's theorem. Planar graphs; the five colour theorem.

Combinatorics: Introduction to combinatorics, The Pigeonhole Principle, Permutations and Combinations

Binomial identities, combinatorial proofs, binomial and multinomial theorems. The Principle of Inclusion and Exclusion, permutations with forbidden positions, circular permutations with forbidden relations.

Suggested Readings:

1. Richard A. Brualdi, Introductory Combinatorics, Prentice Hall, 4 edition, 2004.
2. Behzad M. and G. Chartrand, Introduction to the Theory of Graphs. Allyn and Bacon Inc., Boston.
3. G. Chartrand and L. Lesniak, Graphs and Digraphs, Chapman & Hall/CRC, 4 edition, 2004.
4. Bondy J.A. and U.S. R. Murty, Graph Theory with Applications, The Macmillan Press Ltd.
5. Deo Narsingh, Graph Theory with Applications to Engineering and Computer Science, Prentice-Hall, India, 1994.
6. Harary F., Graph Theory, Addison-Wesley publishing Co.
7. Swamy M. N. Sand K. Thulasiraman, Graphs, Networks and Algorithms, The wiley Inter-Science publication.
8. Wilson R.J., Introduction to Graph Theory, Addison Wesley; 4th edition, 1996.
9. Peter J. Cameron, Combinatorics: Topics, Techniques, Algorithms, Cambridge University Press, 1995.

CSB604B	Digital Signal Processing	Credits: 3

Communication systems: Amplitude and frequency modulation, single side-band modulation, PAM, PCM, PSK, FSK.

Fundamentals of information theory: measure of information, mutual information, entropy, capacity, lossless source coding schemes like Huffman code, run-length code etc., delta modulation.

Signal Processing: Fourier series, Fourier transform, discrete time Fourier series and fourier transform, discrete Fourier transform, FFT, z-transform, Properties of the above transforms, LTI systems, stability of LTI systems, IIR and FIR filters.

Suggested Readings:

1. Understanding Digital Signal Processing by Richard G. Lyons, Prentice Hall PTR; 2nd edition , 2004.

2. The Scientist and Engineer's and Guide to Digital Signal Processing by Steven W. Smith, California Technical Pub.; 1st ed edition , 1997.

3. Digital Signal Processing and the Microcontroller by Dale Grover and John R. (Jack) Deller with illustrations by Jonathan Roth, Prentice Hall, 1998.

4. A.V. Oppenheim, R.W. Schafer, J.R. Buck: Discrete-Time Signal Processing , 2nd Edition, Prentice Hall, 1999.

5. Digital Signal Processing: Principles, Algorithms, and Applications by J. G. Proakis and D. G. Manolakis, Prentice-Hall, 1999.

6. Digital Signal Processing in Communication Systems by Marvin E. Frerking, Van Nostrand Reinhold, 1994.

7. R. E. Crochiere and L. R. Rabiner, Multirate Digital Signal Processing, Prentice-Hall.

8. L.R. Rabiner, B. Gold, Theory and application of digital signal processing, Prentice-Hall.

9. Alan V. Oppenheim and Ronald W. Schafer, John R. Buck, Digital Signal Processing, Prentice Hall.

10. William D. Stanley, Gary R. Dougherty, Ray Dougherty, Digital Signal Processing, Reston Pub Co.

CSB604C	Operation Research	Credits: 3

Network Analysis: Terminology of network, shortest route problem, minimal   spanning tree problem, max-flow problem.

Project Scheduling by PERT, CPM: Diagram, representation, critical path calculation, construction of time chart and resource labeling, probability and cost   consideration in project scheduling, project control.

Linear Programming: Simplex Method, Revised simplex method, Duality in Linear   programming, Application of Linear Programming to Economic and Industrial Problems.

Nonlinear Programming: The Kuhn-Tucker conditions, Quadratic programming, Convex programming.

Replacement Models: Introduction, Replacement policies for items whose efficiency   deteriorates with time, Replacement policies for items that fail   completely.

Sequencing Model: Classification of self problems, processing of n jobs through   two machines, three machines, processing of two jobs through m   machines.

Suggested Readings:

1. Taha, Operations Research, Macmillan.
2. B.E. Gillet, Introduction to Operations Research, McGraw-Hill.
3. S.S.Rao, Optimization Theory and Applications, Wiley Eastern.
4. G.Hadley, Linear programming, Addison-Wesley.

CSB605	*Lab. Exercises based on course CSB601*	**Credits: 2**

This practical paper would carry the exercises based on course CSB601: DBMS.

CSB606	*Lab. Exercises based on course CSB602*	**Credits: 2**

This practical paper would carry the exercises based on course CSB602: Data and File Structures.

CSB607	*Project*	**Credits: 4**

Students will be required to pursue a project work allotted to them in accordance with their preference subject to their supervisor's approval. They will have to submit a report of the project work done by them during the semester.

B. Sc. INDUSTRIAL MICROBIOLOGY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Botany

Faculty of Science

Banaras Hindu University

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Semester-I

Course Code	Title	Credits
IMB101	Microbial Physiology, Biochemistry, Genetics and Molecular Biology	4
IMB102	Lab. work based on Course IMB101	2
	Total	**6**

Semester-II

Course Code	Title	Credits
IMB201	Environmental Microbiology and Biotechnology	4
IMB202	Lab. work based on Course IMB201	2
	Total	**6**

Semester-III

Course Code	Title	Credits
IMB301	Agricultural and Food Microbiology	4
IMB302	Lab. work based on Course IMB301	2
	Total	**6**

Semester-IV

Course Code	Title	Credits
IMB401	Fermentation Technology	4
IMB402	Lab. work based on Course IMB401	2
	Total	**6**
	Grand Total	**24**

After having secured admission in their respective Honours subjects, the students will have to submit **Dissertation** on Project Work to qualify themselves for their final B.Sc.(Hons.) degree. The dissertation shall have no credit.

Dissertation will be evaluated through oral presentation and Viva-voce examination. His/her result will be declared after clearing this requirement of the Dissertation work during B.Sc. Part III. Resubmission of the Dissertation work of the failed Candidates will be allowed within two months of the declaration of the result.

IMB101: Microbial Physiology, Biochemistry, Genetics and Molecular Biology   Credits: 4

Section – A
1. Introduction to microbial physiology
2. Nutrition: Types of microbes based on nutrition and growth characteristics
3. A brief account in sulphur and phosphorus metabolism
4. Biological Nitrogen Fixation: Process and factors affecting nitrogen fixation
5. Photosynthesis: Light harvestation, transfer of energy, photophosphorylation, carbon fixation in bacterial photosynthesis
6. Respiration: Aerobic and anaerobic pathways for energy production

Section - B
1. Scope and importance of microbial biochemistry
2. Biomolecules: Structure and significance of carbohydrates, lipids, amino acids and proteins
3. Enzymes: Major classes, basic mechanism of action, kinetics and factors affecting enzyme activities, introduction to ribozymes

Section - C
1. Organization of prokaryotic genome
2. Gene mutation: Types, mutagens and their mode of action, applications of genetic mutants
3. Nucleic acid: Structure and types, DNA replication
4. Genetic information flow: mechanism of transcription, genetic code and translation
5. Basic concept of gene regulation: *Lac operon*
6. Organization of genetic material: Transposons, split genes and overlapping genes
7. Basic strategies of genetic engineering and its application

IMB102:   Lab work based on Course IMB101   Credits: 2

SEMESTER II

IMB201: Environmental Microbiology and Biotechnology   Credits: 4

Section - A
1. Occurrence of microbes in diverse environments; physico-chemical factors affecting growth and multiplication of microorganisms
2. Extremophilic microorganisms (thermophilic, alkalophilic, acidophilic halophilic and desiccation-tolerant microbes) and mechanisms of their survival
3. Aeromicroflora: Sources, diversity, methods of sampling and enumeration, harmful effects on humans
4. Microbes in water and wastewater: Pathogenic enterobacteria and enteroviruses and their collective enumeration; microbial indicators of water quality
5. Role of microbes in biogeochemical cycling of iron, phosphorus and sulfur

Section - B

1. Role of microorganisms in secondary treatment of sewage: activated sludge, trickling filter and oxidation pond
2. Anaerobic digestion of sludge; methane and energy production from agricultural and domestic wastes
3. Microbial degradation of synthetic pesticides and petroleum hydrocarbons; bioremediation of oil spills

Section - C
1. Useful microbes in biotechnology; strain selection and improvement with special reference to the role of genetic engineering in strain development
2. Importance and application of plant tissue and animal cell culture, development of transgenic plants and animals
3. Prospects of microbial biotechnology in the context of agriculture, environment, medicine and energy
4. Regulation of the safety of biotechnology procedures and products
5. Genetically engineered microbes: fate and effects

IMB202   **Lab work based on Course IMB201**   **Credits: 2**

SEMESTER III

IMB301: Agricultural and Food Microbiology   Credits: 4

Section – A: Agricultural Microbiology
1. Role of microbes in agriculture
2. General symptoms of plant diseases, mode of infection and dispersal of plant pathogens
3. Microbiological control of plant pathogens, pests and weeds
4. Symbiotic and free living bacteria and cyanobacteria
5. Phosphate solubilizing bacteria; vesicular-arbuscular mycorrhiza
6. Role of microbes in plant growth promotion and crop production
7. Role of microbes in restoration of soil fertility
8. Biofertilizers: Types, technology for their production and application, plant response to biofertilizers

Section –B: Food Microbiology
1. Introduction: General account of the microbes associated with food
2. Microbes as source of food: mushrooms, single cell protein
3. Microbial spoilage of food and food products: cereals, vegetables, prickles, fish and poultry and dairy products
4. Role of microbes in food poisoning, microbial toxins and their bioassay methods
5. Microbial food borne diseases
6. Microbes and fermented foods: butter, cheese, bakery products

IMB302   **Lab work based on Course IMB301**   **Credits: 2**

SEMESTER IV

IMB401: Fermentation Technology   *Credits: 4*

1. Scope and opportunities of fermentation technology
2. Selection, improvement, maintenance and preservation of industrially important cultures of microorganisms, metabolic regulations and over production of metabolites
3. Microbial growth kinetics
4. Principles of different modes of fermentation processes viz. submerged, solid state, batch, fed batch and continuous
5. Sterilization of fluids: Media sterilization, batch and continuous media sterilization processes, sterilization of fermenter, sterilization of the feeds, sterilization of air, theory of fibrous filter, filter design
6. Fermentative production of vinegar, alcohol (ethanol, wine, beer, glycerol) acids (acetic acid, lactic acid, citric acid and gluconic acid), solvents (acetone & butanol), amino acids (lysine & glutamine acid), antibiotics (penicillin and streptomycin) and vaccines
7. Microbial production of toxins and pigments
8. Microbial production of enzymes like amylase, protease, invertase
9. Bioproduct recovery: Conventional and advanced methods
10. Fundamentals of biostatistics, application of biostatistics in industrial microbiology

IMB402   **Lab work based on Course IMB401**   **Credits: 2**

B. Sc. (HONS.) GEOGRAPHY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Geography

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

I SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC101	Theory	Physical Basis of Geography	4
GBP102	Practical	Map: Reading and Interpretation	2
Total	**Semester I**		**6**

II SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC103	Theory	Human Geography	4
GBP104	Practical	Elementary Statistics	2
Total	**Semester II**		**6**

III SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC105	Theory	Regional Study of Selected Developed and Developing Countries: U.S.A. and China	4
GBP106	Practical	Map Projection and Weather Map	2
Total	**Semester III**		6

IV SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC107	Theory	Economic Geography	4
GBP108	Practical	Surveying	2
Total	**Semester IV**		**6**

V SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC109	Theory	Geomorphology	4
GBC110	Theory	Geography of India	4
GBP114	Practical	Representation of Geographical Data	3
GBP115	Practical	Geological Map and Map Projection	3

		Students may select any ONE from the following Elective (Theory)Papers		
GBE111	Theory	Population Geography	4
GBE112	Theory	Social Geography	4
GBE113	Theory	Agricultural Geography	4
Total	**Semester V**		**18**

VI SEMESTER

Paper Code	Explanation	Title of the Paper	Credit
GBC116	Theory	Climatology	4
GBC117	Theory	Evolution of Geographical Thought	4
GBP121	Practical	Field Study, Field Trip and Report Writing	3
GBP122	Practical	Elementary Remote Sensing	3
GBPr 123	*Project (Compulsory)*	*Project: Field based*	**4**
Students may select any ONE from the following Elective (Theory)Papers			
GBE118	Theory	Regional Development and Planning	4
GBE119	Theory	Political Geography	4
GBE120	Theory	Industrial Geography	4
Total	**Semester V I**		**22**

Physical Basis of Geography

Unit I

Origin of the solar system and earth (James and Jeffereys, Russell, Lytilleton, Lemaitre); Interior of the earth; Rocks: origin and classification; Earth's movements.

Unit II

Major landforms: mountains, plateaus and plains; Gradational processes: weathering and erosion; Works of water, glacier and wind.

Unit III

Composition and structure of the atmosphere; Insolation; Temperature: vertical and horizontal distribution; Pressure and pressure belts; Winds: planetary, periodic and local.

Unit IV

Theories on origin of ocean basin, Physical properties of sea water: temperature and salinity; Ocean currents; Tides and Coral reefs.

Books Recommended
1. Barry, R. G. and Chorley, R. J. (1998): Atmosphere, Weather and Climate. Routledge, London.
2. Bryant, H. Richard (2001): Physical Geography Made Simple, Rupa and Company. New Delhi
3. Bunnett, R.B. (2003): Physical Geography in Diagrams, Fourth GCSE edition, Pearson Education (Singapore) Private Ltd.
4. Garrison, T. (1998): Oceanography, Wordsworth Company., Belmont.
5. Lake, P. (1979): Physical Geography (English and Hindi editions), Cambridge University Press, Cambridge.
6. Leong Goh Cheng (2003): Certificate Physical and Human Geography, Oxford University Press, New Delhi.
7. Monkhouse, F.J. (1979): Physical Geography. Methuen, London
8. Singh, S. (2003): Physical Geography. (English and Hindi editions.). Prayag Pustak Bhawan, Allahabad;
9. Trewartha, G.T., Robinson, A.H., Hammond, E.H., and Horn, A.T. (1976/1990): Fundamentals of Physical Geography, 3rd edition. MacGraw-Hill, New York.
10. Singh, M.B. (2001): *Bhoutik Bhugol,* Tara Book Agency, Varanasi
11. Singh, S.N. and Singh, V. (2002): *Bhoutik Bhugol,* Mishra Trading Corporation, Varanasi.

12. Strahler, A.N. and Stahler, A.M. (1992): Modern Physical Geography. John Wiley and Sons, New York.

13. Wooldridge, S.W. and Morgan, R.S. (1959): The Physical Basis of Geography- An Outline of Geomorphology. Longman, London.

GBP102. Practical, Paper: 1

Map: Reading and Interpretation

Meaning and types of scale: simple, diagonal and comparative; Elements of map reading and Interpretation of toposheets, Relief features and profiles (serial, superimposed, composite and projected), Reduction and enlargement of maps.

Books Recommended

1. Monkhouse, F. J. and Wilkinson, F.J. (1985): Maps and Diagrams. Methuen, London

2. Raisz, E. (1962): General Cartography. John Wiley and Sons, New York. 5th edition.

3. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.

4. Sharma, J. P. (2001): *Prayogik Bhugol.,* Rastogi Publication, Meerut 3rd. edition.

5. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions). Kalyani Publishers, New Delhi,.

6. Singh, L.R. (2006): Fundamentals of Practical Geography, Sharda Pustak Bhawan, Allahabad.

GBC103. Theory, Paper: 2

Human Geography

Unit I

Meaning, nature and scope of human geography; Development and branches of human geography; Concepts of human geography, Man-environment dynamic relationships: determinism, possibilism and probabilism.

Unit II

Evolution of man; Classification of races; Characteristics of races and their broad distribution; Human adaptation to environment: Eskimo, Masai and Bushman; Primitive people of India: Naga and Bhil.

Unit III

Growth of population; Distribution of population; Major human agglomerations; Trends of urbanization.

Unit IV

Rural settlements: characteristics, types and regional patterns; Urban settlements: evolution and classification; Rural houses in India: types, classification and regional patterns; Cultural regions of the world: classification and its attributes.

Books Recommended
1. Chisholm, M. (1985): Human Geography, 2nd edition, Penguin Books, London.
2. de Blij, H.J.(1996): Human Geography: Culture, Society and Space,. 2nd edition. John Wiley and Sons, New York,
3. Fellman, J. D., Arthur, G., Judith, G., Hopkins, J. and Dan, S. (2007): Human Geography: Landscapes of Human Activities. McGraw-Hill, New York. 10th edition.
4. Haggett, P. (2004): Geography: A Modern Synthesis. 8th edition, Harper and Row, New York.
5. Husain, M. (1994): Human Geography, Rawat Publications, Jaipur.
6. Johnston, R. J., Gregory, D., Pratt, G. and Watts, M. (2000): The Dictionary of Human Geography. 4th edition, Basil Blackwell Publishers, Oxford.
7. Kaushik, S.D. and Sharma, A.K. (1996): Principles of Human Geography (in Hindi), Rastogi Publication, Meerut.
8. Michael, C. M. (1997): Process and Change in Human Geography. Nelson, London.
9. Norton, W. (1995): Human Geography, Oxford University Press, New York.
10. Singh, K. N. and Singh, J. (2001): *Manav Bhugol*. Gyanodaya Prakashan, Gorakhpur. 2nd edition.
11. Singh, L.R. (2005): Fundamentals of Human Geography, Sharda Pustak Bhawan, Allahabad
12. Smith, D. M.(1977): Human Geography- A Welfare Approach, Edward Arnold (Publishers) Ltd., London
13. Stoddard, R.H., Wishart, D.J. and Blouet, B.W. (1986): Human Geography. Prentice-Hall, Englewood Cliffs, New Jersey.

GBP104. Practical, Paper: 2

Elementary Statistics

Sources of data; Tabulation and classification of data.

Measures of central tendency: mean, median and mode; quartile, decile and percentile;

Measures of dispersion: range, quartile deviation, mean deviation, standard deviation

and relative dispersion;

Measures of skewness: coefficient of skewness

Correlation (Karl Pearson and Spearman) and regression analysis.

Books Recommended
1. Bhagwathi, V. and Pillai, R.S.N. (2003): Practical Statistics, Sultan Chand and Company, New Delhi
2. Ebdon, D. (1977): Statistics in Geography: A Practical Approach, Blackwell Publishers Inc., Massachusetts

3. Gregory, S. (1973): Statistical Methods and the Geographer, Longman, London.
4. Gupta, S.P. (1998): Advanced Practical Statistics, Sultan Chand and Company, New Delhi
5. Mahmood, A. (1986): Statistical Methods in Geographical Studies, Rajesh Publications, New Delhi
6. Zamir, A. (2002): Statistical Geography: Methods and Applications, Rawat Publications, Jaipur.

GBC105. Theory, Paper: 3

Regional Study of Selected Developed and Developing Countries: USA and China

Unit I

Concepts, bases and characteristics of developed and developing countries; Levels of development: First, Second, Third and Fourth Worlds.

Unit II

Physical resource base: physiography, climate, soil, vegetation, power and mineral resources

Unit III

Cultural resource base: population, agriculture and industries

Unit IV

Agricultural and industrial regions of USA; Agricultural and geographical regions of China.

Books Recommended
1. di Blij, H. and Muller, O. (1993): Geography: Regions and Concepts. John Wiley and Sons, New York..
2. Jackson, R. H. and Husman, L. E. (1991): World Regional Geography: Issues for Today. John Wiley and Sons, New York.
3. Jones, P. and Bryan, P. (1954): North America: An Historical, Economic and Regional Geography, Methuen and Company. Ltd, London.
4. Kolb, A. (1971): East Asia, China, Japan, Korea, Vietnam, Methuen, London.
5. Rai, Gayatri (2007): *Vishwa Ka Pradeshik Bhugol,* Mishra Trading Corporation, Varanasi
6. Sharma, P. R. (ed.) (1991): Perspectives on Third World Development. Rishi Publication, Varanasi.
7. Stamp, L. D. (1976): Asia: A Regional and Economic Geography, Methuen, London.

GBP 106. Practical, Paper: 3

Map Projection and Weather Map

Map Projection: Conical: simple conic with one and two standard parallels, Bonne's,

Cylindrical: simple and equal area

Zenithal (Polar case): equidistant and equal area.

Weather Map: Weather symbols, Representation of atmospheric features, Interpretation of Indian daily weather maps (July, October and January)

<u>**Books Recommended**</u>
1. Monkhouse, F. J. and Wilkinson, F.J. (1985): Maps and Diagrams. Methuen, London.
2. Raisz, E. (1962): General Cartography. John Wiley and Sons, New York. 5th edition.
3. Robinson, A., Sale, R. Morrison, J. and Muehrcke, P. C. (1984): Elements of Cartography, John Wiley and Sons, New York
4. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.
5. Sharma, J. P. (2001<u>): *Prayogik Bhugol*</u>., Rastogi Publication, Meerut 3rd edition.
6. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions). Kalyani Publishers, New Delhi,

GBC107. Theory, Paper: 4

Economic Geography

Unit I

Meaning, scope and approaches to economic geography; Main concepts of economic geography; Resource: concept and classification; Natural resources: soil, forest and water.

Unit II

Mineral resources: iron ore and bauxite; Power resources: coal, petroleum and hydro electricity; Resource conservation; Principal crops: wheat, rice, sugarcane and tea

Unit III

Agricultural regions of the world (Derwent Whittlesey); Theory of agricultural location (Von Thunen); Theory of industrial location (Weber); Major industries: iron and steel, textiles, petro-chemical and sugar; industrial regions of the world.

Unit IV

World transportation: major trans-continental railways, sea and air routes; International trade: patterns and trends; Major trade blocks: NAFTA, EEC, ASEAN; Effect of globalization on developing countries.

Books Recommended
1. Alexander, J. W. (1988): Economic Geography. Prentice-Hall, New Delhi,.
2. Boesch, H. (1964): A Geography of World Economy. Von Nostrand, New York,.

3. Bryson, J., Henry, N., Keeble, D. and Martin, R. (eds.) (1999): The Economic Geography Reader: Producing and Consuming Global Capitalism. John Wiley and Sons, Inc, New York.

4. Clark,G. L., Gertler, M. S. and Feldman, M. P. (eds.) (2000): The Oxford Handbook of Economic Geography. Oxford University Press, USA.

5. Coe, N. (2007): Economic Geography: A Contemporary Introduction. Blackwell Publishers, Inc., Massachusetts.

6. Gautam, A. (2006): *Aarthik Bhugol Ke Mool Tattava,* Sharda Pustak Bhawan, Allahabad.

7. Guha, J. S. and Chattoraj, P.R.(2002): A New Approach to Economic Geography: A Study of Resources. The World Press Private Limited, Kolkata.

8. Hanink, D. M. (1997): Principles and Applications of Economic Geography: Economy, Policy, Environment. John Wiley and Sons, Inc, New York.

9. Hartshorne, T. A. and Alexander, J. W. (1988): Economic Geography (3rd revised edition) Englewood Cliff , New Jersey, Prentice Hall

10. Hudson, R. (2005): Economic Geographies: Circuits, Flows and Spaces. Sage Publications, London.

11. Jones, C. F. and Darkenwald, D.D. (1975): Economic Geography, Macmillan, New York.

12. Knowles, R, Wareing, J. (2000): Economic and Social Geography Made Simple, Rupa and Company, New Delhi.

13. Leong, G. C. and Morgan, G. C.(1982): Human and Economic Geography, Oxford University Press, Singapore .

14. Mackinnon, D. and Cumbers, A. (2007): Introduction to Economic Geography: Globalization, Uneven Development and Place. Prentice Hall, Inc., New York

15. Roy, P.K. (2005): Economic Geography, A Study of Resources, New Central Book Agency (P) Ltd, Kolkata.

16. Royen, W.V. and Bengtson, N.A. (1964): Fundamentals of Economic Geography. Englewood Cliffs: Prentice Hall, New Jersey.

17. Sheppard, E. and Barnes, T. J. (eds.) (2002): A Companion to Economic Geography. Blackwell Publishers, Inc., Massachusetts.

18. Singh, K. N. and Singh, J. (2003): *Aarthik Bhugol ke Mool Tattva*, Gyanodaya Prakashan., Gorakhpur.

19. Stutz, F. and Warf, B. *(2005)*: World Economy: Resource, Location, Trade and Development (4th edition). Prentice Hall, Inc, New York

20. Wheeler, J. O. (1998): Economic Geography (3rd revised edition). John Wiley and Sons, Inc, New York.

GBP108. Practical, Paper: 4

Surveying

Surveying: meaning, classification and significance.

Chain and Tape surveying; Plane Table surveying;

Prismatic Compass,

Abney Level and Indian Clinometer

Books Recommended

1. Davis, R.E. and Foote, F.S. (1953): Surveying, 4ᵗʰ edition, McGraw Hill Publication, New York
2. Jones, P.A.(1968): Fieldwork in Geography, Longmans, Green and Company Ltd., First Publication, London
3. Kanetker, T.P. and Kulkarni, S.V.(1967): Surveying and Levelling, Vol I and II V.G. Prakashan, Poona.
4. Natrajan, V. (1976): Advanced Surveying, B.I. Publications., Mumbai.
5. Pugh, J.C. (1975): Surveying for Field Scientists, Methuen and Company Ltd., London, First Publication.
6. Punmia, B.C.(1994): Surveying, Vol I, Laxmi Publications Private Ltd, New Delhi.
7. Shephard, F.A. (1968): Surveying Problems and Solutions, Edward Arnold (Publishers) Ltd, London
8. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions), Kalyani Publishers, Ludhiana and New Delhi.
9. Venkatramaiah, C. (1997): A Text Book of Surveying, Universities Press, Hyderabad.

GBC 109. Theory, Paper: 5

Geomorphology

Unit I

Nature and scope of geomorphology; Principles and basis of geological time scale; Fundamental concepts: uniformitarianism and dynamic equilibrium, relief and differential rates of geomorphic processes; Models of landscape development- Davis, Penck and King.

Unit II

Cycle of erosion and slope evolution; Isostasy, Plate tectonics, Earthquakes; Folded structure and topography; Faulted structure and topography.

Unit III

Mass wasting and different geomorphic agents and processes- running water, wind, glacier, wave and underground water.

Unit IV

Evolution and development of river valleys; Drainage pattern and their significance; concept of graded stream; river channels- form, pattern and dynamics; Photo-geology and remote sensing application; Regional geomorphology of Appalachian Highland, Uttarakhand Himalaya and Middle Ganga Plain.

Books Recommended

1. Bloom, A. L. (1992): Geomorphology–A Systematic Analysis. Prentice-Hall India, New Delhi.
2. Chorley, R. J., Schumm, S. A. and Sugden D.E.(1984): Geomorphology. Methuen, London
3. Holmes, A. (1987): Principles of Physical Geology. Nelson, New York, 3ʳᵈ edition.

4. Sparks, B.W.(1969) : Geomorphology. Longman, London.

5. Stoddard, D. R. (ed.)(1996): Process and Form in Geomorphology. Routledge, London,.

6. Kale, V. and Gupta, A. (2001): Elements of Geomorphology. Oxford University Press, Delhi.

7. Thornbury, W. D. (1990): Principles of Geomorphology. Wiley Eastern Edition, New York,.

8. Singh, S. (2000): Geomorphology. (in Hindi). Vasundhra Prakashan, Gorakhpur.

9. Singh, S. (2004): Geomorphology, Prayag Pustak Bhawan, Allahabad

10. Skinner, B. J. and Porter, S.C. (1996): The Dynamic Earth. John Wiley and Sons, New York,.

11. Wooldridge, S.W. and Morgan, R.S. (1959): The Physical Basis of Geography: An Outline of Geomorphology. Longman, London, several reprints.

GBC 110. Theory, Paper: 6

Geography of India

Unit I

Geology; Physiographic divisions; Drainage system; Climate and climatic regions; Soil and vegetation

Unit II

Minerals and power resources (iron ore, bauxite, coal and petroleum); Multipurpose projects; Irrigation; Major industries (iron and steel, cotton textile, sugar and cement).

Unit III

Crops (rice, wheat, sugarcane, cotton and tea) and agricultural regions, Green revolution and its consequences

Unit IV

Macro-regions of India and their geographical specialities; Transport and communication; Trade: composition and recent changes.

Books Recommended

1. Chauhan, P.R. and Prasad, M. (2003): *Bharat Ka Vrihad Bhugol*, Vasundhara Prakashan, Gorakhpur.

2. Farmer, B.H. (1983): An Introduction to South Asia. Methuen, London

3. Gautam, A. (2006): Advanced Geography of India, Sharda Pustak Bhawan, Allahabad

4. Johnson, B.L.C. (1963): Development in South Asia. Penguin Books, Harmondsworth

5. Krishnan, M.S. (1982): Geology of India and Burma, CAS Publishers and Distributors, Delhi.

6. Khullar, D.R. (2007): India: A Comprehensive Geography, Kalyani Publishers, New Delhi

7. Nag, P. and Gupta, S. S. (1992): Geography of India, Concept Publishing Company, New Delhi.

8. Rao, B.P. (2007): *Bharat kee Bhaugolik Sameeksha*, Vasundhara Prakashan, Gorakhpur.

9. Sharma, T.C. and Coutinho, O. (2003): Economic and Commercial Geography of India, Vikas Publishing House Private Ltd. New Delhi.
10. Singh , J. (2003): India: A Comprehensive Systematic Geography. Gyanodaya Prakashan, Gorakhpur
11. Singh, J. (2001): *Bharat: Bhougolik Aadhar Avam Ayam*, Gyanodaya Prakashan, Gorakhpur.
12. Singh, R.L. (ed.) (1971): India: A Regional Geography. National Geographical Society of India, Varanasi,.
13. Spate, O.H. K., Learmonth A. T. A. and Farmer, B. H. (1996): India, Pakistan and Sri Lanka. Methuen, London, 7th edition.
14. SukhwaI, B.L. (1987): India: Economic Resource Base and Contemporary Political Patterns. Sterling Publication, New Delhi
15. Tiwari, R.C. (2007): Geography of India, Prayag Pustak Bhawan, Allahabad.
16. Wadia, D. N. (1959): *Geology of India*. Mac-Millan and Company, London and student edition, Madras.

GBE 111. Theory: Elective, Paper: 7

Population Geography

Unit I

Nature, scope and development of population geography; Sources and types of population data: census, sample survey and vital registration system.

Unit II

World population: growth, causes and consequences; Factors affecting population distribution; Demographic transition theory; Migration: types and determinants.

Unit III

Population characteristics: fertility and mortality, age and sex structure, occupational structure, human resource development, urbanization.

Unit IV

Population growth and distribution in India, density types, population problems and Population Policy in India

Books Recommended
1. Chandna, R. C. (2006): Geography of Population. Kalyani Publishers, New Delhi.
2. Clarke, J.I. (1972): Population Geography. Pergamon Press, Oxford.
3. Demko, G.J., Rose, H.M., and Schnell, G.A. (1970): Population Geography: A Reader. McGraw-Hill, New York.
4. Dube, K.K. and Singh, M.B.(1994): *Jansankhya Bhoogol*, Rawat Publications, Jaipur.
5. Garnier, B.J. (1993): Geography of Population. 3rd edition. Longman, London.
6. Jones, H. R. (1981): A Population Geography. Harper and Row, New York.

7. Peters, G. L. and Larkin, R.P. (1983): Population Geography: Problems, Concepts and Prospects. Kendall/Hunt, Dubuque, IA.

8. Trewartha, G.T. (1985): A Geography of Population: World Patterns. John Wiley and Sons, New York.

9. Zelinsky, W. (1966): A Prologue to Population Geography. Prentice Hall, New Jersey.

GBE 112. Theory: Elective, Paper: 8

Social Geography

Unit I

Meaning, nature and development of social geography; Social Geography in the realms of social sciences; Concept of social space; Social differentiation and stratification; Social segregation and social morphology

Unit II

Social differentiation and region formation; Evolution of socio-cultural regions of India; Bases of social region formation; Role of race, caste, tribe, religion and languages; India- unity in diversity

Unit III

Concept of social wellbeing, physical quality of life; Human development: concept and measurements; Rural-urban deprivation in India with respect to health care, education and shelter; Gender issues in India

Unit IV

Public policy and social planning in India; Review of Five-Year Plans and area plans towards social policy in India, Social policy and planning for drought and flood prone areas, Social and environmental impact assessment of development projects

Books Recommended

1. Ahmad, A. (1999): Social Geography. Rawat Publications, Jaipur and New Delhi.

2. Anderson, K. (2006): Race and Crises of Human Development. Routledge, London and New Delhi.

3. Betizlle, A.(1983): Equality and Inequality, Oxford University Press, New Delhi

4. Brewer, J.D. (2000): Ethnography, Open University Press, Buckingham, Philadelphia, First Edition.

5. Coates, B.E., Johnston, R.J. and Knox, P.L. (1977): Geography and Inequality, Oxford University Press, Oxford, London.

6. Eyles, J. (ed.) (1986): Social Geography in International Perspective. Rowman and Littlefield, New Jersey and Los Angeles.

7. Dubey. S.C. (1991): Indian Society. National Book Trust, New Delhi.

8. Forde, C. D. (1934): Habitat, Economy and Society, Methuen and Company London

9. Gregory, D. and Larry, J. (eds.) (1985): Social Relations and Spatial Structures. McMillan, London

10. Gore, M.S. (1985): Social Aspects of Development, Rawat Publications, Jaipur

11. Jackson, P. and Susan, J. S. (1984): Exploring Social Geography, George Allan Unwin, Boston and Sydney.

12. Jones, E. (ed.) (1975) : Readings in Social Geography, Oxford University Press, London.

13. Haq, M. (2000): Reflections on Human Development. Oxford University Press, New Delhi.

14. Maloney, C. (1974): People of South Asia. Winston Norton, New York.

15. Moseley, W. G., Lanegran, D. A. and Pandit, K. (eds). (2007): The Introductory Reader in Human Geography. Contemporary Debates and Classic Writings. Blackwell Publishers., Oxford.

16. Norton, W. (2006): Cultural Geography. Environments. Landscapes. Identities. Inequalities. Oxford University Press, Toronto. 2nd edition.

17. Planning Commission, Government of India (1981): *Report on Development of Tribal Areas*. New Delhi.

18. Sahlins, M. D. (1968): Tribesmen, Prentice Hall, New York.

19. Sharma, K.L. (1980): Essays on Social Stratification, Rawat Publications, Jaipur and New Delhi, first edition.

20. Smith, D. (1977): Geography: A Welfare Approach. Edward Arnold, London.

21. Sopher, D. (1980): An Exploration of India: Geographical Perspectives on Society and Culture, Cornell University Press, Ithaca, New York, first edition.

22. Subba, R. B. (1958): Personality of India: Pre- and Proto- Historic Foundation of India and Pakistan. 2nd edition. M.S. University Baroda, Vadodara.

23. Valentine, G. (2001): Social Geographies: Space and Society. Prentice Hall, Harlow, UK.

GBE113. Theory: Elective, Paper: 9

Agricultural Geography

Unit I

Meaning and scope of agricultural geography; Approaches to agricultural geography; Physical, cultural and institutional factors affecting agriculture.

Unit II

Crop concentration and crop diversification; Delineation of crop combination regions; Agricultural regions of the world; Detailed study of subsistence, plantation, commercial and mixed farming.

Unit III

Agricultural land-use and carrying capacity; Land use pattern with special reference to India; Measures of agricultural efficiency and agricultural productivity.

Unit IV

Agricultural planning and policies in India, Agro-climatic regions of India, Green revolution in India; Second generation reforms in Indian agriculture: Land and institutional reforms, Evergreen revolution; Organic and contract farming.

Books Recommended

1. Dumont, R.(1970): Types of Rural Economy: Studies in World Agriculture, Douglas Manin, London Methuen
2. Gregor, H. P. (1970): Geography of Agriculture. Prentice-Hall, New York.
3. Husain, M. (1996): Systematic Agricultural Geography, Rawat Publications, Jaipur.
4. Mishra, R. P. (1967): Diffusion of Agricultural Innovations, University of Mysore, Mysore.
5. Mohammad, A.(1978): Studies in Agricultural Geography, Rajesh Publications, New Delhi
6. Morgan, W. B. and Norton, R.J.C. (1971): Agricultural Geography. Methuen, London.
7. Sauer, O. C. (1969): Agricultural Origins and Dispersals. MIT Press, Cambridge.
8. Shafi, M. (2006): Agricultural Geography, Pearson Education, New Delhi.
9. Sen, Sudhir (1975): Reaping the Green Revolution. Tata McGraw-Hill, New Delhi
10. Shafi, M.(2000): Agricultural Geography of South Asia, McMillan, Delhi
11. Singh, B.B. (1979) : *Krishi Bhugol*. Tara Publications, Varanasi.
12. Singh, J. and Dhillon, S.S. (2000): Agricultural Geography. Tata McGraw Hill, New Delhi.
13. Singh, S. (1994): Agricultural Development in India: A Regional Analysis, Kaushal Publications, Shillong.
14. Symons, L. (1967): Agricultural Geography. George Bell and Sons, London.
15. Tarrant J. R. (1974): Agricultural Geography. John Wiley and Sons, New York.

GBP 114. Practical, Paper: 5

Representation of Geographical Data

Graphical Representation
Bar diagram, Histogram, Frequency polygon, Frequency curve, Cumulative frequency curve or Ogive
Rainfall dispersion diagram, Climograph, Hythergraph, Ergograph

Cartographic Representation
Distribution maps**:** Dot, Isopleth, Choropleth, Chorochromatic and Choroschematic; Pie diagram.
Cartogram: Traffic flow diagram, Isochronic cartogram.

Books Recommended

1. Monkhouse, F. J. (1985): Maps and Diagrams. Methuen, London.
2. Raisz, E. (1962): Principles of Cartography, McGraw Hill, New York.
3. Robinson, A. H., Sale. R. D., Morrison, J. L. and Muehrcke, P. C. (1984): Elements of Cartography. 5th edition, John Wiley and Sons, Inc. New York.
4. Sarkar, A. K. (1997): Practical Geography: A Systematic Approach. Orient Longman, Kolkata.
5. Sharma, J. P. (2001): *Prayogik Bhugol*., Rastogi Publication, Meerut 3rd. edition.
6. Singh, R.L. and Singh Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions). Kalyani Publishers, New Delhi.

GBP 115. Practical, Paper 6

Geological Map and Map Projection

Geological Map: Conformable and folded geological structure and their description.

Map Projection: Conical: Polyconic, Sinusoidal, and Mollweide's; Cylindrical: Gall's and Mercator's; Zenithal: Gnomonic, Stereographic and Orthomorphic; International Map Projection

Books Recommended
1. Hinks, A. R. (1921): Map Projection, Cambridge University Press, London.
2. Mishra, R.P. and Ramesh A. (1989): Fundamentals of Cartography, Concept Publishing Company, New Delhi.
3. Raisz, E. (1962): Principles of Cartography, McGraw Hill, New York..
4. Robinson, A. H., Sale, R., Morrison, J. and Muehrcke, P. C (1984): Elements of Cartography. 5th edition, John Wiley and Sons, New York,
5. Singh, R.L. and Singh, Rana P.B. (1993): Elements of Practical Geography. (Hindi and English editions), Kalyani Publishers, New Delhi.
6. Steers, J. A. (1965): An Introduction to the Study of Map Projection. University of London Press, London.

GBC 116. Theory, Paper: 10

Climatology

Unit I

Meaning and scope of climatology; Atmospheric chemistry; Insolation: determinants and distribution, Temperature: factors, Distribution and processes of heating and cooling of the atmosphere.

Unit II

Heat budget of earth and atmosphere, Temperature change, Air stability and its importance, Laws of horizontal motion and general atmospheric circulation.

Unit III

Monsoon, Jet Stream and their significance with reference to India; Precipitation: forms and types; Air Masses: classification and modification; Fronts: source regions, types and associated weather.

Unit IV

Cyclones: tropical and temperate; Climatic classification: Koppen and Thornthwaite; Climatic change: evidences and theories; Global warming and micro-climate,

Books Recommended
1. Barry, R.G. and Carleton, M. (2001): Synoptic and Dynamic Climatology, Routledge, London.
2. Chorley, R.J. (2001): Atmosphere, Weather and Climate. Methuen, London.

3. Critchfield, H.J. (2002): General Climatology. Prentice-Hall of India, New Delhi..

4. Finch, J. C. and Trewartha, G. T.: Elements of Weather and Climate. Prentice-Hall, London.

5. Kendrew, W.C. (1998): Climatology. Edward Arnold, London. 5th edition.

6. Lal, D.S.(1986): Climatology. Chaitanya Publications, Allahabad.

7. Oliver, J.E. and Hidore, J.J. (2003): Climatology: An Atmospheric Science, Pearson Education Private Ltd, Patparganj, Delhi.

8. Robinson, P. J. and Henderson, S. (1999): Contemporary Climatology, 2nd edition, Pearson Education Ltd., Harlow, UK.

9. Singh, M.B. (1998): *Jalvayu Avam Samudra Vigyan*. Tara Book Agency, Varanasi.

10. Singh, M.B. (1999): *Jalvayu Avam Jal Vigyan*. Tara Book Agency, Varanasi,.

11. Singh, S. (2005): Climatology. Prayag Pustak Bhawan, Allahabad.

12. Singh, S. (2006): *Jalvayu Vigyan*. Prayag Pustak Bhawan, Allahabad.

GBC 117. Theory, Paper: 11

Evolution of Geographical Thought

Unit I

The field of geography; Geography as a discipline: natural science vs. social science; Relation with other branches of knowledge; Approaches to geography; Relevance of geography

Unit II

Classical contributions to geographical thought: Greek, Roman, Indian, Arab; Geography rethought: Varenius and Immanuel Kant.

Evolution of geography in India: formative periods and establishments.

Unit III

Foundations of geography: major contributions of Alexander von Humboldt, Carl Ritter, and Frederick Ratzel; Dualism and Unity in geography

Unit IV

Schools of geographical thought: French, British, Swedish and American; Evolution of modern geography in India; Recent trends in geography.

Books Recommended

1. Ali, S.M. (1960): Arab Geography, Institute of Islamic Studies, Aligarh Muslim University, Aligarh, First Edition.

2. Ali, S.M. (1983): The Geography of Puranas, People's Publishing House, New Delhi, Third Edition

3. Daniel, P., Bradshaw, M., Shaw, D. and Sidaway, J. (2000): Human Geography. Issues for the 21st Century. Prentice Hall, London.

4. Diddee, J. (ed.) (1990): Indian Geography, Institute of Indian Geographers, Pune, first edition.

5. Dikshit, R. D. (2003): Geographical Thought. A Critical History of Ideas. Prentice-Hall of

India, New Delhi. (in English and Hindi).

6. Dickinson, R.E. (1969): Makers of Modern Geography , XIV Frederick A. Praeger, New York

7. Dube, B.(1967): Geographical Concepts in Ancient India, National Geographical Society of India, Varanasi

8. Getice, A., Getis, J. and Fellman, J. D. (2007): Introduction to Geography. 10th edition. McGraw Hill, New York.

9. Hartshorne, R. (1939): Nature of Geography, Association of American Geographers, Indian Reprint- Rawat Publications, Jaipur.

10. Hartshorne, R. (1959): Perspective on the Nature of Geography, John Murray, London

11. Harvey, D. (1969): Explanations in Geography. Arnold, London.

12. Holt-Jensen, A. (1980): Geography: Its History and Concepts. Harper and Row Publishers, London.

13. Husain, M. (2002): Evolution of Geographical Thought, Rawat Publications, Jaipur.

14. Johnston, R., Gregory, D., Pratt, G., Watts, M. and Whatmore, S. (2003): The Dictionary of Human Geography. Blackwell Publishers, Oxford. 5th edition.

15. Johnston, R. and Sidaway, J.D. (2004): Geography and Geographers: Anglo-American Human Geography Since 1945, Arnold Publishers, London.

16. Kaushik, S.D. and Sharma, A.K. (1995): Geographic Thought and Methodology (in Hindi), Rastogi Publication, Meerut.

17. Rawling, E. and Daugherty, R. (eds.) (2005): Geography into the Twenty-first Century. 2nd edition. John Wiley and Sons, Chichester.

18. Singh, J. (2001): *Bhougolik Chintan Ke Moolaadhar*, Gyanodaya Prakashan, Gorakhpur.

19. Taylor, G. (ed.) (1953): Geography in the Twentieth Century. Methuen and Company, London.

20. Wooldridge, S.W. and East, W.G. (1966): Spirit and Purpose of Geography, Hutchinson University Library, London.

GBE 118. Theory: Elective, Paper: 12

Regional Development and Planning

Unit I.

Meaning, concepts and scope of regional planning; Approaches to regional planning; Theories of regional development (Myrdal and Perroux).

Unit II

Concepts and types of regions; Macro, meso and micro planning regions of India

Unit III

Regional patterns of development and imbalances in India; Planning for regional development; Role of agriculture, industry and infrastructure in regional development.

Unit IV

Area development and planning: National Capital Region, Micro-level planning and panchayati raj; Planning strategy for Eastern Uttar Pradesh and Chattisgarh.

Books Recommended

1. Bhat, L.S. (1972): Regional Planning in India, Indian Statistical Institute, Calcutta.
2. Bhat, L.S. (2003): Micro Planning: A Case Study of Karnal Area, KB Publications, New Delhi.
3. Chand, M. and Puri, V.K. (2004): Regional planning in India; Allied Publishers, New Delhi, reprint.
4. Chandana, R. C. (2005): Regional Development and Planning. Kalyani Publishers, New Delhi.
5. Dube, K.K. and Singh, M.B. (1986): *Pradeshik Niyojan*. Tara Book Agency, Varanasi.
6. Friedman, J. and Alonse, W. (eds.) (1968): Regional Development and Planning, M.I.T. Press, Cambridge-Massachusetts.
7. Kuklinski, A.R. (ed.) (1975): Regional Development and Planning: International Perspectives, Sijthoff-Leyder.
8. Kuklinski, A.R. (1972): Growth Centres in Regional Planning. Mounton and Company, Paris.
9. Mishra, R.P, Sundaram, K.V., and Prakasarao, V.L.S. (1976): Regional Development Planning in India, Vikas Publishers., New Delhi.
10. Mishra, R.P. (1969): Regional Planning. University of Mysore, Mysore.
11. Mishra, R.P. (2002): Regional Planning, Concepts, Techniques, Policies and Case Studies. Concept Publishing Company, New Delhi.
12. Sharma, P.R. (ed.) (1993): Regional Policies and Development in the Third World. Rishi Publication., Varanasi.
13. Sundaram, K.V. (1977): Urban and Regional Planning in India, Vikas Publishers. New Delhi.
14. Sundaram, K.V. (1997): Decentralized Multilevel Planning: Principles and Practice. Asian and African Experience. Concept Publishing Company, New Delhi

GBE 119. Theory: Elective, Paper: 13

Political Geography

Unit I

Nature, approach and significance of political geography; Historical development of political geography; Relations between geography and geopolitics.

Unit II

Nations, states and nation states; Frontiers and boundaries; Capital cities, core and periphery regions.

Unit III

Geographical basis of international relations; Strategic locations, routes and raw material, Geostrategic regions of the world; Theories of Heartland and Rimland

Unit IV

Geopolitical and geo-economic significance of Indian Ocean, West Asia and Central Asia; Problems of nation building in India; Geopolitical issues of West Asia.

Books Recommended
1. Cohen, Samuel (1964): Geography and Politics in Divided World. Random House, New York.
2. De Blijj, H. J. and Glassner, M. (1968): Systematic Political Geography. John Wiley and Sons, New York.
3. Dikshit, R.D. (1987): Political Geography and Geopolitics. Tata McGraw Hill, New Delhi.
4. Dikshit, R.D. (2000): Political Geography: A Contemporary Perspective. Prentice-Hall, New Delhi.
5. Siddiq, M. (1997): Indian in the Indian Ocean: A Geopolitical Study, Rawat Publications, Jaipur
6. Moddie, A.E. (1961): Geography Behind Politics. Hutchinson, London.
7. Pannikar, K.M. (1959): Geographical Factors in Indian History. 2 vols. Asia Publishing House, Bombay.
8. Pearcy, G. E. and Fifield, R. (1948): World Political Geography, Thomas Y Crowell, New York
9. Pounds, N.J.G. (1972): Political Geography. McGraw Hill Publication., New York.
10. Short, John R. (1982): An Introduction to Political Geography. Routledge, London
11. Singh, T. D. (1988): *Hind Mahasagar Avam Parimandaliya Rashtra: Ek Bhougolik Adhyayan*, Tara Book Agency, Varanasi.
12. Sukhwal. B.L. (1987): Modern Political Geography of India. Sterling Publication, New Delhi.

GBE 120. Theory: Elective, Paper: 14

Industrial Geography

Unit I

Meaning and scope of industrial geography; Processes of industrialization; Concept of industrial revolution with reference to Britain and India.

Unit II

Factors of industrial location; Theories of industrial location:Weber: Hoover, Losch and Smith.

Unit III

Distribution, growth, production trends and problems of iron and steel, cotton textile, sugar and cement industries; Industrial policies in India, Role of industries in regional development.

Unit IV

Concept and methods of industrial regionalization; Major industrial regions of the world; Structure of major industrial complexes: Mid -Atlantic coastal region of USA, Ruhr Industrial region, Mumbai - Ahmedabad industrial region.

Books Recommended

1. Alexanderson, C. (1967): Geography of Manufacturing. Prentice-Hall of India, New Delhi.
2. Hoover, E. M. (1948): Location and Space Economy. McGraw Hill, New York.
3. Lodha, R.M.(2005): *Audyogika Bhoogol*, Rajasthan Hindi Granth Academy, Jaipur
4. Miller, E. (1962): A Geography of Manufacturing. Prentice-Hall, Englewood Cliffs, New Jersey.
5. Riley, R. C. (1973): Industrial Geography, Chatto and Windus Ltd. London.
6. Singh, M. B. (1990): New Perspectives in Industrial Geography. Lotus Publication, Varanasi.
7. Singh, M. B. (1988): Industrial Geography. Lotus Publication, Varanasi.

GBP 121. Practical, Paper: 7
Field Study, Field Trip and Report Writing

Fieldwork: Meaning, types and objectives of fieldwork; Fieldwork methods and techniques; Importance of fieldwork in geography, Field work-based report writing.

Field Study in Local Environment: Preparation of field report through fieldwork on any **ONE** of the following areas:
A locality of Varanasi city, a village near BHU, a river course near Varanasi.

Field Trip: Garhwal Himalaya, Kumaon Himalaya, Vindhyan Plateau, Thar Desert.

Books Recommended
1. Archer, J.E. and Dalton, T.H. (1968): Field Work in Geography, William Clowes and Sons Ltd. London and Beccles
2. Bolton, T. and Newbury, P.A. (1968): Geography through Fieldwork, Blandford Press, London.
3. Jones, P. A. (1968): Field Work in Geography, Longmans, Green and Company Ltd., London and Harlow.
4. Lousenbury, J. F. and Aldrich, F.T. (1986): Introduction to Geographic Field Methods and Techniques, Charles E. Merrill Publishing. Company, Colombus.
5. Pugh, J.C. (1975): Surveying for Field Scientists, Methuen and Company Ltd. London.

GBP122. Practical, Paper: 8
Elementary Remote Sensing

Interpretation of vertical aerial photographs; Determination of scale and height of objects from single and stereopaired photographs; Basic principles of photogrammetry; Elements of photo/image interpretation; Identification of geomorphic features from stereogram atlas, Digital image

processing(DIM); Microwave and Lider system; Application of remote sensing in natural resource studies and monitoring environmental changes.

Books Recommended

1. Campell, J. B. (2003): Introduction to Remote Sensing. 4th edition. Taylor and Francis, London.
2. Chaunial, D. D. (2004): Remote Sensing and Geographical Information System(in Hindi), Sharda Pustak Bhawan, Allahabad
3. Cracknell, A. and Ladson, H. (1990): Remote Sensing Year Book. Taylor and Francis, London.
4. Curran, P.J. (1985): Principles of Remote Sensing. Longman, London.
5. Deekshatulu, B.L. and Rajan, Y.S. (ed.) (1984): Remote Sensing. Indian Academy of Science, Bangalore.
6. Floyd, F. and Sabins, Jr. (1986): Remote Sensing: Principles and Interpretation. W.H. Freeman, New York.
7. Gautam, N.C. and Raghavswamy, V. (2004). Land Use/ Land Cover and Management Practices in India. B.S. Publication., Hyderabad.
8. Jensen, J.R. (2004): Remote Sensing of the Environment: An Earth Resource Perspective. Prentice-Hall, Englewood Cliffs, New Jersey. Indian reprint available.
9. Lillesand, T.M. and Kiefer, R.W. (2000): Remote Sensing and Image Interpretation. John Wiley and Sons, New York.
10. Nag, P. (ed.) (1992): Thematic Cartography and Remote Sensing. Concept Publishing Company, New Delhi.
11. Rampal, K.K. (1999): Handbook of Aerial Photography and Interpretation. Concept Publishing. Company, New Delhi.

GBPr 123. Practical, Paper: 9
Project: Field Based

B. Sc. (HONS.) GEOLOGY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Geology

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

SEMESTER – I		
Course Code	**Title**	**Credits**
GLB101	Elementary Physical and Structural Geology	4
GLB102	Practicals connected with GLB101(inclusive of Geological Field Training)	2
	Total	**6**
SEMESTER - II		
GLB201	Elements of Mineralogy and Crystallography	4
GLB202	Practicals connected with GLB201 (inclusive of Geological Field Training)	2
	Total	**6**
SEMESTER - III		
GLB301	Petrology and Economic Geology	4
GLB302	Practicals connected with GLB301(inclusive of Geological Field Training)	2
	Total	**6**
SEMESTER - IV		
GLB401	Paleontology and Stratigraphy	4
GLB402	Practicals connected with GLB401(inclusive of Geological Field Training)	2
	Total	**6**
SEMESTER - V		
GLB501	Physical and Structural Geology	4
GLB502	Igneous Petrology, Mineralogy and Crystallography	4
GLB503	Sedimentary and Metamorphic Petrology	4
GLB504	Practicals connected with GLB501	2
GLB505	Practicals connected with GLB502	2
GLB506	Practicals connected with GLB503	2
	Total	**18**
SEMESTER – VI		
GLB601	Paleontology	3
GLB602	Stratigraphy	3
GLB603	Hydrogeology, Environmental Geology, Exploration Geology and Computer Application	3
GLB604	Economic Geology	3
GLB605	Practicals connected with GLB601	2
GLB606	Practicals connected with GLB602	2
GLB607	Practicals connected with GLB604	2
GLB608	Geological Field Study	4
	Total	**22**
	Grand Total	**64**

The B.Sc. (Hons.) Geology shall be imparted to students for three academic sessions consisting of six semesters as given below. Candidates will be examined and evaluated on grade basis at the end of each semester in the different courses of theory and practical as per credits given against each course. The B.Sc. (Hons.) Geology will consist of (a) Core Courses and (b) Geological Field Training.

a) The Core courses will be compulsory for all the admitted students. There will be eleven core courses, each of 6 credits (4 credits for theory and 2 credits for practical) covering major branches of Geology.

b) The compulsory geological field training includes a few days field work. The field training will be conducted by faculty members. Geological field training for semesters I to IV is included in the respective practicals. Geological field training course GLB608 may by undertaken any time during the combined duration of semester (V &VI) inclusive of semester break.

SEMESTER – I

Course No. GLB101: ELEMENTARY PHYSICAL AND STRUCTURAL GEOLOGY
Credit: 4

Section – A: Physical Geology

Unit-1
Introduction to geology, scope, subdisciplines and relationship with other branches of science; Earth in the solar system, origin, size, shape, mass, density, rotational and evolutional parameters.

Internal constitution of the earth, core, mantle and crust; Convections in the earth's core and production of magnetic field; Composition of earth in comparison to other bodies in the solar system; Origin of hydrosphere and atmosphere, biosphere; Origin of oceans, continents and mountains; Age of the earth; Radioactivity and its application in determining the age of the earth; Rocks, minerals and fossils.

Unit-2
Earthquakes - causes, geological effects and their measurement, distribution of earthquake belts;Volcanoes - types, causes and geological effects, distribution of volcanic belts; Relationship of earthquakes with volcanic belts; Weathering and erosion; Soil, soil formation, soil profile and soil type; Geological time scale; Major events in the earth's history.

Section – B: Structural Geology

Unit-3

Topography and its representation; Dip and strike; Outcrop, effects of topography on outcrop; Forms of igneous rocks; Clinometer compass and its use; Folds, parts of fold, nomenclature and description of folds and causes of folding.

Unit-4

Faults - parts of faults, types of faults and causes of faulting; Joints- their geometric classification; Unconformity, its kinds and significance; Overlap; Outlier and inlier.

Books Recommended:

Physical Geology and Structural Geology

Billings, M.P. (1972): Structural Geology, Prentice Hall.

Dennis, J.G. (1972): Structural Geology, Ronald Press Company, NewYork.

Hills, E.S. (1963): Elements of Structural Geology, Farrold and Sons, London.

Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.

Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.

Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.

Ruhe, R.V. (1975): Geomorphology, Houghton Miffin Co., Boston.

Singh, R. P. (1995): Structural Geology, A Practical Approach, Ganga Kaveri Publ., Varanasi.

Sparks (1960): Geomorphology, Longmans, London.

Course No.GLB102: Practicals (connected with GLB101) (inclusive of Geological Field Training)
Credit: 2

Physical Geology:

Study of important geomorphological models; Reading topographical maps of the Survey of India; Elementary study of aerial photographs.

Structural Geology:

Study of clinometer compass; Exercises on structural problems; Completion of outcrops; Drawing and interpretation of sections across elementary representative geological structures.

<center>**SEMESTER – II**</center>

Course No. GLB201: ELEMENTS OF MINERALOGY AND CRYSTALLOGRAPHY
Credit: 4

Section – A: Introductory Mineralogy

Unit-1

Minerals, definition and classification; Processes of mineral formation (magmatic, post-magmatic, pegmatitic, weathering, sedimentary and metamorphic); Common physical properties of minerals (form and shape, colour, streak, luster, cleavage, fracture, hardness, tenacity, transparency, specific gravity, magnetic nature).

Unit-2

Chemical composition and diagnostic physical properties of rock forming minerals mentioned below:

quartz, orthoclase, microcline, albite, labradorite, nepheline, muscovite, biotite, augite, hypersthene, tremolite, hornblende, olivine, serpentine, talc, chlorite, apatite, calcite, dolomite, garnet, kyanite, sillimanite, andalusite, staurolite, topaz, tourmaline, corundum, gypsum, graphite and kaolinite.

Section – B: Optical Mineralogy

Unit-3

Polarizing microscope, its parts and functioning; Prism and its construction; Optically isotropic and anisotropic substances; Ordinary and polarized lights; Common optical properties observed under ordinary and polarized lights and crossed nicols; Optical properties of some common rock forming minerals (quartz, orthoclase, microcline, plagioclase, garnet, biotite, muscovite, augite, hypersthene, hornblende, olivine and calcite).

Section – C: Introductory Crystallography

Unit-4

Crystal, elementary idea of crystal structure; Parts of crystal - face, edge, apex, solid angle and interfacial angle; Crystallographic axes and angles; Parameters and indices; Common crystal forms - dome, prism, pyramid and pinacoid; Elements of crystal symmetry; Introduction to different crystals systems.

Books Recommended:

Elements of Mineralogy and Crystallography

Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.

Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).

Nesse, D.W. (1986): Optical Mineralogy, McGraw Hill.

Phillips, F.C (1971): Introduction to Crystallography,Longman Group Publ.

Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.

Course No.GLB202: Practicals (connected with GLB201) (inclusive of Geological Field Training)

Credit: 2

Mineralogy and Crystallography

Study of physical properties of minerals mentioned in theory course; Study of elements of symmetry of representative crystals from each system; Use of polarizing microscope; Study of optical properties of important rock forming minerals.

SEMESTER – III

Course No.GLB301: PETROLOGY AND ECONOMIC GEOLOGY
Credit:4

Section – A: Petrology

Unit-1: Igneous Petrology

Magma and its composition; Phase rule application to H_2O system; Common textures; Magmatic differentiation and assimilation; Introduction to mineralogical classification; Brief petrographic description of common igneous rocks (granite, diorite, syenite, gabbro, dolerite, basalt, rhyolite, trachyte, pyroxenite and peridotite)

Unit-2: Sedimentary Petrology

Weathering and denudation of supra-crustal rocks; Origin of clastic and nonclastic sediments and genesis of sedimentary rocks; Primary sedimentary structures; Elementary idea about texture and mineral composition of clastic and nonclastic sedimentary rocks; General classification of sedimentary rocks; Descriptive petrography of fundamental rock types such as - conglomerate, breccia, sandstone, limestone and shale.

Unit-3: Metamorphic Petrology

Definition, types and agents of metamorphism; Classification of metamorphic rocks; Metamorphic textures and structures; Metamorphic zones and isogrades; Progressive, regional and thermal metamorphism of pelitic, calcareous and basic igneous rocks; Common metamorphic rocks and their protoliths as given below:
slate, phyllite, schist, gneiss, hornfels, marble, quartzite.

Section – B: Economic Geology

Unit-4

Definition of ore, ore mineral and gangue; Classification of ore deposits; Chemical composition, diagnostic characters, uses and distribution in India of the following minerals:

magnetite, hematite, chromite, psilomalane, pyrolusite, chalcopyrite, galena, sphalerite, native gold, magnesite, bauxite, pyrite, diamond, muscovite, beryl, fluorite, gypsum, barite, halite, phosphorite, talc, kyanite, graphite, asbestos, monazite and corundum; Elementary idea regarding origin, uses and distribution of coal and petroleum in India.

Books Recommended:

Petrology and Economic Geology

Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.

Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.

Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.

Ehlers, E.G. & Blatt, H (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.

Huang: (1962): Petrology, McGraw Hill Book Co.

Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.

Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.

Nockold, Knox and Chinner (1978): Petrology for students, Cambridge Univ. Press.

Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ.

Winkler, H. G.F. (1967): Petrogenesis of Metamorphic Rocks, Springer–Verlag.

Course No.GLB302: Practicals connected with GLB301 (inclusive of Geological Field Training) Credit: 2

Petrology

Megascopic and microscopic study of the following rock types:

granite, syenite, nepheline syenite, diorite, gabbro, peridotite, rhyolite, trachyte, dolerite, basalt, sandstone, limestone, conglomerate, breccia, gneiss, schist, quartzite, marble.

Economic Geology

Study of ore and economic minerals in hand specimens as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

<center>**SEMESTER – IV**</center>

Course No. GLB401: PALEONTOLOGY AND STRATIGRAPHY
Credit:4
Section – A: Paleontology
Unit-1

Paleontology, definition, subdivisions and scope, its relationship with other sub-disciplines of geology; History of development in paleontology; Fossils, definition, characters, kinds (body and trace fossils); Conditions of fossilization; Incompleteness of fossils record; Elementary ideas about origin of life; their adaptation to various kinds of environments; Bathymetric distribution of organisms.

Unit-2

Systematic classification of organisms; Elementary knowledge about the chief characteristics of the following phyla - Arthropoda, Hemichordata, Brachiopoda, Mollusca, Echinodermata, Cnidaria and

Bryozoa; A detailed study of the morphology and geological distribution of the following classes/orders - Trilobita, Graptoloidea, Anthozoa and Echinoidea.

Section – B: Stratigraphy

Unit-3
Stratigraphy: Definition, its scope and relationships with other subdisciplines of geology; History of advancement in stratigraphy; Principles of stratigraphy; Geological time scale; Elements of stratigraphic classificaton; Rock units, time units and time rock units; Physical and structural subdivisions of India and their characteristics; Brief elementary account of important Indian Paleozoic, Mesozoic and Tertiary stratigraphic horizons.

Unit-4
Study of the following supergroups of Indian Precambrian rocks with special reference to classification, lithology and economic significance - Dharwar of Karnataka, Mahakoshal (Bijawars) of Central India, Cuddapah of Andhra Pradesh and Vindhyan of Son valley.

Books Recommended:

Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ.

Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.

Jain, P.C. and Anantharaman, M.S. (1983): Palaeontology: Evolution and Animal Distribution, Vishal Publ.

Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.

Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.

Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.

Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.

Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.

Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.

Wadia, D.N. (1966): Geology of India, English language Publ.

Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.

Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.

Course No.GLB402: Practicals connected with GLB401 (inclusive of Geological Field Training) Credit: 2

Paleontology
Study of modes of preservation of fossils; Study of morphological characters of about 30 genera pertaining to Trilobita, Graptoloidea, Echinoidea and Anthozoa.

Stratigraphy
Preparation of lithostratigraphic maps of India showing distribution of the following -
Dharwar Supergroup, Mahakoshal (Bijawars) Supergroup, Cuddapah Supergroup and Vindhyan Supergroup.

Study of important rock types of the above mentioned stratigraphic units; Preparation of physiographic map of India showing important features.

SEMESTER – V

Course No.501: PHYSICAL AND STRUCTURAL GEOLOGY
Credit:4

Section –A: Physical Geology

Unit-1

Exogenic and endogenic geomorphic processes; Evolution of landscape; A detailed account of the geological work of natural agencies - groundwater and springs, rivers, glaciers, lakes, ocean and wind.

Unit-2

Origin and classification of mountains; Concept and theories of isostasy; Origin and significance of mid oceanic ridges and trenches; Sea floor spreading & continental drift; Brief idea about plate tectonics and distribution of plates; Mitigation of environmental hazards - earthquakes, landslides, floods, basic concepts of remote sensing; Indian space mission; elements of photogeology.

Section –B: Structural Geology

Unit-3

Geological significance and recognition of unconformities; Fold morphology, geometric and genetic classifications, mechanics and causes of folding; Geometric and genetic classification of faults.

Unit-4

Effects of faulting on the outcrops; Geometric and genetic classification of joints; Foliation, descriptive terminology, origin and relation to major structures; Stereographic projection and its use in structural analysis.

Books Recommended:

Billings, M.P. (1972): Structural Geology, Prentice Hall.

Ghosh, S.K. (1993): Structural Geology, Pergamon Press, New York.

Holmes, Arthur (1992): Principles of Physical Geology, Vol. 1, Chapman and Hall, London.

Leet, L.D. and Judson, S. (1969): Physical Geology, Prentice Hall.

Mallory, B.F and Cargo, D.N. (1979): Physical Geology, McGraw Hill.

Monrow, James S. (1986): Physical Geology: Exploring the Earth, Booke Cole, Australia.

Ramsay, J.G. and Huber, M.I. (2000): Techniques of Modern Structural Geology, Vol. III, Academic Press.

Ritter, Dale F. (1986): Processes of Geomorphology. Wm C. Brown Publ.

Singh, S (2001): Geomorphology, Prayag Pustak Bhandar, Allahabad

Sitter, L.U. De (1959): Structural Geology, Mc Graw Hill Publ.

Strahler, A. N. and Strahler, A.H. (1973): Environmental Geoscience, Hamilton Publ. Co.

Turner, F.J. and Weiss, L.E. (1963): Structural Analysis of Metamorphic Tectonites McGraw Hill Book Co.

Course No. GLB502: IGNEOUS PETROLOGY, MINERALOGY AND CRYSTALLOGRAPHY
Credit: 4

Section - A: Igneous Petrology

Unit-1
Physical properties, genesis, evolution and types of magma; Concepts of rock series and rock association; Phase equilibrium in one (SiO_2), two (Di-An, Fo-Silica, Ab-An) and three (Di-Ab-An and Di-Fo-An) component silicate systems.

Unit-2
IUGS mineralogical (QAPF) and chemical (total alkali-silica diagram) classification schemes; Common igneous textures; Detailed petrographic description of granite, granodiorite, diorite, syenite, phonolilte, gabbro, norite, dolerite, basalt, andesiste, dunite, pyroxenite, peridotite, komatite, trachyte, rhyolite and dacite.

Section – B: Mineralogy and Crystallography

Unit-3
Classification of minerals; Introduction to crystal chemistry - Ionic size, packing, radius ratio and coordination number, solid solution; Isomorphism, polymorphism, diadochy, pseudomorphism, chemical bonds, Pauling's rules; Structural classification of silicates; Study of the following group of minerals with reference to chemical and structural formulae; Classification and occurrences - olivine, garnet, alumino-silciates, pyroxene, amphibole, mica, silica and feldspar.

Unit- 4
Introduction to 32 crystals classes of crystallography and description of the holosymmetric class; Contact goniometer; Angular measurement of crystal faces; Different types of crystal projections – spherical and stereographic and their uses; Electromagnetic spectrum, light, optics of light (reflection, refraction, Snell's law), dispersion, double refraction, sample preparation techniques for optical microscopy, refractive index liquids, Becke effect, relief, birefringence, retardation, pleochroism, extinction and interference colours; Classification of minerals into uniaxial and biaxial minerals.

Books Recommended:

Berry, L.G., Mason, B. and Dietrich, R.V. (1982): Mineralogy, CBS Publ.

Best, Myron G.(2002): Igneous and Metamorphic Petrology, Blackwell Science.

Blatt, H. and Tracy, R.J. (1996): Petrology (Igneous, Sedimentary, Metamorphic), W.H. Freeman and Co., NewYork.

Dana, E.S. and Ford, W.E.(2002): A textbook of Mineralogy (Reprints).

Kerr, P. F. (1977): Optical Mineralogy, McGraw Hill.

Moorhouse, W.W. (9151): Optical Mineralogy, Harper and Row Publ.

Ness, D.W. (1986): Optical Mineralogy, McGraw Hill.

Phillips, F.C. (1971): Introduction to Crystallography.

Read, H.H. (1968): Rutley's Element of Mineralogy (Rev. Ed.), Thomas Murby and Co.

Verma, A.R. and Srivastava, O.N. (1991): Crystallography of solid state Physics, New Age Int. Publ.

Course No.GLB503: SEDIMENTARY AND METAMORPHIC PETROLOGY
Credit:4
Section – A: Sedimentary Petrology

Unit-1

Processes of formation of sedimentary rocks; Classification of rudaceous, arenaceous, argillaceous and calcareous rocks; Structures of sedimentary rocks; Mineralogical characteristics, textures, and diagenesis of sedimentary rocks; Heavy minerals and provenance interpretations.

Unit-2

Petrographic details of important siliciclastic and carbonate rocks such as - conglomerate, breccia, quartz-arenite, arkose, lithic arenite, quartzwake, felspathicwacke, lithicwacke, mudrocks / shale, limestones: crystalline, micritic and sparitic.

Section – B: Metamorphic Petrology

Unit-3

Phase rule and Goldschmidt's mineralogical phase rule; Principles of metamorphic reactions, metamorphic facies and metamorphic facies series; Graphical representation of mineral assemblages in ACF, AKF, AFM diagrams; Prograde, retrograde and polymetamorphism.

Unit-4

Progressisve metamorphism of (a) Pelitic rocks in $K_2O – FeO-MgO-Al_2O_3-SiO_2$ system, (b) Basic rocks in $CaO – FeO – MgO – Al_2O_3 – SiO_2$ system, (c) Calcareous rocks in $CaO – MgO –SiO_2 – CO_2 – H_2O$ system; (d) Ultramafic rocks in $MgO – Al_2O_3 – SiO_2 – H_2O$ system.

Books Recommended:
Bucher, K. and Martin, F. (2002): Petrogenesis of Metamorphic Rocks (7th Rev. Ed.), Springer–Verlag.

Ehler, E.G. and Blatt, H. (1982): Igneous, Sedimentary and Metamorphic Petrology, CBS Publ.

Greensmith, J. T. (1984): Petrology of Sedimentary rocks, Thomas Murby Publ.

Hatch, F.H., Rastall, R.H. and Black, M. : Petrology of Sedimentary Rocks, Thomas Murby Publ.

Mason, R. (1978): Petrology of Metamorphic Rocks, CBS Publ.

Pettijohn, F.J. (1957): Sedimentary rocks (3rd Ed.), Oxford Book Co.

Winkler, H.G.C. (1967): Petrogenesis of Metamorphic Rocks, Narosa Publ.

Yardlley, B.W.D. (1989): An introduction to Metamorphic Petrology, Longman Scientific and Technical, New York.

Course No.GLB504: Practicals (connected with GLB501)
Credit: 2

Physical Geology
Slope analysis from Topographical Maps. Interpretation of aerial photographs.

Structural Geology
Exercises on structural geology problems; Stereographic projection of structural data; Geometrical problems on folds and faults; Drawing and interpretation of profile sections across the geological maps.

Course No.GLB505: Practicals (connected with GLB502)
Credit: 2

Igneous Petrology
Megascopic and microscopic study of the igneous rocks as per list given in the theory paper.

Mineralogy
Study of the following silicate minerals with regards to their diagnostic physical properties -
Olivine Group, Garnet Group, Aluminosilicate Group, Staurolite, Topaz, Zircon, Epidote Group, Tourmaline, Beryl, Pyroxene Group, Amphibole Group, Mica Group, Talc, Serpentine, Chlorite, Kaolinite, Silica Group, Feldspar Group, Feldspathoid Group, Zeolite Group; A study of few models of silicate and non-silicate structures.

Optical Mineralogy
Optical study of few rock-forming minerals; Determination of length fast and length slow characters of minerals; Scheme of pleochroism, extinction.

Crystallography
A study of about 12 crystal models belonging to the seven crystal systems; Determination of axial ratio and face symbols of orthorhombic and monoclinic crystals, Stereographic projection of olivine and hornblende.

Course No.GLB506: Practicals (connected with GLB503)
Credit: 2

Megascopic and microscopic examination of conglomerate, breccia, quartz arenite, arkose, lithic arenite, quartzwacke, feldspathicwacke, lithicwacke (grewacke), mudrocks/shale and carbonates (micrite, sparite and accretionary limestones).Examination of some common heavy minerals in grain mounts; Megascopic and microscopic study of metamorphic rocks - slate, phyllite, schist, gneiss, marble, quartzite, charnockite, hornfels, khondalite

Course No.GLB601: PALEONTOLOGY
Credit:3

Unit-1

Application of paleontology with special reference to problems of geological refinement, sequence stratigraphy, correlation, paleoecology and paleobiogeographic reconstructions; Organic evolution - ancient and modern concepts, evidences, theories of organic evolution: Lamarckism, Darwinism, Synthetic theory.

Unit-2

Binomial nomenclature and procedures in taxonomy; Species concept; Skeletons and their compositions; Types of fossils; Collection and preparation of macro- and micro– fossils; Identification of fossils; Describing a fossil specimen.

Unit-3

Detailed study of morphological characters and geological distribution of the following invertebrate fossil groups -

Brachiopoda, Bivalvia, Gastropoda, Cephalopoda, Crinoidia and Bryozoa.

Stratigraphic significance of Trilobites, Graptolites, Ammonites and Conodonts; Elementary ideas about different types of microfossils (calcareous, siliceous, phosphatic, chitinous, organic walled and agglutinated).

Unit-4

Modes of preservation of plant fossils; Classification and broad characteristics of major plant groups; elementary knowledge of Gondwana flora.

Origin and general characteristic of vertebrates; Elementary ideas about vertebrate classes; Elementary knowledge of Siwalik vertebrate fauna.

Books Recommended:

Black, R.M. (1988): The Elements of Palaeontology, Cambridge Univ..

Clarkson, E.N.K. (1986): Invertebrate Palaeontology and Evolution, Allen and Unwin Publ.

Jain, P.C. and Anantharaman, M.S. (1983): Palaeontology: Evolution and Animal Distribution, Vishal Publ.

Lehmann, U. (1983): Fossils Invertebrate, Cambridge Univ. Press.

Moore, R.C., Lalicker, C.G. and Fischer, A.G.(1997): Invertebrate Fossils, CBS Publ.

Nield, E.W. and Tucker, V.C.T. (1985): Palaeontology: An Introduction, Pergmon Press.

Prothero, D.R. (2004): Bringing Fossil to Life – An Introduction to Paleontology (2nd Ed.), McGraw Hill.

Rastogi (1988): Organic Evolution, Kedarnath and Ramnath Publ.

Raup, D.M. and Stanley, S.M. (1985): Principles of Palaeontology, CBS Publ..

Shrock, R.R. and Twenhoffel,W.H. (1952): Principles of Invertebrate Paleontology, CBS Publ.

Stebbins (1979): Process of Organic Evolution (3rd Ed.) Prentice Hall.

Woods, H. (1985): Palaeontology Invertebrate, CBS Publ.

Course No.GLB602: STRATIGRAPHY

Credit: 3

Unit-1

Historical advancement in stratigraphy; Stratigraphic classification and terminology; Methods of collecting stratigraphic data; Identification of stratigraphic contact.

Unit-2

Criteria for stratigraphic refinement and correlation; Outline of sequence stratigraphy; Elements of facies concept in stratigraphy.

Unit-3

A detailed study of succession, lithology, age, economic importance and fossil content of the following –

Archaean of Southrn Indian Shield, Proterozoic of Son Valley, Palaeozoic of Kashmir, Gondwana Supergroup, Triassic of Spiti, Jurassic of Kachchh, Cretaceous of Tiruchirapalli.

Unit-4

A detailed study of succession, lithology, age, economic importance and fossil content of the following:

Deccan Trap and equivalents, Paleogene of Assam, Kachchh and Andaman, Siwaliks of Jammu and Himachal Pradesh and Karewas of Kashmir.

Books Recommended:

Boggs, S. (2001): Principles of Sedimentology and Stratigraphy, Prentice Hall.

Dunbar, C.O. and Rodgers, J. (1957): Principles of Stratigraphy, John Wiley and Sons.

Krishnan, M.S. (1968): Geology of India and Burma, Higgibothon, Madras.

Kumar, R. (1985): Historical Geology and Stratigraphy of India, Wiley Eastern Ltd.

Wadia, D.N. (1966): Geology of India, English language Publ.

Weller, J.M. (1960): Stratigraphic Principles and Practices, Universal Book.

Course No. GLB603: HYDROGEOLOGY, ENVIRONMENTAL GEOLOGY, EXPLORATION GEOLOGY AND COMPUTER APPLICATIONS

Credit:3

Unit-1

Definition of hydrogeology, geohydrology and hydrology; Hydrological cycle and groundwater in the hydrological cycle; Hydrological parameters - Precipitation, evaporation, transpiration and infiltration; Origin and age of groundwater; Vertical distribution of groundwater; Types of aquifers; Water bearing properties of rocks - Porosity and Permeability; Retention of water in rocks and yield of water from rocks; Different types of springs and their formations; Darcy's law and its validity; Dissolved constituent of groundwater; Salinization of groundwater; Groundwater provinces of India.

Unit-2

Definition and dimensions of environment; General idea about components and composition of different environmental domains such as atmosphere, hydrosphere and biosphere; Types of environmental pollution; Introduction to weather and climate; Past-climates in the earth history; Concept and origin of monsoon; Elements of natural hazards.

Unit -3

Fundamentals of geological, geochemical and geophysical techniques employed in exploration of mineral deposits.

Unit-4

Elementary idea of computer knowledge in geological sciences; Use of MS-Excel and Power Point; Basic knowledge to graphics and drawing softwares (Adobe Illustrator, CorelDraw, Photoshop).

Books Recommended:

Arogyaswamy, R.N.P. (1973): Courses in Mining Geology, Oxford and IBH Publ.

Bryant, E. (1985): Natural Hazards, Cambridge Univ. Press.

Chaussier, Jean – Bernard and Morer, J. (1987): Mineral Prospecting Manual., North Oxford Academic.

Davies, S. N. and De Wiest, R. J. N. (1966): Hydrogeology, John Wiley and Sons.

Dobrin, M. B., and Savit, C. H., (1988): Introduction to Geophysical Prospecting, McGraw-Hill Book Co.

Karanth, K. R. (1989): Hydrogeology, Tata McGraw Hill Publ.

Keller, E.A. (1978): Environmental Geology, Bell and Howell, USA.

Lal, D. S. (2007): Climatology, Sharda Pustak Bhawan, Allahabad.

Nagabhushaniah, H. S. (2001): Groundwater in Hydrosphere, CBS Publ.

Raghunath, H. M. (1990): Groundwater, Wiley Eastern Ltd.

Rajendran S. et al (2007) : Mineral Exploration : Recent Strategies.

Telford, W.M., Geldart, L.P, Sheriff, R.E. and Keys, D.A. (1990): Applied Geophysics, Cambridge Univ. Press.

Todd, D. K. (1995): Groundwater hydrology, John Wiley and Sons.

Tolman, C. F. (1937): Groundwater, McGraw Hill Book Co.

Valdiya, K.S. (1987): Environmental Geology – Indian Context, Tata McGraw Hill.

Course No.GLB604: ECONOMIC GEOLOGY
          Credit: 3

Unit-1

Concept of ore, ore minerals and gangue in economic geology; Tenor of ores; Ore forming minerals – metallic and non-metallic; Common forms and structures of ore deposits; Paragenesis, paragenetic sequence and zoning in metallic ore deposits.

Unit-2

Processes of formation of ore deposits; Magmatic, contact metasomatic, pegmatitic, hydrothermal, sedimentation, residual concentration, mechanical concentration, oxidation and supergene suphide enrichment and metamorphism.

Unit-3
Study of important industrial minerals of India with particular reference to the industries - cement, glass and ceramics, refractory, fertilizer and building stones, chemicals and gemstones.

Unit-4
Processes of formation, geological occurrence, uses and distribution of coal and petroleum in India; A brief study of atomic fuels.

Books Recommended:

Brown, C. and Dey, A.K. (1955): Indian Mineral Wealth, Oxford Univ.

Gokhale, K.V.G.K. and Rao, T.C. (1983): Ore Deposits of India, East West Press Pvt. Ltd.

Jense, M.L., Bateman, and A.M. (1981): Economic Mineral Deposits, John Wiley and Sons.

Krishnaswamy, S. (1979): India's Minerals Resources, Oxford and IBH Publ.

Mookherjee, A. (2000): Ore Genesis-A Holistic Approach, Allied Publisher.

Sharma, N.L. and Ram, K.V.S. (1972): Introduction to India's Economic Minerals, Dhanbad Publ..

Course No.GLB605: Practicals (connected with GLB601)
Credit: 2

Study of morphological characters, systematic positions and age of about 30 representative genera belonging to the following groups -
Brachiopoda, Bivalvia, Cephalopoda, and Gastropoda.
A detailed systematic description of the following genera -
Rhynchonella, Terebratula, Arca, Modiolus, Perisphinctes, Nautilus, Natica and Conus.

Course No.GLB606: Practicals (connected with GLB602)
Credit: 2

Distribution of following geological formations on sedimentary basin map of India -
Marine Lower Permian, Gondwana Supergroup, Marine Mesozoics, Deccan Traps and equivalents, Marine Cenozoic and Siwalik Group.
Preparation of land/sea distribution on sedimentary basin map of India during Late Precambrian/Early Cambrian, Early Permian, Jurassic, Cretaceous and Eocene; Study of rocks from important Indian stratigraphic horizons.

Course No.GLB607: Practicals (connected with GLB604)
Credit: 2

Study of ore and economic minerals in hand specimen as detailed in the theory syllabus; Preparation of maps showing distribution of important metallic and non-metallic deposits and important coal and oil fields of India.

Course No.GLB608: GEOLOGICAL FIELD TRAINING
                    Credit:4

B.A./B. Sc. (HONS.) HOME SCIENCE

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Hpme Science

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Semester - I		
Course Code	**Title**	**Credits**
HSB101	**(A)** Introduction to Foods *(Credit – 2)*, and **(B)** Human Development *(Credit – 2)*	4
HSB102	*Practicals based on course* HSB101	2
	Total	**6**
Semester – II		
HSB201	**(A)** Introduction to Clothing Textiles, *(Credit – 2)* and **(B)** Family Resource Management *(Credit – 2)*	4
HSB202	*Practicals based on course* HSB201	2
	Total	**6**
Semester – III		
HSB301	**(A)** Home Science Extension Education, *(Credit – 2)* and **(B)** Human Nutrition *(Credit – 2)*	4
HSB302	*Practicals based on course* HSB301	2
	Total	**6**
Semester – IV		
HSB401	**(A)** Interior Design, *(Credit – 2)* and **(B)** Clothing Construction *(Credit – 2)*	4
HSB402	*Practicals based on course* HSB401	2
	Total	**6**
Semester – V		
HSB501	Home Science Extension Education and Rural Development	3
HSB502	Consumer Economics	3
HSB503	Fundamental of Human Development	3
HSB504	Diet Therapy I	3
HSB505	Fashion Designing	3
HSB506	*Practicals based on course* HSB501 & HSB502	3
	Total	**18**
Semester – VI		
HSB601	Advanced Home Science Extension and Communication	3
HSB602	Diet Therapy II	3
HSB603	Advanced Human Development	3
HSB604	Consumer Products Safety and Legislation	3

HSB605	Statistics and Research Methods (Elective)	4
HSB606	*Practicals based on course* HSB601	2
HSB607	*Practicals based on course* HSB602	2
HSB608	*Practicals based on course* HSB603	2
	Total	**22**
	Grand Total	**64**

SEMESTER – I
Paper – I
HSB101: INTRODUCTION TO FOODS AND HUMAN DEVELOPMENT
(Credit 4)
Section A: INTRODUCTION TO FOODS
(Credit 2)

Foods History: Composition and function of food, classification, Food hygiene, cost availability; quality, and quantity of foods, food tables, food groups. Energy foods, body building foods, protective food. Cookery Kitchen; Layout, arrangements, fuel, sanitation & cleanliness. Kitchen and dining equipments. Principles and objects of cooking. Methods of preparation prior to cooking. Comparative study of cooking. Comparative study of various methods of cooking. Effect of cooking on nutritive value, colour, appearance and palatability, serving of food.

Cereals & Cereal Products: Importance, composition and structure of cereal grains, Processing of cereals & storage; methods & their limitations, Germination. Enrichment and fortification of cereals. **Pulses and legumes:** Importance, composition, processing of pulses **Vegetables & Fruits:** Classification, composition, pigments, flavour compounds, selection, purchase, storage and Home Care. **Milk & Milk Products :** Composition, processing, uses in cookery, effect of heat, enzymes, acids and salts on milk & milk products

Flash Foods: Egg; Structure, composition, quality of eggs, uses in cooking. Meat, Fish, Poultry; Classification, structure, composition, ripening, ageing, factors affecting tenderness of meat, buying and care in Home. Gelatin; composition, properties & uses. Beverages; Tea, coffee, chocolate & cocoa powder. Other Beverages; aerated beverages, juices. Nuts & Oilseeds; Composition, role in the diet. Spices & Condiments; Properties, uses & abuses in diet. Adulteration, Food Standards; ISI, Agmark, FPO, MPO, PFA, Additives, food lows.

Food Microbiology: Brief history of food microbiology and introduction to important micro-organisms in foods. Food Spoilage; Contamination and micro-organisms in the spoilage of different kinds of foods & their prevention, Cereal & cereal products, vegetable & fruits, fish and other sea foods, meat & meat products, Egg & poultry, milk & milk products, canned foods. Public Health hazard due to contaminated foods; Food borne infections and intoxications; symptoms, mode and source of transmission and methods of prevention. Fundamentals of control of micro-organism in foods; extrinsic and intrinsic parameters affecting growth and survival of microbes, use of high & low temperature, dehydration, freezing, freeze drying, irradiation and preservatives in food preservation. Industrial & pharmaceutical microbiology.

Indices of food, milk & water sanitary quality; Microbiological criteria of foods, water and milk testing (Bacteriological analysis).

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Section B: HUMAN DEVELOPMENT

(Credit 2)

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Concept of Human Development: Meaning and importance of Human Development, Principles of Development, meaning of terms "Growth" and "Development", Stages of Human Development, Biological and Environmental and other influences on Development and related issues.

Prenatal Period: Reproductive System (Male and Female)conception, Stages of Prenatal Development, Genetic and Environmental factors, Birth process and complications, Maternal Health and Care during pregnancy vaccination schedule

Hazards during prenatal development, Immediate care of new born, Types of feeding Natural and Artificial, Weaning, Infant and mother mortality and morbidity, Child rearing Practices.

Infancy and Babyhood: The neonate upto 4 weeks; Physical, Physiological, Cognitive and Social Capabilities, 4 weeks to 2 years; Physical and motor Social and emotional, cognitive and language development, sensory and perceptual development, Developmental tasks of infancy, milestones, factors influencing development, Early Environment and its importance, effect of environmental derivation

Childhood (2 – 12 years): Physical, motor, social, emotional, cognitive and language development, Development tasks and Milestones, Preschool Education: Concept and Significance, Problems of preschool period; obstinacy, negativism, aggression, shyness, thumb sucking, nail biting, enuresis, temper tantrums, sibling rivalry, eating disorders. Emotional Development; development of positive and negative emotions, factors influencing emotions, Peer Group; Importance, types and functions, function of school, family and community in growth of children,

Adolescence (13 – 18 years): Physical Development; Puberty, Growth spurt primary and secondary sex characteristics early and late maturing adolescents, Development of Identity; Definition, body image, role confusion and ego identify, Social development; Peer and heterosexual relationship, Relationship of adolescent with family and teachers, social interests, Vocational interests; Choosing a career, factors affecting career choice, Vocational guidance and counseling. Problems; Heightened emotionality, drug and alcohol abuse, psychological problems, teenage pregnancy, sexually transmitted disease (AIDS, delinquency) **Young Adult hood and middle Adult hood (20 years – 60 years):** Development task, milestones, Development of Self, physical and Psychological changes, sex role issues and implications for adult hood. Responsibilities and adjustment (New family work place, parent hood, financial security stresses (at family & work place) pre-retirement and leisure.

Old age and ageing: Physical, Physiological, Cognitive and memory Changes Status and statistics of aged in India, Governmental and non-governmental efforts towards issues related to aged, Special needs of elderly persons, Retirement – Effect of retirement on self, family, society, financial problems faced, leisure time activities for aged, Psychological changes before death, The life review, preparation and coping strategies

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PRACTICAL

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HSB102: INTRODUCTION TO FOODS AND HUMAN DEVELOPMENT

(Credit 2)

Part A: Introduction to Food

   1   Preparing different food items by using different cooking methods and calculation of nutrients based on food composition table.

   2   Study of the effect of cooking on carbohydrates, fats, protein, texture and colour.

   3   Preparing & Serving food items

           pulses – vegetable, milk, paneer, khoa, desserts, cakes, biscuits/cookies and snacks.

   4   Study of Microorganism through permanent slides.

   5   Demonstration of microbiological analysis of water, milk & food for enumeration of standard plate count & coliform count.

Part B: Human Development

   1   Study of Reproductive system through Models and charts.

   2   Visit to various Institutions and report writing

           Maternity welfare centers

           Old age homes

           Creche

           Ckky lqÌkj / fdÓksj lnu

           Ukkjh fudsru

References :-

1. Tauro P., Kapoor K.K., Yadav K.S., 1996, An Introduction to Microbiology, Wiley Eastern Limited.
2. Wilson E.D., Fisher K.H. and Garcia P.A., Principles of Nutrition, John Wiley & Sons, New York, 1980.
3. Potter N.N., Hotchkiss J.H. (1996) : Food Science, Edition 5, CBS Publishers and Distributors, New Delhi.
4. MacMillan M. (1984) : Experimental Foods Laboratory Manual, Surjeet Publications.
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6. Prevention of Food Adulteration Act (1994) : Govt. of India.
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HSB201: INTRODUCTION TO CLOTHING TEXTILES AND FAMILY RESOURCE MANAGEMENT
(Credit 4)
Section A: INTRODUCTION TO CLOTHING TEXTILES
(Credit 2)

Introduction: Concepts and classification of textile fibres; Natural fibres; Cotton, flax, jute, hemp, remie, silk, wool, asbestos, mineral fibres (structure, properties and formation). Man made fibres; Rayon, acetate, nylon, polyster, acrylic and glass fibres. Blends and mixture.

Yarn: Classification; Simple yarn, complex yarn, fancy yarn, spun yarn, filament yarn. Twist, crimp, yarn numbering system, tex, denier, count. Methods of fabric formation.

Weaving: Introduction to weaving, Loom, its parts and working, Basic weaves and its derivatives, Fabric count. Non woven fabric construction; felts and non woven. Knitted fabric; Warp knitting, weft knitted & circular knitting.

Fabric finishes: Processes of removing impurities from fabric; scouring, degumming, carbonizing. Basic finishes that alter texture; felting, singering, stiffening, decatazing. Surface finishes; Bleaching, delustering, calendering, beetling, napping, flocking, burnt out design, tentering, shearing and brushing.

Functional finishes – water proofing, water repellent, shrinkage control, flame retardation, mildew proof, moth proof, antibacterial, anti-static.

Dyes and Dyeing: Classification of dyes & their applicability; Natural and synthetic dyes; Direct dye, acid dye, basic dye, Vat dye, sulphur dye, azoic dye, mordant dye, disperse dye, reactive dye, pigments. Methods of dyeing; Jet, Jig, winch & warp beam. Techniques of dyeing; Solution dyeing, fibre and yarn dyeing, piece dyeing, cross dyeing, union dyeing. Colour fastness of fabric for washing, perspiration & light.

Printing: Hand printing methods; block printing, stencil, screen printing, spray printing, tie & dye, batik, warp printing. Machine printing; roller, screen printing, heat transfer printing, flock printing.

Laundry: Introduction to laundry process, materials and equipments in laundry.

Hard and soft water; Temporary and permanent hardness, methods of softening water, chelating and sequestering agents. Soap and detergents; Definition, chemical nature, manufacturing, properties and cleansing action.

Bleaches: Classification, application of bleaches to various fibres & fabric. Additives used in laundry; optical brightener, bluing agent. Starches, stiffening and softeners. Principles of laundering; Hand washing methods, washing machine.

Dry cleaning & Label. Disinfections of clothes.

Stain removal: Classification of stains, principles of removal, types of stain removers, techniques of removal. Care & Storage of apparel and household linen.

Traditional Embroidery: Types & techniques, traditional embroidery of India, Kashida of Kashmir & Bihar, Kantha of Bengal, Kasuti of Karnataka, Embroidery of Kutch & Kathiavar, Phulkari of Punjab, Chikankari of Lucknow, Manipuri Embroidery, Chamba Rumal, Quilting of Bihar, Orissa. Value addition of fabric (with respect to entrepreneurship)

Section B: FAMILY RESOURCE MANAGEMENT
(Credit 2)

Management as a discipline and Science: Interdisciplinary nature of management, Stages of development, Classical Organization Theory, Behavioral theory, Qualitative. Relevance to family resource management; Meaning, Nature and scope. Management Abilities; Principles of Management:- Technical, Conceptual, Human. Process of Management & functions; Planning, controlling and Evaluation. Motivation for Management; Values, goals & standards. Decision Making; Meaning**,** Types of decision**,** Mode of decision making**,** Cost-benefit analysis**,** Decision tree

Resources: Type of Resources. Classification and Characteristics of Resources; National & global, human, material, economic & non-economic. Principles in the use of resources; Scarcity utility, accessibility, exchange, transferability, substitution, reverse & investment, exchange linkage. Management of Resources; Time and Energy Management, Time as a resource, time orientation and perception, planning & using time resources effectively. Energy as resource; Identifying energy resources and factor affecting energy consumption, work simplification

Financial Management: Money as a resource in economic welfare; Planning, Family life stages & use of money, Budget ; Types, steps, advantages and disadvantages, Income**;** Productive income, money income, hidden income, Savings & Capital Investment; Objective, types of saving & investment; Saving Institution Schemes, Credit; Types, sources, rural, urban use of credit and credit instrument to increase level of living of urban or rural households.

Concept of Ergonomics: Scope of Ergonomics in home and other occupations; Nature of work in household & other occupations; Interdisciplinary and applied nature of Ergonomics as a field of study.

Introduction to foundation of art: Elements of design; Line, Size, Form, Structure, Space, Pattern, Shape, Light, characteristics & classifications

Designs: Definition & types of structural & decorative, Principles of design; Definition & their characteristics & types, Balance, Harmony, Scale, Proportion, Rhythm, Emphasis. Study of Colours; Classification dimensions, colour schemes & effect

PRACTICALS
HSB202: INTRODUCTION TO CLOTHING TEXTILES AND FAMILY RESOURCE MANAGEMENT
(Credit 2)

Part A: Introduction to Clothing Textiles

1. Identification of fibres – Visual inspection, burning, microscopic and solubility test.
2. Identification of yarns.
3. Demonstration on part of looms & motion of loom.
4. Preparation of basic weaves sample.
5. Warp and weft yarn counting in fabric.
6. Identification of fabric finishes and collection of samples.
7. Dyeing of cotton, wool & silk with natural & synthetic dyes i.e. Direct, napthol, acid, reactive etc.
8. Preparation of sample by Tie & Dye Techniques & Batik.
9. Preparation of samples by Block printing, Stencil printing, screen printing & spray printing.
10. Bleaching, whitening & starching.

11   Stain removal.

12   Laundry of cotton, silk, wool & synthetic.

13   Making samples by using contemporay embroidery & samples of traditional embroidery.

14   Visit to weaving centre & any one museum.

Part B: Family Resource Management

1. Preparation of colour wheel & colour scheme

2. Flower arrangement/Different areas

3. Gift wrapping & preparing decorative articles

4. Sketching of elements of arts

5. Sketching of principles of design

6. Motif development – reducing & enlarging

7. Study of various types of cheques & saving schemes

8. Work simplification techniques

9. Table setting and decoration

References :-

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5. Nickell and Dorsey, 1976. Management in Family Living (4th Ed.) Wiley Eastern Limited, New Delhi

6. Gross, Crandall & Knoll, 1980, Management for Modern Families, Prentice – Hall, Inc. Englewood cliffs, New Jersy

7. Grossack, I.M. & Martin, D.D. (1980) : Managerial Economics, Little Brawn & Co.

8. Adhikari, M. (1978), Economic Environment of Business, Sultan Chand

SEMESTER – III
Paper – III
HSB301: HOME SCIENCE EXTENSION EDUCATION AND HUMAN NUTRITION
(Credits 4)
Section A: HOME SCIENCE EXTENSION EDUCATION
(Credit 2)

Extension Education: Concept, meaning, philosophy, principles, aims & objectives of extension education, models; Technology; innovation; transfer model, Social Education Model, Indigenization Model, Social Action/Concretization Model, Empowerment of participation Model, Relationship with other social science subjects. Brief History of extension activities in India (present and past Independence), Extension Teaching Methods, Difference between formal & extension education, Steps in extension teaching

Classification of extension teaching methods according to different criterias; according to use, form &

nature, function, steps in extension teaching, Learning Objectives, Innovation Decision Process, Adoption process, Adopter's Category, Combined use of extension teaching methods (purpose, significance & types of combinations), Types of demonstrations (method, result & combined demonstration), Group Discussion, Campaign, Teaching Through Village Leaders, Criteria for Selection of Extension Teaching Methods, Factors affecting Extension Teaching Methods, Extension Teaching Aids, Circular letters, Leaflet, pamphlet & bulletin, Newspaper, Blackboard, Photograph, Posters & charts, Flash card, Flannel graph, Exhibition & Melas, Educational Tour, Talk (Symposium, seminar, workshop, panel, forum, debate & elucution, competition) Specimen, Model & exhibits (3 dimensional aids); Radio & T.V. Programme (Electronic aids)/L.C.D. Projector, Tape/cassette Recorder, Microphone speaker/Public Address System, OHP, Epidiascope, Slide Projectors, Camcorder, Films, Puppets, Traditional Folk programmes, Educational Psychology & its application to extension education, Concept, meaning & aim of education psychology, Relationship between educational psychology & extension education, Objective and contribution of Psychology, Intelligence, emotions & motivation (concept, related Theories, types, importance, use in extension teaching), Psychology of Learning; Definition, meaning & concept of Teaching, Principles of Teaching; Qualities of a good Teacher, Guidelines for the teacher, Teaching plan (method of preparation, essentials & precautions), Teacher evaluation (concept & criterias), Some psychological terms & their definition; Attention & Perception, Thinking, Conflicts, Psychological barriers, Propaganda

Communication: Concept of communication – meaning, functions, problems & barriers, Elements of communication process, Communication media – meaning, classification, advantages & limitations, Importance of communication in extension work, Communication Models, Functions of Communication, Communication Channels, Communicator – Communicate relationships; Orientation, Empathy, Feedback, Physical Interdependence, Credibility, Interaction, Homophily, Heterophily, Feedback in communication & role of feedback in Extension Education, Communication and extension approaches; Individual approach, Group approach, Mass approach

H.Sc. Extension: Concept, meaning of H.Sc. extension, History of H.Sc. extension education, History of H.Sc. extension education in India, Various H.Sc. associations across the world including India, Various H.Sc. Institutions / Universities in India, Role of H.Sc. in Rural Development

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Section B: HUMAN NUTRITION
(Credit 2)

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Concept of Nutrition: relation of nutrition to health, optimum nutrition, adequate nutrition, malnutrition, growth of the Science of nutrition with particular reference of India. Composition of human body, structure and functions of digestive organs, excretion of waste products, study of urine, sweat and faeces, blood body fluids and hormones, Microscopic study of stomach, tissues of human body, digestion absorption and metabolism of foods. Brief history of Nutritional Science, Scope of Nutrition. Minimal Nutritional requirements & RDA – Formation of RDA and Dietary guidelines – Reference Man and Reference Woman. Human Body Composition and Changes through the life cycle. Energy in Human Nutrition – Energy Balance, Assessment of Energy Requirements, Deficiency & Excess. Introduction to Biochemistry – Definition, objectives, scope and inter-relationship between biochemistry and other biological sciences.

Carbohydrates: Definition, classification, structure and properties, Digestion and Absorption, Blood glucose and effect of different carbohydrates on blood glucose, Glycemic Index, Significance of Dietary Fibre. Proteins – Definition, classification, structure & properties of : amino acids – Essential & non-essential & proteins : Assessment of protein quality (BV, PER, NPU), Digestion and

Absorption and Deficiency (PEM). Lipids – Definition and classification, structure, properties, significance of acid value, iodine value and saponification value, Digestion & absorption.

Vitamins: Physiological role, broavailability, requirements, sources, deficiency and excess (Fat soluble and Water soluble). Minerals & Trace Elements – Physiological role, bio-availability and requirements, sources, deficiency and excess (Calcium, Phosphorus, Magnesium, Iron, Fluoride, Zinc, Selenium, Iodine, Chromium). Water & Electrolyte; Functions, Requirements. Enzymes; Definition, Types & Classification of Enzymes, Enzyme kinetics including factors affecting velocity of enzyme catalysed reactions, Enzyme inhibition, Mechanism of enzyme action. Hormones; Biological role of harmones of Pituitary, Adrenal Cortex & Medulla, Thyroid, Parathyroid, Pancreas. Physiology of Nutrition; Digestive System, Circulatory System, Excretory System. Intermediary metabolism.

Community Nutrition: Community Nutrition or a field; Public Health Nutrition, Goals for Nutrition programmes, planning, implementation and evaluation of nutrition education programme, food fads & food habits. Introduction to national nutrition programmes & policies; Integrated Child Development Services (ICDS); National Rural Development Programme (NRDP); National Rural Employment Programme (NREP); Miscellaneous monofocal programmes. Role of international agencies and programmes in community nutrition; Food & Agriculture Organization (FAO); World Health Organization (WHO); United Nations Childrens Fund (UNICEF); Other voluntary & government agencies. Direct nutritional assessment of human groups; Nutritional anthropometry; Biochemical tests; biophysical tests; clinical signs; individual nutrient deficiencies. Diet Survey methods at national, institutional, family and individual level. Indirect nutritional assessment of human groups : Indicators and their use; health policy indicators; social and economic indicators, indicators of the provision of health care; coverage by primary health care; basic health status indicators.

PRACTICAL
HSB302: HOME SCIENCE EXTENSION EDUCATION AND HUMAN NUTRITION
(Credits 2)

Part A:- Home Science Extension Education

1. Preparation and use of following aids; Circular letter, Lealflet and Pamphlet, News paper, Flash cards, Poster, Chart
2. Arranging an exhibition/mela in a community.
3. Excursion tour to an institution teaching H.Sc.
4. To get familiar with use and care of projected aids.
5. Attending and preparing report of departmental seminar.

Part B:- Human Nutrition

1. Preparation of dishes rich in : Energy, protein, fat, fiber, calcium, iron, vitamin A, vitamin C, thiamine, riboflavin and niacin.
2. Reaction of mono, Di and polysaccharides and their identification in unknown mixtures, Iodine test for cooked and uncooked starch & dextrin.
3. Reactions of different types of fats (saponification and iodine value)
4. Reactions of proteins
5. Study of microscopic structure of tissues, liver, kidney, stomach, intestine, blood
6. Evaluation of nutritional status : By Anthropometry survey, Dietary survey
7. Other determinants of family nutrition : Socio-economic status survey, using SES

scale,

8. Weaving practices.
9. Immunization practices.
10. Sanitary practices.
11. Dietary practices, fads and fallacies during illness, pregnancy, lactation and other special conditions.
12. Assessment of nutritional status using above criteria in a community set up and report writing.

References :-

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3. Dhama O.P. & Bhatnagar O.P., Education & Communication for Development, Oxford & I.B.H. Publishing Co. Pvt. Ltd., New Delhi
4. Sampath K., Pannirselvam A., Santhanam S., Introduction to Educational Technology, New Delhi, Sterling Publishers
5. Swaminathan M. (1985) : Essentials of Food and Nutrition, Vols. I & II, Ganesh & Co., Madras
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7. Indian Standards Institution (1985) : ISI Handbook of Food Analysis, Parts I to XI, Manak Bhawan, New Delhi
8. Sundararaj P and Siddhu A. (1995) : Quantitative tests and Quantitative procedures in Bio-chemistry – A practical manual, Wheeler Publishing
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10. Guyton A.C., Hall J.E. (1996) : Textbook of Medical Physiology, 9th Ed. Prism Books (Pvt.) Ltd., Bangalore
11. Obert J.C. (1986) Community Nutrition, 2nd Edition, MacMillan Publishing Co., New York

SEMESTER – IV
Paper – IV
HSB401: INTERIOR DESIGN AND CLOTHING CONSTRUCTION
(Credit 4)
Section A: INTERIOR DESIGN
(Credit 2)

Housing: Family's Housing Needs, Protective, economic, affectional, social standard of living housing goals, style, function, occupation, Factors influencing selection and purchase of site for house building, Legal aspects, location, physical features, soil conditions, cost, services, House Planning, Reading house plans Grouping of rooms, orientation, circulation, flexibility, privacy, spaciousness, services, aesthetics, economy light and ventilation

Planning different rooms: Living room, dining room, bedrooms, kitchen, store room, toilet, passage, staircase, Financial Consideration, Availability of funds for housing, Housing Development Finance Corporation, Cooperative Housing Society, Life Insurance Corporation, Cooperative Banks, Loan

from Provident Fund, Finance Corporation of India, Residential structural features of architecture

Foundations, footing, plinth, beams, columns, walls, slabs, floor, ceiling, window, doors, staircase, Types of building materials and its characteristics & uses, Gardening plan & indoor gardening, State & Central Housing Scheme; National Housing Policy, Urban Land (Ceiling & Regulation) Act, 1976, Rent Control Act and Govt. Policies & Programmes, Housing problems, causes and remedial measures, Housing Standards & Legislation

Interior Planning & Decoration: Introduction to interior planning & decorations

Application of elements and principles of design in interior planning and decoration, Furniture; Furniture design based on anthropometric dimensions

Styles of furniture; Traditional, contemporary and modern, Selection of furniture for comfort, rest & relaxation for work, for storage, Arrangement of furniture for living, sleeping, dining and multipurpose rooms, Upholstered furniture materials, techniques and designs, Furnishing Fabrics, Types of curtains; Draperies, floor coverings, rugs and carpets, cushion covers, slip covers, bed linen and table linen

Selection and use, Functional & decorative accessories for interiors, painting, sculpture, pots etc., Lighting in interior; Lighting plans for illumination and special effects, Lighting sources; Developing a lighting plan for different areas, Kitchen Modular Design; Types of kitchen, Kitchen Geometry; Work height of different work areas and storage areas, space dimensions of different work centres and work areas, Materials; Floor, walls, sink, ceiling and its characteristics, platforms, storage etc., Types of finishes, Essetial services needed in a kitchen,

Water supply, Hot & cold, tap fittings, water purifiers, Electricity services; electricity current, air purifier, MCB fuses, exhaust, Drainage services; Waste water drainage system, waste disposal, cleaning agents & equipments

Mechanics: Introduction to properties of matter, solid, liquid and gases, Forces; Centripetal and centrifugal forces, spin dryer in washing machine, Friction**,** Advantages and disadvantages; Concept of ball bearing, sewing machine, Heat; Sources & properties of heat, heat and temperature, heat transfer, Application of heat transfer; Household thermometers, Pressure cooker, Refrigeration**;** Refrigerator, Compressor and absorption type.

Light: Introduction to light, properties of light, velocity of light, Electricity and Magnetism, Static and current electricity, Basic electric circuits, Electroplating, Electrolysis Thermal effect; Automatic, steam iron, toaster, geyser, Water heater

Induced current; Transformer, House Wiring, Distribution of current to the house, kilowatt hour meter, Circuits; Number of circuits in a house, Choice and care of motor driven appliances; Mixer, blender, Materials used for household equipments

Cleaning and care of different materials; Metal, glass, wood, paints, upholstery, floor & floor coverings, electrical appliance and decorative articles

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Section B: CLOTHING CONSTRUCTION

(Credit 2)

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Traditional textiles and costumes of India, Dyed & Printed textiles of India; Kalamkari, Patola, Pochampalli, Ikat of Orissa, Tie & Dye of Tamil Nadu, Woven Textiles of India; Brocades, Shawals of Kashmir, Muslins of Bengal, Silk of Karnataka, Cotton of Kerala, Woven sarees of different states of India, Traditional Costumes of India; Costumes of Men & Women & Traditional marriage costumes of different states of India (Details of costumes, jewellery & accessories), Elements and Principles of design as applied to apparel designing, Figure types, silhouettes, Sewing equipments and other tools required for drafting, cutting, stitching, sewing machine; Part of machine, their use, care & remedy, Body measurement; Anthropometric measures and method of taking body measurement for

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different garment, General construction techniques for garment; Drafting, folding, lay out, marking and cutting of pattern pieces, Essentials of Children's Clothing , Importance of Clothing, Psychological effect of clothing on children, Effect of clothes and child's growth, Sociological & Psychological aspects of clothing, Drafting of Jhabla, Baby frock, plain frock, shirt, trouser.

Pattern Making: Techniques of flat pattern making, Principles and application of flat pattern for different styles of bodies, skirt and sleeves, slash & spread method. Fabrics for garment making; Handling of different types of fabrics, selection of fabric for different garment, study of texture, surface, colour in relation to garment design, material required for different garment. Sources of inspiration for apparel designing fashion and current fashion trends.

Seams: Types of seam, seam finishes (Darts, Tucks, Pleats, Gather, Yokes, Pockets, Collars, Loops & fastners, Trimmings, Stay Stitching, Lining, Neckline, Interlining, Top Stitching, Facing, Interfacing), Sewing supplies.

PRACTICAL
HSB402: INTERIOR DESIGN AND CLOTHING CONSTRUCTION
(Credits 2)

Part A :- Interior Designing

1. Learning architectural symbols
2. Drawing of house plans for different income levels
3. Planning of different kitchen layouts (considering various kitchen sizes)
4. Study of furniture detailing
5. Furniture layout for different rooms & drawing of designs
6. Presentation of Market survey of furnishing fabrics
7. Drawing of kitchen garden layout
8. Interior design for small flat/large residential space/different rooms
9. Development of designs and construction of any three of undermentioned items; cushions, curtains, carpets, doormats, tablemats

Part B:- Clothing Construction

1. Visit to museum & report writing on traditional textiles of India.
2. Group Discussion on traditional costumes of India.
3. Illusion of different garment on Silhoultee.
4. Preparation of Bodice block, adult.
5. Drafting of sleaves basic & variation.
6. Drafting of collar & its variation
7. Construction of frocks, trouser, shirt.
8. Preparation of samples of seams dart, tucks, pleats, pockets, collars, loops, fastner.
9. Sketching of designs of variation in frocks.

References :-

1. Cherunilam, Frances & Heggade, Odeyan; D (1987) : Housing in India, Bombay, Himalaya Publishing House
2. Again Tessie (1970) : The House : Its Plan & use, New York, J.B. Lippincott Co.
3. Deshpande R.S. (1980) : Modern Ideal Homes for India (9th Ed), Smt. L.S.Deshpande for Deshpande Publications Trust

4. Deshpande R.S. (1980) : Building your own House, United Book Corporation
5. National Building Organization – Monograph of Housing Statistics
6. Ball Victoria Kloss (1982) : Art of Interior Design, John Wiley & Sons
7. Ruth Morton : The Home and its furnishings, U.S.A. McGraw-Hill, 1953
8. Complete Guide to Sewing, The Reader's Digest Association, Inc., Pleasantville, New York/Montreal, Canada
9. Pandit Savitri, Manual for Children's Clothing, Orient Longman Limited, Bombay
10. Zarakkar K.R. : Zarakkar System of Cutting, Bombay
11. Doongaji (1975) : Basic Process & Clothing Construction, New Delhi, Raj Book Dep.
12. Brij Bhushan, Jamila : The Crafts of Weavers, The Costumes & Textiles of India, D.E. Tarapore Valla Sons & Co.

SEMESTER – V
Paper – I
HSB501: HOME SCIENCE EXTENSION EDUCATION AND RURAL DEVELOPMENT
(Credit 3)

Community Development: Meaning, objectives, organization of Community Development, Scope of Community Development Programme Types of Community Development Programme; Integrative Type, Adaptive Type, Project Type, Various community development programmes, Govt. sponsored programmes for family development; DWCRA, IRDP, NREP, RLEGP, TRYSEM etc. (source of funding), Cooperative Movement (Brief history of cooperative movement in India), Panchayati Raj & Democratic Decentralization, Concept & evolution of Panchayati Raj, Organization of Panchayati Raj Institutions, Functions & Importance of Panchayat in rural development, Five Year Plans; Concept & evolution of Five Year Plans, Major contribution of Five Year Plans in rural development, Various community development and rural development programmes under Five Year Plans, Leadership Development, Concept & definition of leader & leadership, Types of leaders; Principles of democratic leadership, Personality Dynamics of leader, Functions of a leader, Factors determining effectiveness of leader, Role of leader in group mobilization, Gender and Development, Concept of development, Indicators for development, Women as a partner in the developmental process & national planning, Approaches of Development, Shifts from welfare approach to development & empowerment approaches, National efforts for Development of Women; National Policy on Women, Role of National Commission for Women

Rural Sociology: Concept, meaning, definition of Rural Sociology, Nature & scope of Rural Sociology, Rural Sociology in India; Origin & development, Importance of Rural Sociology in India, Subject matter of Rural Sociology, Study methods of Rural Sociology, Functions & utility of rural Sociology, Rural Social System, Indian Village (meaning & concept), Characteristics of Rural Society, Rural and Urban life, Rural Social Problems, Indian rural social structure, Rural development and programme; Integrated Rural Development Programme, Rural Reconstruction & Planning

REFERENCES :-
1. Patnayak Rama, Rural Development in India, New Delhi, Vikas Publishing House Pvt. Ltd.
2. Thingalaya N.K., Rural India – Real India, Bombay, Himalaya Publishing House
3. Indian Journal of Extension Education, The Indian Society of Extension Education, Division of Agricultural Extension, IARI, New Delhi – 110012

4. Desai, Vasanth, Rural Development Programme & Strategies, Bombay, Himalaya Publishing House

Paper – II
HSB502: CONSUMER ECONOMICS
(Credit 3)

Family as an economic unit: Family types, functions, Economic goal of family, economic demands in different stages of family life cycle, Sources of money income; wages, salaries, rent, profits, interests, transfer of payments, Consumer economics, meaning and definition, Market; Definition, types of markets, characteristics, functions, changing business environment; Telemarket, global, privatisation of monopolistic services, e-business & e-commerce, Wants; Definition, characteristics, Law of diminishing marginal utility, equimarginal utility, Demands; Law of demands

Price fixation

Consumer and Consumer Problems: Definition of consumers, choice and buying problems of consumers, faulty weights and measures, adulteration and other malpractices Type of Products; Consumer durables and non-durables, consumer items Services; Types of services available to consumers like (Transportation, health, education, communication, gas distribution, electricity supply, telephones etc.), Role of Standards in Consumer Protection; Meaning of standards, benefits of standards to consumers and manufacturers, product certification & role of certification,

Quality Control and Standardization: Introduction to quality control, advantage & disadvantages, application of quality control and standardization for products like (food, textile, consumer durables, materials and consumer items), Consumer Protection Law; Importance and scope, The sale of goods act 1930, The agricultural produce (grading + marketing 1937), Prevention of Food Adulteration Act, 1954, The Essential Commodities Act, 1955, The Monopolies and Restrictive Trade Practice Act, 1969

The Standards of Weight & Measures Act, 1976, Prevention of Black Marketing and Maintenance of Supplies of Essential Commodities Act, 1980, The Bureau of Indian Standards Act, 1986, Advertising Regulation & Consumer Protection under the law of court, 1986, Role of different organizations/Agencies towards consumers, Ministry of law and justice, Consumer guidance Society of India, Consumer cooperative, Govt. & Municipal agencies, Grahak Panchayat, Advertising & Labelling Information, Introduction to advertisement, Role of advertising in consumer decision

Types of advertising: Newspaper, magazines direct advertising, radio and television, Outdoor advertising; Advantages & disadvantages of each

Entrepreneurship: Definitions, need, scope and characteristics of entrepreneurship, entrepreneurship development and employment promotion, Environmental scanning and opportunity identification; Methods, sources and types of opportunity, Assessment, criteria and profiling opportunities, Infrastructure and support system, Industrial support agencies, Procedures and steps involved in setting up an enterprise, Whom to contact for what? Schemes of assistance, Sources of information and industry organizations, Laws governing Business operation, Indian Contract Act & Sales of Goods Act

References :-
1. Gordon Lee (1972), Economics for Consumers, D. Van Nostrand Company, New York
2. Singh Gurbax (Comp) (1990) : Law of Consumer Protection, Jaipur, Bharat Law Publishers
3. Kewal Krishan Dewett & Adarsh Chand (1981) : Modern Economic Theory, 12th Ed., Shyamlal Charitable Trust

4. Gupta B.D. (1973), Consumption Pattern in India, Tata McGraw Hill

PRACTICAL
HSB506 (BASED ON HSB501 AND HSB502)
(Credit 3)

Part A: HOME SCIENCE EXTENSION EDUCATION AND RURAL DEVELOPMENT

1. Visit to a village to gain knowledge through standard questionnaire about;
   (a) The Rural Society
   (b) The Gram Panchayat, Regional Committee ¼{ks=h; lfefr½ at block level and their functioning.
2. Visit to cooperatives (Dairy, Agricultural, ¼efgyk lgdkfjrk½ and to know about their functioning pattern.
3. To know about different programmes running for rural development and to interact with the people involved.
4. To develop a training programme for urban society for different persons.
5. Educational tour to institutions related to the course.

Part B: CONSUMER ECONOMICS

1. Market survey on Products with regards to advertisement, labels, packaging.
2. Impact of advertising on consumer buying on children and women.
3. Collection of various advertisements and classification by identifying intended consumer appeal.
4. Assignments.

HSB503: FUNDAMENTAL OF HUMAN DEVELOPMENT
(Credit 3)

Methods of studying Human Development: (case study interview, naturalistic observation and laboratory observation). Experimental methods, Data collection methods (cross sectional and longitudinal and sequential studies). Ethics of Research (ethical issues and standards). Introduction to theories of Human Development. Piagets's theory of Cognitive Development. Psycho; sexual theory of Sigmund frued (Defiance Mechanisms, stages of Psychosexual development, Id, ego and super ego). Psychosocial theory of Erik, Erik son. Traditional learning theories (Pavlov, Watson and Skinner).

Social learning theory (Bandura): Kohlberg's Theory of Moral Development. Theories of language acquisition. Maslow's self actualization Theory. Theory of Emotional Development. The psychology of behaviour perception, concept formation, reasoning and thinking. Imagination, creativity memory, remembering and forgetting. Intelligence Motivation and Learning Early Childhood Education and Management Meaning, importance and origin in India Different methods and philosophic of Early Childhood education

Early childhood education centers: Infrastructure and Administration, Staff building and Equipment, record heeping parent meeting, Curriculum for ECCE centers, Importance of Science, nature, music, role plays and stories in ECCE programme, Understanding and guiding children, Child with special needs definition, terminology, history of studying disability in India Different types of disabilities their definition Classification genetic and environmental causes, prevention, Rehabilitation facilities Sensory Deficits (Auditory impairment, Visual impairment), Speech disability, Communication disorders, Cerebral palsy and orthopedic disability, Behavioural disorders, Mental Retardation

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1. Gangrae K.D. (1971), Community Organization in India, Popular Prakashan, New Delhi
2. State of World Children, UNICEF, Annual Publication
3. Parakesh B.S. (1985), Population Education – Inception to Institutionalization, NCERT, New Delhi
4. Bernard H.W. & Fullner D.W., Principles of Guidance, Bombay, Allied Publishers
5. Verma Hildebrand (1985) Guiding Young Children, New York, MacMillan Publishing Company
6. Hallan D.P. & Kauffman T.M. (1991), Introduction to Exceptional Children (5th Ed.), Boston, Allyn & Bacon

HSB504: DIET THERAPY I
(Credit 3)

Basic concepts of diet therapy: Therapeutic adaptations of normal diet, principles and classification of therapeutic diets. Team approach to health care. Assessment of patient's needed. Routing Hospital Diets; Regular, light, soft, fluid, parenteral and enteral feeding.

Energy Modifications and nutritional care for weight management, Identifying the overweight and obese, etiological factors contributing to obesity, prevention and treatment, low energy diets balanced

energy reduction and behavioural modification. Underweight; Aetiology and assessment, high energy diets for weight fain, anorexia nervosa and bulimia, Diets for Febrile conditions, Infections and Surgical conditions

Etiological factors, symptoms, diagnostic tests and management of Upper GI tract disease – Diseases of Oesophagus and dietary management, Diseases of stomach and dietary management. Gastric and duodenal ulcers and dietary management, Etiology, symptoma, diagnostic tests and management of Intestinal diseases; Diarrhoea, Steatorrhoea, Diverticular disease, Inflammatory Bowel Disease, Ulcerative Colitis. Flatulence, Constipation, Irritable Bowel Syndrome, Hemorrhoids, Etiology, symptoms, diagnostic tests and management of Malabsorption Syndrome, Celiac sprue, Tropical sprue. Intestinal brush border deficiencies (Acquired Disaccharide Intolerance), Protein losing enteropathy, Anemias, Pathogenesis and Dietary Management: Nutritional Anemias, Sickle cell Anemias, Thalassemia, resulting from Acute Haemorrhage, Diseases of the Liver, Exocrine Pancreas and Biliary System, Liver function tests and Nutritional care in Liver disease in the context of results.

Dietary care and Management: Viral Hepatitits, Cirrhosis of Liver, Hepatic Encephalopathy, Wilson's disease. Dietary care and management in diseases of Gall Baldder and pancreas – Cholelithiasis, cholecystitis, cholecystectomy, Pancreatitis etc.

Reference

1. Anderson, L., Dibble, M.V., Turkki, P.R., Mitchall, H.S., and Rynbergin, H.J. (1982): Nutrition in Health and Disease, 17th Ed., J.B. Lippincot & Co. Philadelphia.

2. Antia, F.P. (1973): Clinical Dietetics and Nutrition, Second Edition, Oxford University Press, Delhi

3. Mahan, L.K., Arlin, M.T., (1992): Krause's food, Nutrition and Diet Therapy, 8Th Ed. W.B. Saunders Company, London.

4. Robinson, C.H., Lawler, M.R., Chenoweth, W.L. and Garwich, A.E. (1986): Normal and Therapeutic Nutrition, 17th Ed., Macmillan Publishing Co.

5. Williams, S.R. (1989): Nutrition and Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis.

6. Raheena, Begum (1989): A textbook of foods, nutrition and dietetics. Sterling Publishers, New Delhi.

7. Joshi, S.A.(1992): Nutrition and Dietetics, Tata Mcgraw Hill Publications, New Delhi.

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Paper – V
HSB505: FASHION DESIGNING
(Credit 3)

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Importance of Textile & Clothing: Industry in the Indian Economy, Preparation of Bodice Block, Adult male & female

Pattern making: Techniques, flat pattern, principles and application of flat pattern for different styles, Developing paper pattern, pattern envelop, guide sheet and understanding the commercial paper pattern, Introduction to draping & draping of bodice block or dress form, Fitting**;** Factors affecting good fit, problems and remedies

Dart manipulation, Principles of figure drawing & sketching of body features, Drawing the form with different angles, Front, side, back, sketching of various designs of salvar kurta, drafting of salvar, kurta, blouse, peticoat, night suit, Fashion Terminology, concept, fashion cycle, fashion forecasting, component of fashion; Silhouttee, details, colour, fabric, texture, seams, trims.

Social & Psychological aspect of Clothing: Fashion Industry, Nationalised Institutes related to Clothing & Textile courses**,** Portfolio development. Detailed study of Industrial machine & equipments used for Cutting, Sewing, Finishing, Embellishment. Finance for small scale industries & price fixation of garment**,** Colour forecast**,** Markets Scanning

<u>**References :-**</u>

1. Armstrong, Helen Joseph : Pattern making for Fashion Design, Harper Collins Publishers, New York
2. Bane A. : Flat Pattern Design, Mcgraw Hill
3. Goldsworthy, M. : Simple Dress-making, London, Mills & Boon Ltd.
4. Allen, Anne & Seaman, Jullian : Fashion Drawing : Basic Principles, B.T. Batsford, London

SEMESTER – VI

Paper – I

HSB601: ADVANCED HOME SCIENCE EXTENSION AND COMMUNICATION

(Credit 3)

Adult Education (A.E.): Formal, non-formal & Informal system of education**,** Concept, background, meaning & definition of A.E.**,** Aim & objectives and goals of A.E.**,** Role of Adult education in National Development**,** History of adult education in Post-Independent India; Gram Shikshan Mohim**,** Farmer's functional literacy project**,** Non-formal education for youth (NAEY)**,** National adult education programme (NAEP)**,** State adult education programme (SAEP), Adult education through voluntary agencies, National Literacy Mission (Achievement & Problems)**,** Literacy scenario of nation, state, district & local areas. Choice of language for literacy, dialects Vs standard.

Community participation in A.E.: Training for Development**,** Concept, meaning & types of training; Institutional**,** Interactive**,** Participatory**,** Various Training Approaches; Creativity Training**,** Field Training**,** Group dynamics**,** Laboratory Training**,** Motivation Training**,** Self-awareness & self development**,** Techniques of Training including RRA, PRA**,** Media Development

Genesis & growth of Folk media in India: Types of folk media, folk music & dances, street theatre & its educational value, role of puppetry & different types of puppets, importance of folk media in development context & criteria for selection of folk media. Meaning, importance & role of visual communication and print media, type of printing (Design & layout), press & public relations, law related to press, agencies governing regulations & ensuring freedom of press, concept & meaning of graphic art, editorials, principles of editing. Concept, meaning & role of electronic media, various forms of electronic media (broadcast media, T.V., film media), their development in India, Types of programmes, their use in extension work, feedback mechanism for all types of electronic media.

Advertisement and Visual Publicity: Advertising as a mass communication process**,** Need for advertising communication, economic & social effect of advertising**,** Types of advertising media; print media**,** broadcast media**,** outdoor advertisement (hoardings, posters, bill board, bulletin board, electronic signs, litterbins, aerial methods, wall magazines)**,** transportation media (mobile vehicles)**,** exhibitions & trade fairs**,** non-media advertising**,** Techniques of Advertising; choosing content**,** layout & design**,** media planning**,** Ethics in Advertising**,** Programme Planning**,** Meaning, need & principles of project planning**,** Abilities needed by planner**,** Steps in programme planning**,** Criteria for good programme planning**,** Execution, monitoring & evaluation of extension programme

Project Planning & Management: Meaning & concept of project**,** Components of project management system**,** Steps for designing the project**,** Proposal writing**,** Cost estimation & financial management**,** Fund raising.

PRACTICAL

HSB606: ADVANCED HOME SCIENCE EXTENSION AND COMMUNICATION

(Credit 2)

1. Plan a programme keeping in mind the steps of Programme Planning.
2. Proposal writing
3. Organizing a Fair/Mela/Exhibition.
4. Excursion Tour

REFERENCES :-

1. McGivney, Veronica & Murray, Frances : Adult Education in Development – Methods & Approaches for Changing Societies, 19 B, De Mant Fort Street Leicester LE, U.K. National Institute of Adult & Continuing Education
2. Lynton Rolf P. & Pareek Uday, Training for Development Homewood, Iwrois, Dorsey Press
3. Jain R, Mass Media & Rural Development, Vol. II, New Delhi, Mank Publication Pvt. Ltd.

Paper – II

HSB602: DIET THERAPY II

(Credit 3)

Diet in disease of the endocrine pancreas: Diabetes Mellitus**;** Classification, Symptoms, diagnosis, Management of diabetes mellitus-clinical Vs. chemical control. Insulin therapy, Oral hypoglycemic agents, Glucose monitoring at home. Dietary care and nutritional therapy, meal plan (with and without insulin). Special dietetic foods, Sweeteners and sugar substitutes. Diabetes in pregnancy, elderly, surger, illness, Diabetic coma, Insulin reaction. Juvenile Diabetes. Patient education.

Hypoglycemia; Classification, symptoms, postprandial or reactive hypoglycemia, Early alimentary and late reactive hypoglycemia, idiopathic hypoglycemia, dietary treatment.

Diseases of the cardiovascular system; Atherosclerosis: Etiology and risk factors, Hyperlipidemias; Brief review of Lipoproteins and their metabolism, classification of Hyperlipidemias. Clinical and nutritional aspects of hyperlipidemias. Dietary care. Lschemic Heart Disease; Nutritional management. Congestive heart disease and nutritional management. Hypertension; Etiology, prevalence, nutritional management and prevention. Cerebrovascular disease and diet, Renal Diseases; Review of physiology and function of normal kidney; Diseases of kidney; Classification, etiology, characteristic symptoms and dietary management in: Glomerulonephritis; Acute and chronic, Nephrotic syndrome, renal failure and uremia, acute and chronic renal failure. Dietary management in renal dialysis and renal transplant. Chronic renal failure in patients with diabetes mellitus and children. Nephrolithiasis. Use of sodium and potassium exchange lists.

Allergies: Definition, symptoms, diagnosis and dietary management. Food selection. Food allergy in infancy. Diseases of Musculoskeletal System**,** Dietary management of rheumatoid arthritis, osteoarthritis, osteoporosis.

Cancer: Nutritional and non-nutritional etiological factors, Management of cancer patients in relation to the clinical treatment and cachexia.

Surgery, trauma and burns: Physiological changes in relation to trauma**.** Assessment of the nutritional status in surgical and burns patients. Pre-operative and post-operative nutritional care.

Nutritional care in trauma. Nutritional management of burns patients.

Inborn errors of metabolism: Biochemical basis and nutritional management of PKU and Maple Syrup Urine Disease. Metabolic disorders; Dietary care in diseases of the Adrenal Cortex, Thyroid and parathyroid glands. Gout. Interactions between drugs, nutrients and nutritional status (in brief).

Reference

1. Anderson, L., Dibble, M.V., Turkki, P.R., Mitchall, H.S., and Rynbergin, H.J. (1982): Nutrition in Health and Disease, 17th Ed., J.B. Lippincot & Co. Philadelphia.
2. Antia, F.P. (1973): Clinical Dietetics and Nutrition, Second Edition, Oxford University Press, Delhi
3. Mahan, L.K., Arlin, M.T., (1992): Krause's food, Nutrition and Diet Therapy, 8Th Ed. W.B. Saunders Company, London.
4. Robinson, C.H., Lawler, M.R., Chenoweth, W.L. and Garwich, A.E. (1986): Normal and Therapeutic Nutrition, 17th Ed., Macmillan Publishing Co.
5. Williams, S.R. (1989): Nutrition and Diet Therapy, 6th Ed. Times Mirror/Mosby College Publishing, St. Louis.
6. Raheena, Begum (1989): A textbook of foods, nutrition and dietetics. Sterling Publishers, New Delhi.
7. Joshi, S.A.(1992): Nutrition and Dietetics, Tata Mcgraw Hill Publications, New Delhi.

PRACTICAL
HSB607: DIET THERAPY II
(Credit 2)

1. High-Risk Management (hospital based) – Nutrition assessment.
2. Review of existing practices in hospitals. Oral supplements indigenous/home based and commercial for stressed patients – burns, surgery, cancer, debilitated patients. Management of patients with feeding problems. Tube feeds – all forms, elemental and parenteral.
3. Diabetes Mellitus
4. Planning and preparation of diets. Without Insulin, with insulin, adult and juvenile, diabetes in pregnancy, diabetes and illness.
5. Managing, patients with hypoglycemic conditions.
6. Diseases of Cardiovascular system-
7. Formulation of low cholesterol and low sodium recipes, planning and preparation of diets for hypertension, CHD, congestive heart failure during acute, chronic and convalescent conditions. Progressive dietary management for cardiac transplantation and cardiac surgery.
8. Protein and mineral modification for patients with renal disease
9. Planning and preparation of diet for glomerulonephritis – acute and chronic, nephritic syndrome, nephrolithiasis, renal failure – acute and chronic, dialysis.
10. Diet for patients with Neoplasia
11. Elimination diets for allergy.
12. Low purine diet.
13. Standardization of Common food preparations for portion size
14. Planning and preparation of Normal diet.
15. Planning and preparation of fluid food preparations.

16. Clear fluid preparations. Full fluid preparations. Planning and preparation of fluid diet-clear and full fluid.

17. Planning and preparation do Recipes of soft/semi-solid diet,

18. Mechanical, pureed, Planning and Preparation of soft diet.

19. Planning and preparation of recipes using protein concentrates, sugar substitutes, low fat and low calorie recipes, high fibre recipes, bland diet recipes and diets for the following conditions:

20. Overweight and obesity, underweight, fevers, ulcers, diarrhoes,

21. Constipation, malabsorption syndrome, viral hepatitis, liver

22. Cirrhosis, cholecystitis, nutritional anaemias.

Paper – III
HSB603: ADVANCED HUMAN DEVELOPMENT
(Credit 3)

Child with Special Needs: Definitions, Terminology, History of studying disability in India & Abroad. Issues in Classification & labelling, Mainstreaming. Education and Rehabilitation facilities. Government & Non-government efforts (Schemes for Physically & Mentally Challenged people). Different Type of disabilities, their definition, classification, statistics, genetic & environmental, causes, prevention, Rehabilitation facilities; Mental Retardation, Sensory Deficits (Auditory Impairment, Visual Impairment), Learning difficulty & disability, Cerebral Palsy & orthopaedic disability, Communication disorders, Behavioural disorders

Family and Child Welfare: Family in India (concept, family composition & structure, changing pattern of family, causes & effects of family disharmony, Implications of family changes). Problems & needs of families in specific situations; Families affected by natural calamities, Families affected by war, riots & terrorism, Families with chronically ill patients, Family in extreme poverty conditions, Family with Marital discord, Children's right & National Policy for children, Demographic Profile of child in India. Family & child welfare services working at National & International level (CSWB, ICCW, ICDS, NIFCCD & others, WHO, UNICEF, CARE, ILO & others). Concept, meaning and coping strategies for violence against women, youth, disabled & others, types of violence. Marriage & Family dynamics, Physiological, social, psychological, financial readiness for marriage, Preparation for Marriage; Selecting a suitable partner, Premarital counseling. Technological advancement and family

Legal Aspects: Laws regarding marriage (Hindu Marriage Act, Muslim Marriage Act, Christian Marriage Act, Special Marriage Act), Divorce, Adoption, Inheritance Dowry) Contemporary issues in family life, breakup of family, migration, dual career families, non-traditional families, influence of extra familial factors-films, TV, peer group, neighbourhood & school.

Population & Family life education: Population statistics of India, Population Policy of India, Meaning, Need, Importance & objective of Population education., Family life education, determination of sex, techniques, fertilization techniques (Amnio centesis, sonography, Gift, IVF & A.I. Pregnancy & its management)., Need & concept of family planning, contraceptive technology, Planned parenthood-spacing between children, size of family, Child Guidance & Counseling, Meaning, nature & scope & objective of child guidance & counselling service. Types of Guidance & Counselling, Educational, Vocational, Occupational, Personal and Behavioural. Assessment Techniques for study of Behaviour, Interests, aptitude, attitude & delayed Development. Family

Support Services, Meaning, Nature & Scope of Family Support Services, Support Services for children (crèches, day care centers, kishore sadan, observation home & Juvenile Jails).

Support Services for Women: Mahila Ashram, Nari Niketan, Govt, Praveshalaya & Shriahalya, Vidhwa Ashrams, Women Study Centers. Support Services for elderly ;Old age homes, day care for aged, Support Services for family; Family courts, family guidance centers.

PRACTICAL
HSB608: ADVANCED HUMAN DEVELOPMENT
(Credit 2)

1. Visit to various institutions related to special need children.
   - ➢ vaÌ fo|ky;
   - ➢ Deaf and Dumb school
   - ➢ Deva Centre
2. Visit to Child Guidance Counsilling Centre.
3. Practicising various counseling techniques.
4. Visit to community centres and report writing.
5. Visit to Mahila Ashram, Nair Niketan, Widhwa Ashram, women study centre, Observation Home/Juvenile Jails.

<u>References :-</u>

1. Gangrae K.D. (1971), Community Organization in India, Popular Prakashan, New Delhi
2. State of World Children, UNICEF, Annual Publication
3. Parakesh B.S. (1985), Population Education – Inception to Institutionalization, NCERT, New Delhi
4. Bernard H.W. & Fullner D.W., Principles of Guidance, Bombay, Allied Publishers
5. Verma Hildebrand (1985) Guiding Young Children, New York, MacMillan Publishing Company
6. Hallan D.P. & Kauffman T.M. (1991), Introduction to Exceptional Children (5th Ed.), Boston, Allyn & Bacon

Paper – IV
HSB604: CONSUMER PRODUCT, SAFETY AND LEGISLATION
(Credit 3)

Type of Products: Consumer Durables and Non-durables, Consumer Items

Services: Types of services available to Consumers like; Transportation, Health, Education, Communication, Gas distribution, Electricity, Supply, Telephones, Etc., Qualitative Assessments of these services, Role of Standards in Consumer Protections; Meaning of Standards Benefit of Standards to Consumers, Benefit of Standards of Manufacturers (Advantages/disadvantages, if any), Product of Certifications, Role of Certifications, Its advantages consumers

Quality Control and Standardization: Introduction to Quality Control, Advantages/Disadvantages of Quality Control, Application of Quality Control and standardization for products like (Food, Textiles, Consumer durables, Materials and Consumer items), Identification of hazards and accidents; Features of Product safety Liabilities with reference to consumer items

Consumer Protections: Consumer Protection Movements, Importance and Scope of law in consumer protections, Consumer Legislations, Legal Problems in buying and paying for goods and services;

Guarantees, Warrantees, Contracts, Installment sales contract, Approval buying, Cash buying, credit buying, Define, Advantage, Disadvantage of each aspect to consumers), Law Protecting Consumers; Indian Penal Code 1860, Indian Contract Act 1872, Law of Protection of Consumers under the Code of Civil Procedures 1908, The sales of goods act 1930. The agricultural produce (grading + marketing) 1937, Drugs and Cosmetics Act 1940, Drugs and Magic Remedies Act 1954, Prevention of Food Adulteration Act 1954, The Essential Commodities Act 1955, The Protection of Civil Rights Act 1963, The Monopolies and Restrictive trade Practice Act 1969, Protection of Law to Consumer under the Code of Criminal Procedure 1973, Water Prevention and Control of Pollution Act 1974, The Standards of Weights and Measures Act 1976, Preventions of Black Marketing and Maintenance of Supplies of Essential Commodities Act 1980, The Prevention and Control of Pollution Act 1981, The Bureau of Indian Standards Act 1986, The Environment Protection Act 1986, Railway Claim Tribunal Act 1987, Advertising Regulation and Consumer Protection under the Law of Courts 1986, Textile Regulation Act 1988

Role of different Organizations/Agencies towards Consumers: Ministry of Law and Justice, Consumer Guidance Society of India, Consumer Co-operatives, Government and Municipal Agencies, Grahak Panchayats

References

1. Bhatt Gopal, R.(1985): Consumerism Concepts and its need in our era. Indian Journal of Marketing. Vol. 15.
2. Mandam, J. (1974): Indian Market Place, guidelines to consumers education. Brindavan Publishing.
3. Foxall Gordon, R. (1983): Consumer Choice, Macmillan Co., London.
4. Gupta, B.D. (1973): Consumption Pattern in India, Tata McGraw Hill.
5. Publications "Consumer Confrontation". Consumer Education and Research Centre, Ahmedabad.
6. Publication "Keemal" Consumer Guidance Society.
7. Sherlekar, S.A.: Trade Practices and Consumerism, Himalaya Publication House.
8. The Standards of Weight & Measures Act (1976): 5th Edn. 1997. Publisher – Law Publishers (India) Pvt. Ltd.
9. Aggarwal Anju, D. (1989): A Practical handbook for consumers, Bombay, Indian Book House.
10. Bassett, W.H. (1992): Environmental health procedures, 3rd edn., London, Chapman & Hall.
11. Mulchandani, N.M. (1992): consumer protection act (No,. 68 of 1986) with consumer protection rules (central), 1987 with amendments and case-law upto Oct. 1997.
12. Singh Gurbax (comp) (1990): Law of consumer protection, Jaipur, Bharat law publishers.
13. Food adulteration and how to bear it (1988): London, Unwin Paperbacks.
14. The Essential commodities act 1955 with short notes.
15. Majumdar, Ramanuj, (1993): Product management in India, New Delhi, Prentice Hall of India.
16. Raut, K.C. and Nadi, M.K. (1994): Buying behaviour of consumer durables in India, Delhi, Indian Publishers Distributors.

Paper – V

HSB605: STATISTICS AND RESEARCH METHODS (Elective)

(Credit 4)

Elementary Statistics: Nature of investigation, scope, objectives. Sources of data, study tools and Techniques of Research, Frequency distributions, Mean, mode, Median, Probability, Standard deviation, Graphs., Research and Documentation, Different types of research and their application, types all data (Primary and Secondary), methods of data collection, classification and organization of data, editing and coding the data, representation of data diagrammatic and graphic presentation, techniques of construction of diagrams and graphs. Techniques of Research Writing

Seminar- 25 marks

Reference

1. Bhandarkar, P.L. and Willanson T.S. 2000 Methodology and Techniques of Social Research, Himalaya Publishing House, Mumbai.
2. Bhatnagar, G.L. (1990): Research Methods and Measurements in Behavioural and Social Sciences, Agri. Cole Publishing Academy, New Delhi.
3. Stranss, A. and Corbin, H. (1990): Basis of Qualitative Research: Grounded Theory Procedures and Techniques, Saga Publications, California.
4. fÓÕk ,ao euksfoKku esa lkaf[;dh: xsjsV gsujhbZ

B. Sc. (HONS.) MATHEMATICS

Offered By:

Department of Mathematics

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Semester –I		
Course Code	**Title**	**Credits**
MTB 101	Algebra	3
MTB 102	Calculus	3
	Total	**6**
Semester –II		
MTB 201	Statics & Dynamics	3
MTB 202	Multivariable Calculus	3
	Total	**6**
Semester –III		
MTB 301	Differential Equations	3
MTB 302	Tensor & Geometry	3
	Total	**6**
Semester –IV		
MTB 401	Partial Differential Equations	3
MTB 402	Mathematical Methods	3
	Total	**6**
Semester -V		
MTB 501	Analysis-I	3
MTB 502	Abstract Algebra	3
MTB 503	Programming in C	3
MTB 504	Differential Geometry	3
MTB 505	Discrete Mathematics	3
	ELECITIVE – I (Any one of the following courses, each of 3 credits)	3
MTB 506	Combinatorial Mathematics	
MTB 507	Business Mathematics	
MTB 508	Special Theory of Relativity-I	
MTB 509	Computational Mathematics Lab-I	
	Total	**18**
Semester -VI		
MTB 601	Analysis-II	3
MTB 602	Linear Algebra	3
MTB 603	Numerical Analysis	3
MTB 604	Mechanics	3

MTB 605	Operations Research	3
	ELECITIVE – II (Any one of the following courses, each of 3 credits)	3
MTB 606	Number Theory	
MTB 607	Probability	
MTB 608	Advanced Differential Geometry	
MTB 609	Special Theory of Relativity-II	
MTB 610	Computational Mathematics Lab-II.	
MTB 611	**Project**	4
	Total	**22**
	Grand Total	**64**

*More Elective papers can be added subject to the availability of subject experts.

MTB 101   Algebra   Credits : 3

Matrix algebra: Introduction, Elementary operations of matrices. Inverse of a matrix. Rank of a matrix. Application of matrices to the system of linear equations, Consistency of the system.

Algebra: Definition of a group with examples and simple properties, Subgroups, Generation of groups, Cyclic groups, Coset decomposition, Lagrange's theorem and its consequences. Homomorphism and Isomorphism. Permutation groups and Cayley's theorem. Normal subgroups, Quotient group, Fundamental theorem of Homomorphism. The Isomorphism theorems for groups.

Recommended Books:

1. I. N. Herstein , Topics in Algebra, Wiley Eastern Ltd. New Delhi, 1975.
2. D.T. Finkbeiner, Introduction to Matrices and Linear transformations, CBS Publishers, New Delhi, 1986.
3. K.B. Datta, Matrix and Linear Algebra, PHI Pvt. Ltd. New Delhi, 2000.
4. P.B. Bhattacharya, S.K.Jain , S.R. Nagpal, First Course in Linear Algebra, Wiley Eastern Ltd. New Delhi, 1983.
5. S. Singh, Modern Algebra, Vikas Publ. House, India.

MTB 102   Calculus   Credits : 3

Differential Calculus: Successive differentiation and Leibnitz theorem. Limit (ε-δ definition), Continuity, Discontinuity, properties of continuous functions. Differentiability, Chain rule of differentiation, Mean value theorems, Taylor's and Maclaurin theorems. Application of differential calculus in curve sketching.

Integral Calculus: Definite Integral as the limit of sum.

Recommended Books:

1. Gorakh Prasad, Differential Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
2. Gorakh Prasad, Integral Calculus, Pothishala Pvt. Ltd. Allahabad, 2000.
3. Gabriel Klambauer, Mathematical Analysis, Marcel Dekkar Inc. New York 1975.
4. Shanti Narayan, Elements of Real Analysis, S. Chand & Company, New Delhi.

MTB 201   Statics & Dynamics   Credits : 3

Statics: Analytic condition of equilibrium for coplanar forces. Equation of the resultant force. Virtual work.

Dynamics: Rotation of a vector in a plane. Velocity and acceleration components in Cartesian, polar and intrinsic systems. Central orbit, Kepler's laws of motion, rectilinear simple harmonic motion. Vertical motion on circular and cycloidal curves.

Motion with respect to linearly moving and rotating plane. Coriolis force and centrifugal force.

Recommended Books:

1. R.S. Verma - A Text Book on Statics., Pothishala Pvt. Ltd., Allahabad
2. S.L. Loney - An Elementary Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
3. J.L. Synge & B.A. Griffith - Principles of Mechanics, Tata McGraw-Hill, 1959.

MTB 202   Multivariable Calculus   Credits : 3

Functions of Two Variables: Limit, Continuity, Differentiability. Partial differentiation, Change of variables, Euler's, Taylor's theorem. Maxima and minima. Double and triple integrals, Change of order in double integrals. Beta and Gamma functions

Vector Calculus: Gradient, Divergence and Curl. Greens, Stokes and Gauss Theorems with applications.

Recommended Books:
1. Shanti Narayan, A Text Book of Vector Calculus, S. Chand & Company, New Delhi.
2. S. C. Mallik, Mathematical Analysis, Wiley Eastern Ltd, New Delhi.
3. Gabriel Klaumber, Mathematical Analysis, Marcel Dekkar, New York 1975.
4. G.B. Thomas, R. L. Finney, M. D. Weir, Calculus and Analytic Geometry, Pearson Education Ltd, 2003.
5. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 1999.

Semester –III

MTB 301   Differential Equations   Credits : 3

Ordinary differential equations of first order: initial and boundary conditions, homogeneous equations, linear equations, Exact differential Equation. First order higher degree equations solvable for x, y, p. Singular solution and envelopes.

Linear differential equations with constant coefficients, homogeneous linear differential equations, linear differential equations of second order with variable coefficients.

Series solutions of differential equations. Bessel and Legendre equations. Bessel and Legendre functions.

Recommended Books:
1. Gorakh Prasad, Integral Calculus, Pothishala Private Ltd. Allahabad.
2. S. Balachandra Rao & H.R. Anuradha, Differential Equations with Applications and Programmes, University Press, Hyderabad, 1996.
3. R.S. Senger, Ordinary Differential Equations with Integration, Prayal Publ. 2000.
4. D.A. Murray, Introductory Course in Differential Equations, Orient Longman (India), 1967.
5. E.A. Codington, An Introduction to Ordinary Differential Equations, Prentice Hall of India, 1961.
6. B.Rai, D.P.Choudhary,Ordinary Differential Equations, Narosa Publ. 2004.

MTB 302   Tensor &Geometry   Credits : 3

Contravariant and Covariant vectors, Transformation formulae, Symmetric and Skew symmetric properties, Contraction of tensors, Quetient law.

Polar equation of a conic, Sphere, Cone, Cylinder, Paraboloids, Central Conicoids.

Recommended Books:
1. Barry Spain, Tensor Calculus, Radha Publ. House Calcutta,1988.
2. R.S. Mishra, A Course in Tensors with Applications to Reimannian Geometry. Pothishala Pvt. Ltd, Allahabad.
3. R.J.T. Bell, Elementary Treatise on Co-ordinate geometry of three dimensions, Macmillan India Ltd., 1994.
4. Shanti Narayan, Analytical Solid Geometry, S. Chand & Company, New Delhi.

Semester –IV

MTB 401   Partial Differential Equations   Credits : 3

Linear partial differential equations of first order. Non linear PDE of first order: Charpit's method.

Linear partial differential equation of second and higher order of homogeneous and non homogeneous forms with constant coefficients. Second order PDE with variable coefficients. Monge's method. Solution of heat and wave equations in one and two dimensions by method of separation of variables.

Recommended Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
2. Ian N. Sneddon, Elements of Partial Differential Equations, McGraw-Hill Book Company, 1988.
3. S.B. Rao and H.R. Anuradha, Differential Equations, University Press, 1996.
4. W.T.H. Piaggio, Elementary Treatise on Differential Equations and their applications, CBS Publishers N.Delhi,1985.

MTB 402   Mathematical Methods   Credits : 3

Integral Transforms: Laplace Transformation, Laplace Transforms of derivatives and integrals, shifting theorems, differentiation and integration of transforms, convolution theorem. Application of Laplace transform in solution of ordinary differential equations. Fourier series expansion.

Calculus of Variations: Functionals, Deduction of Euler's equations for functionals of first order and higher order for fixed boundaries. Shortest distance between two non-intersecting curves. Isoperimetric problems. Jacobi and Legendre conditions (applications only).

Recommended Books:
1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Son Inc., New York, 1999.
2. N. Kumar, An Elementary Course on Variational Problems in Calculus, Narosa Publications , New Delhi.
3. A.S. Gupta, Text Book on Calculus of Variation, Prentice-Hall of India.
4. S.G. Deo, V Lakshmikanthna & V. Raghavendra, Text Book of Ordinary Differential Equations, Tata McGraw-Hill.

5. F.B. Hilderbrand, Advanced Calculus for Applications, PHI, New Delhi, 1997.
6. B. Rai, D.P. Choudhary, H.I. Freedman, Ordinary Differential Equations, Narosa Publ, 2002.

Semester –V

MTB 501   Analysis-I   Credits : 3

Riemann Integral, Integrability of continuous and monotonic functions, Fundamental theorems of integral calculus, Mean Value theorems of integral calculus.

Improper integrals and their convergence. Comparison test, Abel's and Dirichlet's test, Integral as a function of a parameter and its applications.

Sequences, Theorems on limits of sequences, Monotone convergence theorem, Cauchy's convergence criterion. Infinite series, series of non-negative terms. Comparison test, Ratio test, Rabbe's, logarithmic, De Morgan and Bertrand's tests. Alternating series, Leibnitz's theorem.

Recommended Books:
1. Shanti Narayan, A Course of Mathematical Analysis. S. Chand & Co. New Delhi.
2. T. M. Apostol, Mathematical Anslysis, Narosa Publishing House, New Delhi, 1985.
3. R.R. Goldberg, Real Analysis, Oxford & IBH Publishing Co., New Delhi, 1970.
4. S. Lang, Undergraduate Analysis, Springer-Verlag, New York, 1983.
5. P.K. Jain and S.K. Kaushik, An Introduction to Real Analysis, S. Chand & Co., New Delhi, 2000.

MTB 502   Abstract Algebra   Credits : 3

Automorphism and inner automorphism, Automorphism groups and their computations. Normalizer and centre, Group actions, stabilizers and orbits. Finite groups, Commutator subgroups. Rings, Integral Domains and Fields. Ideal and quotient Rings. Ring Homomorphism and basic isomorphism theorems. Prime and maximal ideals. Fields of quotients of an integral domain. Principal ideal domains. Polynomial Rings, Division algorithm. Euclidean Rings, The ring Z[i].

Recommended Books:
1. P.B. Bhatacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra (2nd Edition) Cambridge University Press, Indian Edition, 1977.
2. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
3. N. Jacobson, Basic Algebra, Vol I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company)

MTB 503   Programming in C   Credits: 3

C fundamentals. Constants, Variables and Data types, Operators and expression, formatted input and output. Decision makings, Branching and Looping. Arrays. User defined functions. Structures. Pointers. File handling. Programming based on above.

Recommended Books:
1. B.W. Kernighan and D.M. Ritchie, The C Programming Language 2nd Edition, (ANSI features) Prentice Hall, 1989.
2. V. Rajaraman, Programming in C, Prentice Hall of India, 1994.
3. Byron S. Gotfried, Theory and Problems of Programming with C, Tata McGraw-Hill, 1998.
4. Henry Mullish & Herbert L. Cooper, Spirit of C: An introduction to Modern Programming, Jaico Publishers, Bombay.
5. E. Balagurusamy, Programming in ANSI C, Tata McGraw Hill New Delhi.

MTB 504   Differential Geometry   Credits : 3

Theory of space curves: Space curves, Planer curves, Serret-Frenet formulae. Osculating circles and spheres. Existence of space curves and evolutes and involutes.

Theory of surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines. Developables, Developable associated with space curves, Developable associated with curves on surfaces. Minimal surfaces.

Recommended Books:
1. T.J. Willmore - An Introduction to Differential Geometry. Oxford University Press.1965.
2. B. B. Sinha, Differential Geometry, An Introduction. Shyam Prakashan Mandir Allahabad, 1978.
3. J.A. Thorpe, Introduction to Differential Geometry, Springer-Verlog.
4. M. Docarmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976.
5. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge Univ. Press, 1955.

MTB 505   Discrete Mathematics   Credits : 3

Lattices and Boolean algebra: Logic: propositional and predicate. lattices as partially ordered sets and as algebraic systems. Duality, Distributive, complemented and complete lattices. Lattices and Boolean Algebra. Boolean functions and expressions. Application of Boolean algebra to switching circuits(using AND, OR and NOT gates)

Graphs and Planar Graphs: Graph, Multigraph, Weighted Graphs, Directed graphs. Paths and circuits. Matrix representation of graphs. Eulerian Paths and Circuits. Planar graphs.

Recommended Books:
1. C.L. Liu, Elements of Discrete Mathematics, (Second Edition), McGraw Hill, International Edition, 1986.
2. J.P. Tremblay and R. Manohar, Discrete Mathematical Structures with Applications to Computer Science, McGraw-Hill Book Co., 199
3. S. Wiitala, Discrete Mathematics: A Unified Approach, McGraw-Hill Book Co.
4. N. Deo, Graph Theory with Applications to Computer Science, Prentice-Hall of India,

ELECTIVE -I   **Credits : 3**

(Any one of the following 3 credit courses: MTB 506 - MTB 509)

MTB 506   Combinatorial Mathematics

Introduction to Basic ideas. Selection and Binomial Coefficients: Permutations, Ordered selections, Unordered selections, Remarks on Binomial theorem.

Pairing problems: Pairing within a set, Pairing between sets, an optimal assignment problem, Gale's optimal assignment problem.

Recurrence: Fibonacci type relations, using generating functions, Miscellaneous methods.

Inclusion-Exclusion principle: The Principle, Rook polynomials.

Block Diagram and Error- correction Codes: Block designs, Square block designs, Hadanard Configurations, Error Correcting Codes. Steiner Systems. Golay's Perfect code.

Recommended Books:

1. Ian Anderson, A First course in Combinatorial Mathematics, Springer, 1989.

MTB   507   Business Mathematics

Financial Management: Financial Management. Goals of Financial Management and main decisions of financial management. Time Value of Money: Interest rate and discount rate. Present value and future value-discrete case as well as continuous compounding case. Annuities and its kinds.

Meaning of return. Return as Internal Rate of Return (IRR). Numerical Methods like Newton Raphson Method to calculate IRR. Measurement of returns under uncertainty situations. Meaning of risk. Difference between risk and uncertainty. Types of risks. Measurements of risk. Calculation of security and Portfolio Risk and Return-Markowitz Model. Sharpe's Single Index Model Systematic Risk and Unsystematic Risk.Taylor series and Bond Valuation. Calculation of Duration and Convexity of bonds.

Mathematics in Insurance: Insurance Fundamentals - Insurance defined. Meaning of loss. Chances of loss, peril, hazard, and proximate cause in insurance. Costs and benefits of insurance to the society and branches of insurance-life insurance and various types of general insurance. Insurable loss exposures-feature of a loss that is ideal for insurance. Life Insurance Mathematics. Construction of Mortality Tables. Computation of Premium of Life Insurance for a fixed duration and for the whole life.

Recommended Books:

1   Aswath Damodaran, Corporate Finance - Theory and Practice. John Wiley & Sons. Inc.

2. John C. Hull, Options, Futures, and Other Derivatives, Prentice-Hall of India Private Limited.

3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.

4. Mark S. Dorfman, Introduction to Risk Management and Insurance, Prentice Hall, Englwood Cliffs, New Jersey.

5. C.D. Daykin, T. Pentikäinen and M Pesonen, Practical Risk Theory for Actuaries, Chapman & Hall.

MTB 508   Special Theory of Relativity-I

Review of Newtonian mechanics: Inertial frames. Speed of light and Gallilean relativity. Michelson-Morley experiment. Lorentz-Fitzgerold contraction hypothesis. Relative character of space and time. Postulates of special theory of relativity. Lorentz transformation equations and its geometrical interpretation. Group properties of Lorentz transformations.

Relativistic kinematics: Composition of parallel velocities. Length contraction. Time dilation. Transformation equations for components of velocity and acceleration of a particle and Lorentz contraction factor.

Geometrical representation of space-time: Four dimensional Minkowskian space-time of special relativity. Time-like, light-like and space-like intervals. Null cone, Proper time. World line of a particle. Four vectors and tensors in Minkowiskian space-time.

Recommended Books:

1. C. Moller, The Theory of Relativity, Oxford Clarendon Press, 1952.
2. P.G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.
3. J.L. Anderson, Principles of Relativity Physics, Academic Press, 1967.
4. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.
5. V. A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979.
6. R. Resnick, Introduction to Special Relativity, Wiley Eastern Pvt. Ltd. 1972.
7. J.L. Synge, Relativity : The Special Theory, North-Holland Publishing Company, 1956.
8. W.G. Dixon, Special Relativity : The Foundation of Macroscopic Physics, Cambridge University Press, 1982.

MTB 509   Computational Mathematics Lab-I

The student is expected to familiarize with popular software's for numerical computation. Real life problems requiring knowledge of numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems/ writing computer program in a programming language. To this end software's like MATLAB, MATHEMATICA, MAPLE can be adopted with following course outline.

1. Plotting of functions.
2. Matrix operations, vector and matrix manipulations, Matrix Computation and its applications.
3. Data analysis and curve fitting.
4. Solution of equations.
5. 2-D Graphics and 3-D Graphics - general purpose graphics functions, colour maps and colour controls.
6. Examples : Number theory,

References :

1. MATLAB - High performance numeric computation and visualization software : User's Guide.
2. MATHEMATICA - Stephen Wolfram, Cambridge.

Semester –VI

MTB 601   **Analysis-II**   **Credits : 3**

Complex Analysis: Analytic functions, Harmonic functions, Elementary functions. Mapping by elementary functions, Mobius transformations, Conformal mappings.

Metric spaces: Introduction. Neighbourhood, limit points, interior points, open and closed set, closure and interior, boundary points. Subspace of a metric space, Completeness. Cantor's intersection theorem. Construction of real numbers as the completion of the incomplete metric space of rationals.

Dense subsets. Separable metric spaces. Continuous functions. Uniform continuity, Isometry and homeomorphism. Equivalent metrics.

Recommended Books:

1. Shanti Narayan, Theory of Functions of a Complex Variable, S. Chand & Co. New Delhi.
2. E. T. Copson, Metric Spaces, Cambridge University Press, 1968.
3. R.V. Churchil & J.W. Brown, Complex Variables and Applications, 5th Edition, McGraw-Hill, New York, 1990.
4. Mark J., Ablowitz & A.S. Fokas, Complex Variables: Introduction and Applications, Cambridge University Press. South Asian Edition, 1998.
5. P.K. Jain and K. Ahmad, Metric Spaces, Narosa Publishing House, New Delhi, 1996

MTB 602   **Linear Algebra**   **Credits : 3**

Vector spaces, subspaces and linear spans, linear dependence and independence. Finite dimensional vector spaces. Linear transformations and their matrix representations. Algebra of linear transformations, the rank and nullity theorem. Change of basis. Dual spaces, bi dual space and natural isomorphism. Eigen values and eigen vectors of LT. Diagonalization, Cayley Hamilton theorem.

Inner product spaces, Cauchy-Schwarz inequality, orthogonal vectors. Orthonormal basis, Bessel's inequality, Gram-Schmidt orthogonalization process.

Recommended Books:

1. N. Herstain, Topics in Algebra, Wiley Eastern Ltd., New Delhi, 1975.
2. K. Hoffman and R. Kunze, Linear Algebra, 2nd edition, Prentice-Hall of India, New Delhi, 1971.
3. N. Jacobson, Basic Algebra, Vols I & II, W.H. Freeman, 1980 (also published by Hindustan Publishing Company).
4. K.B. Dutta, Matrix and Linear Algebra, Prentice Hall of India Pvt. Ltd, New Delhi, 2000.
5. I.S. Luther and I.B.S. Passi, Algebra, Vol. I - Groups, Narosa Publishing House, Vol. I 1996.

MTB 603 **Numerical Analysis** **Credits : 3**

Numerical solutions of algebraic equations, Interpolation, Numerical differentiation. Numerical Quadrature. System of linear equations. Eigen value computation. Numerical solution to ordinary differential equations of first order.

Recommended Books:

1. M.K. Jain, S.R.K. Iyengar, R.K. Jain, Numerical Methods for Scientific and Engineering Computation, New Age International, 1999.
2. C.F. Gerald, P.O. Wheatley, Applied Numerical Analysis, Addison-Wesley, 1998.
3. S. D. Conte, C de Boor, Elementary Numerical Analysis, McGraw-Hill, 1980.
4. C.E. Froberg, Introduction to Numerical Analysis, (Second Edition), Addition-Wesley, 1979.
5. Melvin J. Maron, Numerical Analysis A Practical Approach, Macmillan Publishing Co. Inc. New York, 1982.

MTB 604 **Mechanics** **Credits : 3**

Satatics: Analytic conditions of equilibrium in 3-dimension. Poinsot's central axis. Stable and unstable equilibrium.

Dynamics: Moment of inertia, Equimomental systems, Principle axes. D'Alemdert's principle for motion of rigid body-linear and rotation for finite and impulsive forces. Conservation of momentum and energy. Compound pendulum. Reaction of axis of rotation. Kinetic energy and angular momentum for motion in two dimensions.

Recommended Books:

1. S.L. Loney, An Elementary Treatise on Statics, Kalyani Publishers, New Delhi.
2. S.L. Loney, An Elementray Treatise on the Dynamics of a Particle and of Rigid Bodies, Kalyani Publishers, New Delhi.
3. J.L. Synge, B.A. Griffith, Principles of Mechanics, McGraw-Hill, 1959.
4. N.C. Rana and P.S. Joag, Classical Mechanics, Tata McGraw-Hill, 1991.

MTB 605 **Operations Research** **Credits : 3**

Linear Programming problem, Convexity, Simplex and Revised Simplex algorithm, Duality theory, Dual simplex. Transportation, Assignment and Traveling Salesman problems. Portfolio Theory, Principle of Optimality and its applications.

Recommended Books:

1. G. Hadley, Linear Programming, Narosa Publishing House, 1995.
2. S.I. Gass, Linear Programming: Methods and Applications (4th edition) McGraw-Hill, New York, 1975.
3. Kanti Swaroop, P.K. Gupta and Man Mohan, Operations Research, Sultan Chand & Sons, New Delhi, 1998.
4. Hamdy A. Taha, Operations Research, Prentice-Hall of India, 1997.

ELECTIVE -II Credits : 3

(Any one of the following 3 credit courses: MTB 606 - MTB 610)

MTB 606 Number Theory

Primes and factorization. Division algorithm. Congruence and modular arithmetic. Chinese remainder theorem. Euler phi function. Primtive roots of unity. Quardratic law of reciprocity, application. Arithmetical functions. Mobius inversion formula. The Diophantine equations $x^2 + y^2 = z^2$, $x^4 + y^4 = z^4$. Farey sequences.

Recommended Books:

1   David M. Burton, Elementary Number Theory, Wm. C. Brown Publishers, Dubuque, Iowa 1989.
2   K. Ireland, and M. Rosen, A Classical Introduction to Modern Number Theory, GTM Vol. 84, Springer-Verlag, 1972.
3   G.A. Jones, and J.M. Jones, Elementary Number Theory, Springer-Verlag, 1998.
4   W. Sierpinski, Elementary Theory of Numbers, North-Holland, Ireland, 1988.
5   Niven, S.H. Zuckerman, and L.H. Montgomery, An Introduction to the Theory of Numbers, John Wiley, 1991.
6   H.B. Mann, Addition Theorems, Krieger, 1976.
7   Melvyn B. Nathanson, Additive Number Theory: Inverse Problems and the Geometry of Sumsets, Springer-Verlag, 1996.

MTB 607 Probability

Notion of probability: Random experiment, sample space, axiom of probability, elementary properties of probability, equally likely outcome problems.

Random Variables: Concept, cumulative distribution function, discrete and continuous random variables, expectations, mean, variance, moment generating function.

Discrete random variables: Bernoulli random variable, binomial random variable, geometric random variable, Poisson random variable.

Continuous random variables: Uniform random variable, exponential random variable, Gamma random variable, normal random variable.

Conditional probability and conditional expectations, Baye's theorem, independence, computing expectation by conditioning; some applications - a list model, a random graph, Polya's urn model.

Bivariate random variables: Joint distribution, joint and conditional distributions, the correlation coefficient.

Functions of random variables: Sum of random variables, the law of large numbers and central limit theorem, the approximation of distributions.

Uncertainty, information and entropy, conditional entropy, solution of certain logical problems by calculating information.

Recommended Books:

1   S.M. Ross, Introduction to Probability Models (Sixth edition) Academic Press, 1997.
2. I. Blake, An Introduction to Applied Probability, John Wiley & Sons, 1979.
3. J. Pitman, Probability, Narosa, 1993.
4. A.M. Yagolam and I.M. Yagolam, Probability and Information, Hindustan Publishing Corporation, Delhi, 1983.

MTB 608   Advanced Differential Geometry

Geodesics. Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

Elements of general Riemannian Geometry: Reimannian metric, Tensor fields. Covariant differentiation. Symmetric properties of curvature tensor. Concept of affine connection. Christoffel symbols. Curvature and torsion tensors. Riemannian metric and affine connection. Geodesic and normal coordinates. Fundamental theorem of Riemannian geometry. Divergence, Curl and gradient.

Recommended Books:

1.   J.A. Thorpe, Introduction to Differential Geometry, Springer-Verlog.
2.   M. Docarmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976.
3. C.W. Weatherburn, Differential Geometry of Three Dimensions. Cambridge Univ. .Press, 1955.
4.   T.J. Willmore - An Introduction to Differential Geometry. Oxford University Press.
5.   R.S. Mishra, A Course in Tensors with Application to Riemannian Geometry, Pothishala Pvt. Ltd. Allahabad.
6.   B. B. Sinha, Differential Geometry, An Introduction, Shyam Prakashan Mandir, Allahabad, 1978.

MTB 609   Special Theory of Relativity-II

Relativistic mechanics - Variation of mass with velocity. Equivalence of mass and energy. Transformation equations for mass momentum and energy. Energy-momentum four vector. Relativistic force and Transformation equations for its components. Relativistic Lagrangian and Hamiltonian. Relativistic equations of motion of a particle. Energy momentum tensor of a continuous material distribution.

Electromagnetism - Maxwell's equations in vacuo. Transformation equations for the densities of electric charge and current. 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. Maxwell's equations in tensor form. Lorentz force on a charged particle. Energy momentum tensor of an electromagnetic field.

Recommended Books:

1.   C. Moller, The Theory of Relativity, Oxford Clarendon Press, 1952.
2.   P.G. Bergmann, Introduction to the Theory of Relativity, Prentice Hall of India, 1969.

3. J.L. Anderson, Principles of Relativity Physics, Academic Press, 1967.
4. W. Rindler, Essential Relativity, Van Nostrand Reinhold Company, 1969.
5. V. A. Ugarov, Special Theory of Relativity, Mir Publishers, 1979.
6. R. Resnick, Introduction to Special Relativity, Wiley Eastern Pvt. Ltd. 1972.
7. J.L. Synge, Relativity : The Special Theory, North-Holland Publishing Company, 1956.
8. W.G. Dixon, Special Relativity : The Foundation of Macroscopic Physics, Cambridge University Press, 1982.

MTB 610   Computational Mathematics Lab-II

The student is expected to familiarize with popular software's for numerical computation and optimization. Numerical algorithms for linear and nonlinear algebraic equations, Eigen value problems, Finite difference methods. Differentiation; Integration Ordinary differential equations etc. should be attempted.. The objective of such a laboratory is to equip students to model and simulate systems using optimization modelling languages/programming languages. To this end software's like MATLAB, LINDO, MATHEMATICA, MAPLE can be adopted with following course outline.

1. Numerical integration.
2. Nonlinear Equations and Optimization functions.
3. Differential equations.
4. Sparse Matrices - Iterative methods for sparse linear equations, Eigen values of sparse matrices, Game of life.
5. Linear Programming, Integer Programming and Quadratic Programming - Modelling and Simulation Techniques.

References

1. MATLAB - High performance numeric computation and visualization software : User's Guide.
2. MATHEMATICA - Stephen Wolfram, Cambridge.
3. Optimization Modelling with LINDO : Linus Scharge.

MTB 611   Project   Credits: 4

Some innovation in form of the written project, in Mathematics/application of Mathematics, based on the knowledge gained during the under graduate course of studies in view of the developments in Mathematics.

B. Sc. (HONS.) PHYSICS

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Physics

Faculty of Science

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Semester	Course	Title	Credits
I	BPT-101	Mechanics and Relativity	4
	BPL-101	Practical	2
		Total	**6**
II	BPT-201	Thermal Physics	4
	BPL-201	Practical	2
		Total	**6**
III	BPT-301	Optics	4
	BPL-301	Practical	2
		Total	**6**
IV	BPT-401	Electromagnetic Theory and Basic Electronics	4
	BPL-401	Practical	2
		Total	**6**
V	BPT-501	Mathematical Physics	3
	BPT-502	Classical Mechanics	3
	BPT-503	Quantum Mechanics	3
	BPT-504	Electronic Devices and Circuits	3
	BPL-501	Practical	3
	BPL-502	Practical	3
		Total	**18**
VI	BPT-601	Statistical Mechanics	3
	BPT-602	Solid State Physics	3
	BPT-603	Elements of Nuclear Physics	3
	BPT-604	Atomic Physics and Laser	3
	BPL-601	Practical	3
	BPL-602	Practical	3
	BPP-601	Project OR One of the elective papers given below:	4
	BPE-601	Topics in Modern Physics	4
	BPE-602	Elementary Nanoscience and Exotic Materials	4
		Total	**22**

BPT-101: MECHANICS AND RELATIVITY   *Credits: 4*

Mechanics:

Inertial and non-inertial frames of reference, Effect of centrifugal and Coriolis forces due to earth's rotation, Center of mass (C.M), Lab and C.M frame of reference, motion   of CM of system of particles subject to external forces, elastic, and inelastic collisions in one and two dimensions, Scattering angle in, the laboratory frame of reference, Impact parameter, Scattering cross section, Conservation of linear and angular momenta.

Relativity:

Postulates of special theory of relativity, Derivation of Lorentz transformation and physical significance of Lorentz invariance, Length contraction and time dilation, Concept of simultaneity, Relativistic velocity transformation relations, mass energy relation, Concept of zero rest mass of photon, Relativistic relation between energy and momentum.

Mechanical Properties of Matter:

Modulus of rigidity, Poisson's ratio, relation connecting different elastic-   constants, twisting couple of a cylinder(solid and hallow), Statical method (Barton's method), Dynamical method (Maxwell's needle) for determining the modulus of rigidity, Bending moment, Cantilever (neglecting   mass),   Young   modulus   by   bending   of   beam, Viscosity, Poiseulle's equation of liquid flow through a narrow tube, Damped harmonic oscillations, Compound pendulum, Ballistic galvanometer.

Reference Books:
1. Physics Part –1: Resanick and Halliday.
2. Mechanics : D.S.Mathur.
3. Concept in Physics Vol. I : H.C.Verma.
4. Mechanics : R.K.Shukla and Anchal Srivastava.

BPT-201: THERMAL PHYSICS   Credits: 4

Kinetic Theory:

Maxwell's speed distribution, Mean free path, Elementary treatment of transport phenomena, Viscous flow and Thermal conducion in gases.

Real gases, Andrew's curves, Equation of state, Virial coefficients, Van der Waals equation, Critical constants.

Thermodynamics:

Reversible and irreversible processes, Examples of thermal, mechanical and chemical irreversibility, Carnot's cycle and Carnot's theorem. Second law of thermodynamics, Thermodynamic scale of temperature.

Concept of entropy, Entropy change in reversible and irreversible processes. Entropy and disorder, Principle of increase of entropy, Entropy and unavailable energy, Entropy of ideal gases, Entropy as a thermodynamic variable, S-T diagram

Thermodynamic functions, Internal energy, Enthalpy, Helmholtz function and Gibb's free energy, Maxwell's thermodynamical equations and their applications, TdS equations, Energy and heat capacity equations

Clapeyron equations, Application to sublimation, vaporization and freezing processes, Heat capacity of saturated vapours, Thermodynamics of liquid surfaces and paramagnetic solids. Adiabatic demagnetization, Third law of thermodynamics, Nernst heat theorem.
Criterion of equilibrium of a system, Isolated system, System in contact with constant temperature reservoir. System in contact with constant temperature and pressure reservoir, Phase transition, Coexistence of phases, Triple point.

Joule-Thomson effect, Thermodynamic analysis, Inversion temperature, Thermodynamic equations for a Van der Waals gas. Liquefaction of gases. Regenerative principle, Properties of liquid helium, Introduction to superfluidity and superconductivity.

Radiation:
The blackbody spectrum, Wien's displacement law, Rayleigh-Jean's law, Planck's quantum theory of radiation.

Reference Books:
1. Heat and Thermodynamics: K.W. Zeemansky.
2. Thermal Physics: B.K. Agarwal.
3. Heat and Thermodynamics: Brij Lal and N. Subramanyam.
4. Heat and Thermodynamics: Dayal, Verma and Pandey.
5. A Treatise on Heat: M.N. Saha and B.N. Srivastava.

BPL-101 & BPL-201: List of Experiments*   Credits: 2

Group I

1. Determination of Stefan's constant.
2. PN junction diode and Zener diode characteristics.
3. Determination of Young's modulus, modulus of rigidity and Poisson's ratio of material of a wire using Searle's method.
4. Determination of absolute capacity of a condenser.
5. Determination of Young's modulus of material of a metallic bar by bending of beam method.
6. To study series and parallel resonant L. C. R. circuit.
7. Determination of acceleration due to gravity using compound pendulum.

8. Determination of focal length of combination of lenses and nodal distance using nodal slide assembly.
9. Solar cell experiment.

Group II

1. Determination of internal resistance of micro ammeter and conversion of micro ammeter into voltmeter, milliammeter and Ohmmeter.
2. Determination of modulus of rigidity using Bortron's apparatus.
3. Construction of two-input 'OR' and 'AND' gates using diode logic and preparation of their truth tables.
4. Determination of viscosity of liquid using Poiseuille's method.
5. To study variation of magnetic field along the axis of Helmholtz Galvanometer and to determine reduction factor.
6. Determination of resistance per unit length and an unknown resistance using C. F. Bridge.
7. Determination of dispersive power of material of a prism.
8. Determination of temperature coefficient of resistance of material of a given coil.
9. Determination of thermal conductivity of a card-board by Lee's disc method.

* In Semester-I, half of the students will do the experiments of Group-I and the other half will do the experiments of Group-II. In Semester II, the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

BPT-301: OPTICS   *Credits: 4*

Interference:
Conditions for sustained interference, Theory of interference, Lloyd's mirror, Achromatic fringes. Interference in parallel and wedge shaped films, Colour of thin films. Newton's rings and Michelson interferometer and their applications. Multiple beam interference in parallel film and Fabry-Perot interferometer.

Diffraction:
Frenel's diffraction, Zone plate, diffraction due to straight edge. Fraunhoffer diffraction due to single and double slits, plane transmission grating and its resolving power.

Polarization:
Polarized light and its mathematical representation, Production of polarized light by reflection, refraction and scattering. Polarization by double refraction and Huygen's theory, Nicol prism, Retardation plates, Production and analysis of circularly and elliptically polarized light. Optical activity and Fresnel's theory, Biquartz polarimeter.

Reference Books:
1. Physical Optics: B. K. Mathur and T. P. Pandya.
2. A textbook of Optics: N. Subrahmanyam, Brijlal and M. N. Avadhanulu.

3. Geometrical and Physical Optics: Longhurst.
4. Introduction to Modern Optics: G. R. Fowels.
5. Optics: P. K. Srivastav.

BPT-401: ELECTROMAGNETIC THEORY AND BASIC ELECTRONICS   Credits: 4

Vector Calculus:
Gradient, divergence and curl operators; Introduction to Gauss's divergence and Stoke's theorem.

Electromagnetism:
Laws of Electromagnetism using vector calculus; electrostatics and magnetostatics in matter, concepts of electric and magnetic polarizations, bound charges and currents; electrodynamics and displacement current, Maxwell's equations in integral and differential forms; Concepts of vector and scalar potentials, and gauge transformations, Poynting vector, energy and momentum conservation.

EM wave propagation:
EM wave equations and their solutions; Polarization; Propagation of plane EM waves in free space, dielectrics (absorption coefficient) and conductors (skin depth and plasma frequency): Laws of reflection, transmission at normal and oblique incidence in linear media and conducting media (Fresnel's equations and Brewster's angle); Elementary ideas of wave guides (TE, TM modes and cut-off frequency) and coaxial transmission line.

Physics of Semiconductors:
P-N junction diode, depletion width and potential barrier, junction capacitance, I-V characteristics, Rectifier, ripple factors, filter circuits, efficiency and percentage regulation, LED, photodiode.

Transistor circuits, Input, Output characteristics and CB and CE modes, Early effect, $\propto$ and β parameters; DC load line, operating point, biasing and bias-stabilization circuits: Transistor as an amplifier (CE mode) and frequency response.

Reference Books:
1. Introduction to Electrodynamics (3rd Edition): David J. Griffiths.
2. EM Waves and Fields: P. Lorrain and O. Corson.
3. Electronic Devices and Circuits: J. Millman and C. Halkias.
4. Electronics Fundamental and Application: D. Chattopadhyay and P.C. Rakshit.

BPL-301 & BPL-401: LIST OF EXPERIMENTS*   Credits: 2

Group-I

1. Determination of wavelength of sodium yellow line by Fresnal's Biprism.
2. Determination of specific rotation of cane sugar by polarimeter.
3. Determination of wavelength of mercury lines by diffraction grating.

4. Determination of minimum resolution power of a telescope to distinguish two close objects at a large distance.
5. Determination of self inductance of a coil by Anderson's bridge.
6. To draw characteristic curves of a triode valve.
7. To determine the velocity of ultrasonic waves
8. To determine the wavelength of Balmer line of hydrogen atom

Group-II

1. Determination of wavelength of sodium yellow line by Newton's rings.
2. To determine the Plank's constants by Wein's radiation formula using an LDR.
3. To determine diameter/thickness of a thin wire by diffraction method.
4. Measurement of energy band gap of Si using a p-n junction diode.
5. Determination of mutual inductance of a pair of coils.
6. Phase shift between the current and the applied voltage in (a) C.R., (b) L.R. (c) L.C.R. circuits using a CRO and an oscillator.
7. To draw the input and output characteristics of a p-n-p transistor.
8. Resolving power of prism

* In Semester-III, half of the students will do the experiments of Group-I and the other half will do the experiments of Group-II. In Semester IV, the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

BPT-501: MATHEMATICAL PHYSICS   *Credits: 3*

Curvilinear Coordinates:

Orthogonal curvilinear coordinates; concept of a metric, spherical and cylindrical coordinates and their unit vectors.

Tensor Analysis:

Introduction to tensors, Cartesian, covariant and contravariant tensors; contractions and direct-products, Examples: pseudo, dual, isotropic, symmetric and anti-symmetric tensors.

Matrices:

Hermitian, orthogonal and unitary matrices, inverse of a matrix, similarity transformations, Eigenvalue problems and diagonalization of matrices (Examples: non-degenerate and degenerate cases).

Differential Equations:

Second order homogeneous differential equations and their series solution (example: Bessel equation), linear independence of two solutions (Wronskian), Integral and power series methods for second solution.

Special Functions:

Bessel, Legendre (spherical harmonics), Hermite and Laguerre: generating functions and recurrence relations, orthonormality conditions, Dirac delta function,

Fourier Analysis:

Fourier theorem, Fourier analysis of square wave, saw-tooth wave, plucked strings, half wave/full wave rectifier wave forms

Reference Books:
1. Mathematical Methods for Physicists: Arfken and Weber.
2. Mathematical Physics: P. K. Chattopadhyay.
3. Mathematical Methods in Physical Sciences: Boas.
4. Mathematics for Physicists and Engineers: Pipes.

BPT-502: CLASSICAL MECHANICS   Credits: 3

System of particles, Constraints, Generalized coordinates, D'Alemberts principle and Lagrange's equation, Velocity dependent potential of electro-magnetic field.

Calculus of Variation, Hamilton's principle, Lagrange's equation, Lagrangian for simple systems, Cyclic coordinates, symmetries and conservation laws. Advantages of Lagrangian: electro-mechanical analogies, Lagrange's undetermined multipliers, Lagrange's equation for nonholonomic systems, Virial theorem, Principle of mechanical similarity.

Legendre transformations and Hamilton's equations of motion, Hamiltonian for a charge particle in Electro-magnetic field, Cyclic coordinates and conservation laws, Poisson Brackets, Jacobi Identity, Canonical transformation.

Hamilton-Jacobi theory, Action-Angle variables, related problems.

Two body central force problem, reduction to the equivalent one body problem, Differential equation for the orbit and integrable power law potentials, Condition for stable circular orbit, Kepler problems.

Reference Books:
1. Classical Mechanics: H. Goldstein.
2. Mechanics: L . D. Landau and E. M. Lifshitz
3. Introduction to Classical Mechanics: R. G. Takwale and Puranik.
4. Classical Mechanics of Particles and Rigid Bodies: K. C. Gupta.
5. Introduction to Classical Mechanics: N. C. Rana and P. Joag.

BPT-503: QUANTUM MECHANICS   Credits: 3

Limits of Classical Physics:

Black body radiation (without derivation), Photoelectric effect, Compton effect.

Wave Packets and Uncertainty Relation:

de Broglie hypothesis, Wave-particle duality, Davisson-Germer experiment, Wave packets, Group velocity and phase velocity, Uncertainty principle, Complimentarity.

Wave Mechanics:

Schrödinger equation, Physical interpretation of wave function, Probability current density and conservation of probability, Free particle wave function, Schroedinger equation in the presence of a potential, Linear operators, Hermitian operators, Observables, Eigenvalues and Eigenfunctions, Expectation values, Ehrenfest's theorem, Stationary states, Superposition principle, Commutation relations, Commuting observables and compatibility.

Application of Schrödinger Wave Equation:

Particle in one dimensional Box, Square well, Rectangular potential barrier and tunnelling, Linear harmonic oscillator, Spherically symmetric potential, Angular momentum operators and their eigenfunctions, Concept of spin, Hydrogen atom.

Reference Books:
1. Quantum Physics: S. Gasiorowicz.
2. Quantum Mechanics: B. H. Bransden and C. J. Joachain.
3. Quantum Physics of Atoms, Molecules, Nuclei and Solids: R. M. Eisberg and R. Resnick.
4. Quantum Mechanics: V. Devanathan.
5. Quantum Mechanics: C. S. Chaddha.

BPT-504: ELECTRONIC DEVICES AND CIRCUITS   **Credits: 3**

Electronic Devices:

Field effect transistors, I-V Characteristics of JFET and MOSFET, FET biasing, FET as an amplifier. Silicon controlled rectifier, I-V Characteristics, phase controlled rectifier. Unijunction transistor, I-V Characteristics , relaxation oscillator. Operational amplifier (block diagram),characteristics parameters, inverting and noninverting amplifier. Cathode ray oscilloscope, working of CRT, deflection sensitivity, time base and waveform display.

Analog Circuits:

Hybrid parameter model of transistor, analysis of transistor amplifier (with and without R_S and R_L) using h- parameters, simplified hybrid model, brief idea about hybrid π model.

Single stage amplifier in CE,CB and CC modes. RC coupled CE amplifier and its frequency response, tuned voltage amplifier. Power amplifier classification, distortion and efficiency, push pull amplifier, Feedback in amplifiers, positive and negative feedback, effect of negative feedback on the characteristics of different types of amplifiers, voltage and current series feedback circuits.

Barkhausen criterion of oscillations, tuned collector oscillator, Hartley / Colpitt oscillator, phase shift oscillator and multiuvibrators.

Need and types of modulation, amplitude modulation, analysis of A.M. wave, modulator and demodulator circuits.

Digital Circuits:

Boolean algebra, logic gates, NAND and NOR gates as universal gates. Simplification of Boolean expressions using K- maps. Half and full adders and subtractors.

Reference Books:
1. Electronics Fundamental and Application: Chattopadhyay and Rakshit.
2. Principle of Digital Electronics: Malvino and Leach.
3. A Text Book of Electronics: Kakani and Bhandari.
4. Electronic Devices: T.L. Floyd.
5. Integrated Electronics: Millman and Halkias.

BPT-601: STATISTICAL MECHANICS   Credits: 3

Random Walk Problem:
Probability distribution, calculation of mean and dispersion (as a measure of fluctuation), and simple numerical problems.

Basics of Statistical Mechanics:
State of a system (Microscopic and Macroscopic); Phase space, density of states and Liouville's theorem; Postulates of statistical mechanics; Relation between statistical and thermodynamic parameters.

Classical Statistical Mechanics:
Ensemble theory (Micro-canonical, Canonical and Grand-canonical), applications to classical ideal gas and simple numerical problems; Gibbs paradox; Statistical equivalence of three ensembles.

Quantum Statistical Mechanics:
Introduction to Bose-Einstein and Fermi-Dirac statistics; Maxwell-Boltzmann statistics as a classical limit; Comparison of the three statistics; Qualitative features of degenerate Fermi and Bose gases.

Reference Books:
1. Fundamentals of Statistical and Thermal Physics: Frederick Reif.
2. Statistical Mechanics (2nd Edition): R.K. Pathria.
3. Equilibrium Statistical Physics: Michael Plischke and Birger Bergersen.
4. Statistical Mechanics: (Wiley): Kerson Huang.

BPT-602: SOLID STATE PHYSICS   Credits: 3

Structure and Symmetry:
Elements of external symmetry of crystals, space lattice, Bravais lattices, Miller indices for direction and planes, Common crystal structures: NaCl, CsCl, ZnS and Diamond, Close packed structures, Quasicrystals.
Bonding in solids, Lennard Jones potential, concept of cohesive energy, covalent,   van der Waals, ionic and metallic bonding.

Diffraction of x-rays, Laue equations and Braggs law, reciprocal lattice, Brillouin Zones and Ewald construction, atomic scattering and structure factors.

Lattice Vibrations:

Vibrational modes of continuous medium, Debye's theory of specific heat, Vibrations of one dimensional monoatomic and diatomic chain, Phonons, Density of states.

Electronic Properties:

Free electron gas, Electrons in periodic potential, Kronig Penny model, Bloch theorem, energy bands, metals, insulators and semiconductors, Motion of electron in electric and magnetic fields, Hall Effect, Fermi surface.

Magnetic Properties :

Dia-, Para-and Ferromagnetism, origin of magnetism, Langevin's theory of paramagnetism, Weiss Molecular theory, Ferromagnetic ordering, spin waves, magnons, ferromagnetic domains.

Reference Books:

1. Crystalloraphy for Solid State Physics: A. R. Verma and O.N. Srivastava.
2. Introduction to Solids: Azaroff.
3. Solids State Physics: Kittel.
4. Solids State Physics: Ashcroft and Mermin.
5. Solids State Physics: Decker.

BPT-603: ELEMENTS OF NUCLEAR PHYSICS   Credits: 3

Properties of Nuclei and Models:

Introduction to the nucleus, Fermi gas model, Binding energy, Bethe-Weizsaecker mass formula and its application to explain most stable isobars and nuclear fission, Inferences of nuclear size from elastic electron-nucleus experiments (no derivation).

Nuclear Force and Two-nucleon System:

Properties of nucleon-nucleon interaction, General forms of N-N potential, Description of low energy neutron-proton scattering to show the spin dependence of nuclear force, Ground state properties of deuteron, Simple consideration of deuteron using central potential (square well).

Nuclear Stability:

Nucleon emission, separation energy, Alpha decay and its energy spectrum, Q-value, Gamow's theory of alpha decay (no derivation), Beta decay and its energy spectrum (for example, ^{137}Cs), Need for neutrinos, Q-value for beta decay, Gamma decay, Selection rules for gamma transitions (no derivation).

Accelerators and Detectors:

Van de Graaff and Linear accelerators, Synchrotrons, Geiger-Mueller detector, Scintillation detector.

Elementary Particles:

Classification of particles and their interactions, Quantum numbers, Quarks as the building blocks of hadrons, colour degree of freedom.

Reference Books:
1. Introductory Nuclear Physics: S. S. M. Wong.
2. Nuclear Physics: V. Devanathan.
3. Concepts of Nuclear Physics: B. L. Cohen.
4. Fundamentals of Nuclear Physics: B. B. Srivastava.
5. Introduction to Nuclear Physics: H. A. Enge.

BPT-604: ATOMIC PHYSICS AND LASERS   **Credits: 3**

Atomic Physics:

Brief review of Bohr and Sommerfeld model of atom. Effect of finite nuclear mass in relation to Rydberg constant. Idea of discrete energy levels and electron spin: Fanck – Hertz and Stern – Gerlach experiments

Significance of four quantum numbers and concept of atomic orbitals. One valence electron atom: Orbital magnetic dipole moment, Orbital, spin and total angular moenta, Larmor precession, Vector model of atom, Electronic configuration and atomic states, Spin-orbit interaction and fine structure, Intensity of spectral lines, General selection rules. Zeeman Effect.
Two valence electron atoms: LS and JJ coupling schemes and resulting spectra. Idea of normal and inverted doublet.

Lasers and Non-Linear Optics:
Einstein coefficients, Threshold condition for LASER action, Rate equation for three level laser system, Characteristics of laser radiation. He-Ne and Nd-YAG Laser.

Significance of non-linear polarization of lasers and some applications: Second harmonic generation using non-linear optical methods.

Reference Books:
1. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles: Robert Eisberg and Robert Resnick.
2. Introduction to Atomic Spectra: H.E. White.
3. Principles of Lasers: Orazio Svelto.

BPE – 601: TOPICS IN MODERN PHYSICS   **Credits: 4**

Theory of Relativity:

Gravitational red-shift, Doppler effect in relativity, Four dimensional space and concept of four-vector, Transformation properties of four-momentum and four-force, Vector and scalar potentials and Gauge transformation, Four-potential and four-current, Transformation relations for E and B, Invariance of Maxwell's equations.

Astrophysics and Cosmology:

Introduction to the Universe, Expansion of the Universe, The Hertzprung-Russell Diagram, The cosmic microwave background radiation, The Big Bang Hypothesis, Nucleosynthesis: formation of nuclei and atoms, Formations of Galaxies and Stars, Thermal Nuclear Reaction, Astrophysical processes : H and He burning, the r-process, the rp-process, Chandrashekhar-limit, White Dwarf, Neutron star and Black Hole, Dark Matter and Dark Energy.

Atoms, Nuclei and Solids:

Rutherford scattering (detailed derivation), Compton scattering and comparison with Raman scattering, Mössbauer effect, Solid state detectors, Mass spectrometer (illustrated by Bainbridge and Aston spectrometer), Charge particles in magnetic field, Landau levels,

Reference Books:
1. Elementary Modern Physics: A.P. Arya.
2. Introduction to Special Relativity : Robert Resnick.
3. Modern Physics: K.S. Krane.
4. Modern Physics: J. Bernstein, P.M. Fisshbane, Stephen Gasiorowicz.
5. Solid State Physics: N.W. Ashcroft and N.D. Mermin.
6. Cauldrons in the Cosmos: Nuclear Astrophysics: Clous E Rolf and William S. Rodney.

BPE-602: ELEMENTS OF NANOSCIENCE AND EXOTIC MATERIALS   Credits: 4

Background Physics for Nano and Exotic Materials :
Electron Band Structure and Its Modification due to change in dimensionality. Phonon absorption in Nanomaterials.

Nano Materials:
Physical, Chemical and Bio-routes for Synthesis of Nanomaterials, Experimental Techniques for Characterization of Nanomaterials, Metal Nanoparticles, Carbon Nanostructures, Electronic Properties of Nanomaterials, Some applications of Nano Materials.

Exotic Materials:

High Temperature Superconductors and Colossal Magnetoresistance Materials. Meissner Effect, Discovery of HTSC Materials, Structure and Properties of HTSC Materials, Elements of Proposed Mechanisms of high temperature superconductivity, Elementary Concepts of CMR Materials, Double Exchange Mechanism , Some Application of CMR material based devices.

Quasicrystals:

Basic definition of quasicrystal, Fibonaci Sequence, Penose Tiling and its Relevance to Structure of Quasicrystals.

Reference Books:
1. Introduction to Solid State Physics (VI Edition): Charles Kittel.
2. Introduction to Nanotechnology: C.P. Poole and F.J. Owens.
3. Nanobiotechnology : Concepts, Applications and Perspectives (Eds. C.M. Niemeyer and C.A. Mikin).

LIST OF EXPERIMENTS*
Group – I

BPL-501   **Credits: 3**
1. Magnetic susceptibility of nickel ion.
2. Half-life of Indium^{116}.
3. Determination of Cauchy's constant.
4. Prism Spectrograph.
5. Wavelength of laser and thickness of wire.

BPL-502   **Credits: 3**
1. Experiment on logic gates- Verification of laws of Boolean algebra.
2. Transient response of LCR circuit and determination of quality factor.
3. Experiment of negative feedback amplifier.
4. Power supply and filter characteristics.
5. Design of Zener regulated power supply.
6. Experiment on Fourier Analysis.

Group –II

BPL-601   **Credits: 3**
1. Determination of Planck's constant.
2. Grating spectrograph.
3. GM Counter.
4. B-H curve and hysterisis loss.
5. Experiment on fiber optics.
6. Wedge angle and refractive index of water using laser.

BPL-602   **Credits: 3**

1. Positive feedback- Hartley and phase shift oscillator.
2. Amplitude modulation and demodulation characteristics.
3. Characteristics of FET and MOSFET and their application as amplifier.
4. Wave shaping circuits.
5. Characteristics of UJT and its application as relaxation oscillator.

* In Semester-V, half of the students will do the experiments of Group-I and the next half will do the experiments of Group-II. In Semester- VI the students will exchange their groups. Addition and deletion in the list of experiments may be made from time to time by the department.

B. Sc. (HONS.) PSYCHOLOGY

Offered By:

Department of Psychology

Faculty of Arts

Banaras Hindu University

Semester-wise Distribution of Courses and Credits

Semester-I		
Course Code	Title	Credits
PSB 101	(A) **Basic Psychological Processes (*Credit-2)* and** **(B)** Elementary Experimental Methodology & Basic Statistics (*Credit-2*)	**4**
PSB 102	*Practical based on course PSB 101*	**2**
	Total	6
Semester-II		
PSB 201	(A) **Foundations of Human Behaviour (*Credit-2)* and** **(B)** Elementary Experimental Designs and Statistics(*Credit-2*)	**4**
PSB 202	*Practical based on course PSB 201*	**2**
	Total	6
Semester-III		
PSB 301	(A) **Child Psychology (*Credit-2)* and** **(B)** Applied Psychology (*Credit-2*)	**4**
PSB 302	*Practical based on course PSB 301*	**2**
	Total	6
Semester-IV		
PSB 401	(A) **Psychology of Adolescence & Adulthood (*Credit-2)* and** **(B)** Group and Organizational Processes (*Credit-2*)	**4**
PSB 402	*Practical based on course PSB 401*	**2**
	Total	6
Semester-V		
PSB 501	(A) **Social Cognition and Group Processes (*Credit-2)* and** **(B)** Physiological Basis of Behaviour (*Credit-2*)	**4**
PSB 502	Attention and Psychophysics	**3**
PSB 503	Maladaptive Behaviour	**3**
PSB 504	Personnel Psychology	**3**
PSB 505	Psychological Testing	**3**
PSB 506	*Practical based on courses PSB 501, PSB 502, PSB 503, PSB 504, and PSB 505*	**2**
	Total	18
Semester-VI		
PSB 601	(A) **Foundations of Social Psychology (*Credit-2)* and** **(B)** Organic Foundations of Behaviour (*Credit-2*)	**4**
PSB 602	Learning and Memory	**3**
PSB 603	Behavioural Disorders	**3**
PSB 604	Industrial and Organizational Psychology	**3**
PSB 605	Human Assessment	**3**
PSB 606	*Practical based on courses PSB 601, PSB 602, PSB 603, PSB 604, and PSB 605*	**2**
PSB 607	*Project / Field Study*	**4**
	Total	22
	Grand Total	64

B.Sc. (HONS.) PSYCHOLOGY
I Semester

PSB 101 : (A) Basic Psychological Processes   **Credits:** 2

1. Introduction: Historical background. Psychology as a scientific study of behaviour.
1. Areas of Application. Methods of study: Observation, interview and experimentation.
2. Sensory and perceptual processes: Visual and auditory senses: Structure, functions and theories. Attention: Nature, types and determinants. Perception: Nature and determinants; Perceptual organization; Form, space and depth perception.
3. Learning: Learning process. Theories of Learning: Trial and error, conditioning, and insight. Reinforcement. Learning curves.
4. Memory and forgetting: Memorization process; Short-term and long-term memory. Measures of retention. Theories and causes of forgetting. Curve of forgetting. Contributions of Ebbinghouse and Bartlett. Zeigarnik Effect.
5. Thinking and problem solving: Nature of thinking; Problem solving and creative thinking; role of set and insight. Process of concept formation.

Books recommended:

1. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. (1998). Introduction to psychology, (10th edition), New York: Harcourt Brace Jovanovich.
2. Baron, R. A. (2006). Psychology (5th edition). New Delhi: Pearson Education.
3. Ciccarelli, S. K., & Meyer, G. E. (2007). Psychology (1st edition). New Delhi: Pearson Education.
4. Feldman, R. (2004). Understanding Psychology (6th edition). New Delhi: McGraw Hill
5. Gerrig, R. J., & Zimbardo, P. G. (2006). Psychology and Life (17th edition). New Delhi: Pearson Education.
6. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (1986). Introduction to psychology (7th edition) Bombay: Tata-McGraw Hill.
7. Singh, R. N. (2005). Adhunik samanya manovigyan. Agra: Vinod Pustak Mandir.
8. Singh, A.K. (1997). Uchchtar samanya manovigyan. Varanasi: Motilal Banarasi Das.
9. Zimbardo, P. G., Weber, A. L., & Johnson, R. L. (2000). Psychology (3rd editon). Boston: Allyn Bacon.

PSB 101 : (B) Elementary Experimental Methodology and Basic Statistics Credits: 2

1. Nature of science and scientific method. Steps involved in experimentation.

2. Problem and hypothesis: Nature, types and sources. Variables: Nature and types. Control of variables.

3. Meaning and purpose of statistics in psychology: Discrete and continuous scores. Nature and levels of measurement.

4. Frequency distributions and their graphical presentation: Frequency polygons, histograms and Ogive. Percentile point and percentile rank.

5. Measures of central tendency: Mean, median, mode. Measures of variability: Range, quartile deviation and standard deviation.

Books recommended

1. Breakwell, G. M., Hammon, S, Fife-Shaw, C., & Smith, J. (2006). Research methods in psychology (3rd edition). London: Sage.

2. Garrett, H. E. (1969). Statistics in psychology and education. Bombay: Vakils, Feiffer Simons.
3. Garrett, H. E. (1993). Shiksha evam manovigyan mein sankhyiki. New Delhi: Kalyani Publishers.
4. Guilford, J. P., & Fruchter, B. (1973). Fundamentals of statistics in psychology and education. Tokyo: Kogakusha.
5. Haslam, S. A., & McGarty, C. (2003). Research methods and statistics in psychology. London: Sage.
6. Kapil, H. K. (1980). Sankhyaki ke mool tatwa. Agra: Vinod Pustak Mandir.
7. Minium, E. W., King, B. M., & Bear, G. (1993). Statistical reasoning in psychology and education (3rd edition). New York: John Willey.
8. Singh, A. K. (2006). Tests, measurements and research methods in behavioural sciences. Patna: Bharti Bhavan.
9. Singh, A. K. (2004) Monovigyan, samajshastra tatha shiksha mein shodh vidhiyan. Varanasi: Motilal Banarasi Das.
10. Suleman, M. (1997). Sankhyiki ke mool tatwa. Patna: Shukla Book Depot.

PSB 102 : Practical based on course PSB 101   Credits: **2**
(Any five of the following)
   1. Concept Formation.
   2. Human maze learning.
   3. Mapping of the blind spots
   4. Memory span of digits and words.
   5. Perceptual organization
   6. Retroactive inhibition.
   7. Serial position effect
   8. Set in problem solving.
   9. Span of apprehension.
   10. Zeigarnick Effect.

II Semester

PSB 201 : (A) Foundations of Human Behaviour   **Credits: 2**
1. Individual differences: Biological determinants: Genetic factors, hormones and glands. Socio-cultural determinants: Family, school, society and culture.
2. Intelligence: Nature, measurement and types of tests.
3. Personality: Nature, determinants, types and assessment of personality.
4. Motivation: Nature and types: Biogenic and sociogenic. Need hierarchy model. Assessment of motivation.
5. Emotion: Nature of emotions. Physiological correlates. Theories of emotion: James - Lange, Cannon-Bard, Schachter-Singer.

Books recommended:
1. Atkinson, R. L., Atkinson, R. C., & Hilgard, E. R. (1998). Introduction to psychology, (10th edition), New York: Harcourt Brace Jovanovich.
2. Baron, R. A. (2006). Psychology (5th edition). New Delhi: Pearson Education.
3. Ciccarelli, S. K., & Meyer, G. E. (2007). Psychology (1st edition). New Delhi: Pearson Education.
4. Feldman, R. (2004). Understanding Psychology (6th edition). New Delhi: McGraw Hill
5. Gerrig, R. J., & Zimbardo, P. G. (2006). Psychology and Life (17th edition). New Delhi: Pearson Education.
6. Morgan, C. T., King, R. A., Weisz, J. R., & Schopler, J. (1986). Introduction to psychology (7th edition.) Bombay: Tata-McGraw Hill.
7. Singh, R. N. (2005). Adhunik samanya manovigyan. Agra: Vinod Pustak Mandir.
8. Singh, A. K. (1997). Uchchtar samanya manovigyan. Varanasi: Motilal Banarasi Das.
9. Zimbardo, P. G., Weber, A. L., & Johnson, R. L. (2000). Psychology (3rd editon). Boston: Allyn Bacon.

PSB 201 : (B) Elementary Experimental Design and Statistics   **Credits: 2**
1. Experimental inferences: Logical bases of inductive and deductive inferences.
2. Experimental design: Meaning and purpose; Single group design: Pre and post measurements. Between subjects designs: Randomized, matched groups and factorial designs.
3. Normal probability curve: Properties and applications. Skewness and kurtosis.
4. Reliability of statistics: Significance of difference between two means. Chi-square test and its applications.
5. Correlations: Product - moment and rank difference.

Books recommended
1. Breakwell, G. M., Hammon, S, Fife-Shaw, C., & Smith, J. (2006). Research methods in psychology (3rd edition). London: Sage.
2. Garrett, H. E. (1969). Statistics in psychology and education. Bombay: Vakils, Feiffer Simons Pvt. Ltd.
3. Garrett, H. E. (1993). Shiksha evam manovigyan mein sankhyiki. New Delhi: Kalyani Publishers.
4. Guilford, J. P., & Fruchter, B. (1973). Fundamentals of statistics in psychology and education. Tokyo: Kogakusha.
5. Haslam, S. A., & McGarty, C. (2003). Research methods and statistics in psychology. London: Sage.

6. Kapil, H. K. (1980). Sankhyaki ke mool tatwa. Agra: Vinod Pustak Mandir.
7. McGuigan, F. J. (1990). Experimental psychology (5th edition). New Delhi: Prentice Hall, India.
8. Minium, E.W., King, B.M., & Bear, G. (1993). Statistical reasoning in psychology and education (3rd edition). New York: John Willey.
9. Singh, A. K. (2006). Tests, measurements and research methods in behavioural sciences. Patna: Bharti Bhavan.
10. Singh, A. K. (2004) Monovigyan, samajshastra tatha shiksha mein shodh vidhiyan. Varanasi: Motilal Banarasi Das.
11. Suleman, M. (1997). Sankhyiki ke mool tatwa. Patna: Shukla Book Depot.

PSB 202: Practical based on course PSB 201 Credits: **2**

(Any five of the following)
1. Intelligence Test (Verbal).
2. Intelligence Test (Performance).
3. Self Concept.
4. Emotional Maturity.
5. Test of Personality.
6. Test of Interest.
7. Level of Aspiration.
8. Word Association Test.
9. Sentence Completion Test.
10. Recognition of Emotions.

III Semester

PSB 301 : (A) Child Psychology Credits: **2**

1. Concept of development: Principles of growth. Maturation and development. Developmental stages.
2. Determinants of development: Biological and socio - cultural. Methodological approaches: Longitudinal and cross-sectional; Sequential strategies and cohorts. Methods of study: Observation, experimentation, field study, interview and testing.
3. Prenatal development: Stages and factors affecting it. The neonate: Physical characteristics, reflexes, sensory and motor capacities.
4. Development during Infancy: Physical growth and motor development; Sensory and perceptual development; Language, emotional and social development.
5. Development during childhood: Cognitive. Social, emotional and moral. Development of self - identity.

Books Recommended:
1. Berk, L. E. (2005). Child development. New Delhi: Pearson Education.
2. Bhutt, G. (1990). Vikasatmak manovigyan. Delhi : Delhi University.
3. Hurlock, E. B. (1967). Child psychology (Hindi & English Versions). New Delhi: Tata McGraw Hill.
4. Kaluger, G. S., & Kaluger, M. F. (1984). Human development: The span of life (3rd edition). St. Louis: Times mirror.
5. Santrock, J. W. (2006). Life-span development (10th edition). New York: McGraw Hill.
6. Shaffer, D. R. (1996). Developmental psychology. California: Brooks & Cole.

PSP 301 : (B) Applied Psychology   **Credits: 2**

1. Introduction: Nature and fields.
2. Psychology of guidance and counseling: Nature and areas; Procedure; Individual differences and their assessment. Measurement of intelligence, personality, interests and aptitudes.
3. Psychology in education: School as an agent of socialization. Factors influencing school achievement. Learning and motivational problems. Exceptional children: Problem and remedial measures.
4. Psychology and mental health: Symptoms and causes of anxiety neurosis, hysteria, phobia and schizophrenia, mental retardation. Major therapies: Psychoanalytic, behaviour and person - centered.
5. Psychology and sports: Personality traits of efficient sportsmen. Team feeling. Motivational problems.

Books Recommended:
1.   Rastogi, G.D. (1992). Vyavaharik manovigyan. Agra: Har Prasad Bhargava.
2.   Singh, A. P. (1995). Vyavaharik monovigyan. Varanasi: Abhishek publications.
3.   Anastasi, A. (1979). Fields of applied psychology. New Delhi: McGraw Hill.
4.   Goldstein, A. P., & Krasner, B. (1987). Modern applied psychology. Elmford, New York: Pergmon Press.
5.   McCormick, E.J., & Ilgen, D. (1980). Industrial psychology. Englewood Cliffs, N.J.: Prentice Hall.

PSB 302 : Practical based on course PSB 301   **Credits: 2**
(Any five of the following)
1. Academic Anxiety Test
2. Achievement Test
3. Aptitude Test
4. Intelligence Test (Non verbal)
5. Measurement of values
6. Self Efficacy Test
7. Self Identity Test
8. Test of Adjustment
9. Test of Aggression
10. Test of Creativity

PSB 401 : (A) Psychology of Adolescence and Adulthood   Credits: **2**

1.   Introduction: The science of adolescent and adulthood development
2.   Puberty: Biological foundations; Developmental task; Physical and psychological changes.
3.   Adolescence: Developmental task; Physical and psychological changes; Development of identity.
4.   Adulthood: Developmental tasks. Choice of vocation.
5.   Adulthood: Adjusting to career, marriage and family.

Books Recommended:
1.   Berk, L.E. (1994). Child development. New Delhi: Prentice Hall.
2.   Bhutt, G. (1990). Vikasatmak manovigyan. Delhi : Delhi University.
3.   Hurlock, E. B. (1967). Child psychology. New Delhi: Pearson Education.
4.   Kaluger, G. S., & Kaluger, M.F. (1984). Human development: The span of life, (3rd edition). St. Louis: Times mirror.
5.   Santrock, J. W. (1999). Life-span development. New York: McGraw Hill.
6.   Shaffer, D. R. (1996). Developmental psychology. California: Brooks & Cole.

PSB 401 : (B) Group and Organizational Processes   Credits: **2**

1.   Introduction: Nature and Approaches.
2.   Psychology and social behaviour: Social cognition: Prejudice and stereotypes; conflict and resolution.
3.   Psychology and anti-social behaviour: Crime and delinquency. Techniques of crime detection; Treatment of offenders. Drug addiction and remedial measures.
4.   Psychology in organizations I: Characteristics of organizations. Personnel selection. Job analysis and performance appraisal.
5.   Psychology in organizations II: Fatigue and accidents; Advertising and consumer behaviour.

Books Recommended:
1.   Rastogi, G. D. (1992). Vyavaharik manovigyan. Agra: Har Prasad Bhargava.
2.   Singh, A. P. (1995). Vyavaharik monovigyan. Varanasi: Abhishek publications.
3.   Anastasi, A. (1979). Fields of applied psychology. New Delhi: McGraw Hill.
4.   Goldstein, A. P., & Krasner, B. (1987). Modern applied psychology. Elmford, New York: Pergmon Press.
5.   McCormick, E. J., & Ilgen, D. (1980). Industrial psychology. Englewood Cliffs, N.J.: Prentice Hall.

PSB 402 : Practical based on course PSB 401   Credits: 2
(Any five of the following)
1.   Job Anxiety Test
2.   Job involvement
3.   Need for achievement
4.   Person perception
5.   Social conformity
6.   TAT

7. Test of Prejudices
8. Test of Social Cognition
9. Test of stereotypes
10. Vocational Preference Test

PSB 501 : (A) Foundations of Social Psychology   **Credits: 2**

1. Nature and scope of social psychology: Relationship with other social sciences. Interactional perspectives.
2. Methods of social psychology: Observation, experimentation, field study, and cross-cultural.
3. Communication: Verbal and nonverbal strategies. Language and social interaction. Barriers. Interpersonal attraction.
4. Attitudes: Formation, change and measurement.
5. Prejudice and discrimination: Sources and dynamics. Techniques for challenging prejudice.

Books Recommended
1. Allock, J. E., Carment, D. N., & Sadava, S. N. (1991). A textbook of social psychology. Scarborough, Canada: Prentice Hall.
2. Baron, R. A., & Byrne, D. (1998). Social psychology (8th Edition). New Delhi: Prentice Hall of India.
3. Singh, A. K. (1996). Adhunik samajik manovigyan ki roop rekha (3rd Edition). Varanasi: Moti Lal Banarasi Das.
4. Tripathi, L. B. (1992). Adhunik Samajik Manovigyan. Agra: National psychological corporation.
5. Worchel, S., & Cooper, J. (1983). Understanding social psychology. Illinois : Dorsey

V Semester

PSB 501 : (B) Organic Foundations of Behaviour   **Credits: 2**

1. Cells of the nervous system: Structure, types and functions of the neuron and glia cells.
2. Organization of the nervous system: Peripheral nervous system- somatic and autonomic nervous system. Central nervous system- spinal cord and brain.
3. Communication within and between neurons: Membrane potential, Action potential and chemical transmission.
4. Methods of study human and animal brain: Neuro-anatomical, lesion, stimulation and recording.
5. Internal environment: Homeostatic mechanism.

Books Recommended
1. Beatty, J. (2001). The human brain: Essentials of behavioural science. London: Sage.
2. Broadal, P. (1992). The central nervous system: Structure and functions. New York: Oxford University Press.
3. Carlson, N. R. (2005). Foundation of Physiology of Behaviour. New Delhi: Pearson Education.
4. Kalat, J. W. (2001). Biological Psychology. C.A.: Wadsworth.
5. Leukal, F. (1985). Introduction to physiological psychology. Delhi: CAS Publishers & Distributors.

6. Levitt, R. A. (1981). Physiological psychology. New York: Holt Reinhart and Winston.
7. Milner, P. M. (1970). Physiologial Psychology. New York: Holt Reinhart and Winston.
8. Morgan, C. T. (1965). Physiological Psychology. International student Edition, McGraw Hill Inc.
9. Pinel, J. P. J. (2006). Biopsychology. New Delhi: Pearson Education.
10. Thompson, R. F. (1985). An introduction to neuroscience. San Francisco: Freeman.

PSB 502 : Attention and Psychophysics   Credits: 3

1. Psychophysics: Physical psychological continua, absolute and difference limen. Weber's law and Fechner's law, Steven's Power Law. Signal detection theory.
2. Psychophysical scaling: Nominal, ordinal, interval and ratio scales. Direct methods for constructing interval and ratio scales of sensation. Indirect methods. Paired comparison and rank order method.
3. Classical methods of psychophysics: Method of average error, method of limits and method of constant stimuli.
4. Selective attention: Concepts and theories. Filter theory, response selection theory, and mental resonance theory.
5. Sustained attention: Concepts; Theories: Signal detection theory, arousal theory, and habituation theory.

Books Recommended
1. Benjafield, J.C. (1992). Cognition. New Jersey: Prentice Hall.
2. Boof, K., Kaufman, L., & Thomas, J. (1986). Handbok of perception and human performance: Cognitive processes and performance. New York: John Wiley.
3. D'Amato, M.R. (1970). Experimental psychology: Methodology, psychophysics and learning. New Delhi: Tata McGraw Hill.
4. Davies, D.R., & Parasuraman, R. (1982). The psychology of vigilance. New York: Academic Press.
5. Dember, W.N., & Warm, J.S. (1979). Psychology of perception. New York: Holt, Rinehart and Winston.
6. Johnson, A., & Proctor, R. W. (2004). Attention: Theory and Practice. New Delhi: Sage.
7. Matlin, M. W. (2003). Congnition (5th edition). New Delhi: Prism Book.
8. Parasuraman, R. (1998). The attentive brain. Massachusets: MIT Press.
9. Parasuraman, R., & Davies, D.R. (1984). Varieties of attention. Orlando. Academic Press.
10. Posner, M.I., Dwivedi, C.B., & Singh I.L. (1991). Contemporary approaches to cognitive psychology. Varanasi: Rishi Pubisher.
11. Singh, I.L., & Parasuraman, R. (1998). Human cognition : Multidisciplinary perspectives. New Delhi : Sage.
12. Singh, R.N. (1993). Ucchatar prayogik manovigyan. Varanasi: U. S. Publisher.

PSB 503 : Maladaptive Behaviour   **Credits: 3**

1. Concept of normality and abnormality. Criteria of abnormality: Statistical, behavioural, and cultural.
2. Approaches and causes of psychopathology: Biological, psychosocial and cultural.
3. Classification of psychopathology: Diagnostic and Statistical Manual of Mental Disorders (DSM IV) and ICD 10.
4. Stress and problems of adjustment: Frustration, conflict and coping strategies.
5. Patterns of maladaptive behaviour: Drug addiction and alcoholism; anti social behaviour and delinquency.

Books Recommended
1. Carson, R. C., Butcher, J. N., & Mineka, S. (1998). Abnormal psychology and modern life (10th edition). New York: Longman.
2. Sue, R., Sue, D., & Sue, S. (1990). Understanding abnormal behaviour. Boston: Houghton Mifflin.
3. Kapil. H.K. (1985). Apsamanya manovigyan. Agra: Vinod Pustak Mandir.
4. Lamm, A. (1997). Introduction to psychopathology. New York: Sage.
5. Buss, A. H. (1999). Psychopathology. New York: John Wiley.

PSB 504 : Personnel Psychology   **Credits: 3**

1. Introduction: Historical development. Scientific management and human relations movements.
2. Selection and placement: Measurement of individual differences. Basic selection model.
3. Techniques of selection. Application blank, interview and testing.
4. Training: Methods, and evaluation of training programmes.
5. Accident and safety: Causes of accidents, Accident proneness; Risk taking behaviour and accidents; Preventive and safety measures of accidents.

Books Recommended
1. Blum, M. L. & Naylor, J. C. (1968). Industrial psychology: Its theoretical and social foundations. New York: Harper and Row.
2. Gilmer, B.V.H. (1991). Industrial and organizational psychology. Tokyo: McGraw Hill, Kogakushra.
3. Krumm, P. (2001). Psychology at work: An introduction to industrial/ organizational psychology. New York: Worth Publishers.
4. Schultz, D. P., & Schultz, S. (2006) Psychology and work today: An introduction to industrial and organizational psychology. New Delhi: Pearson Education.
5. Wexley, K. N., & Yukl, G. A. (1987). Organizational behaviour and personnel psychology. Illinois: Richard Irwin.

PSB 505 : Psychological Testing   **Credits: 3**

1. Psychological measurement: Test and scale: Concept, kind, characteristics and uses. Levels of measurement: Nominal, ordinal, interval and ratio scales: Their salient features and uses.
2. Test development: Item construction. Item analysis: determining difficulty. Discrimination and homogeneity indices (item validity). Item selection.
3. Reliability of tests and scales: Meaning of reliability. True and error variance. Standard error of measurement: Methods for estimating internal consistency: Split half, and alpha coefficient. Stability: test-retest and alternate forms. Extrinsic and intrinsic factors influencing reliability.
4. Validity: Content validity; criterion validity; predictive and concurrent validity. And Construct validity: convergent, discriminant and factorial validity. Cross validation.
5. Statistics: Significance of differences between proportions. SDs. Correlations. Regression and prediction.

Books   Recommended
1.   Anastasi, A., (2004). Psychological testing. New Delhi: Pearson Education.
2.   Bhargava, M. (1982). Adhunik manovigyan mein mapan (5th edition). Agra: National Psychological Corporation.
3.   Freeman, F. S. (1962). Theory and practice of psychological testing. New York: Holt, Reinhart and Winston.
4.   Garrett, H. E. (1969). Statistics in psychology and education. Bombay: Vakils, Peffer, Simans Pvt. Ltd.
5.   Gregory, R. J. (2005). Psychological Testing: History, Principles, and Applications (4th edition). New Delhi: Pearson Education.
6.   Guilford, J. P. & Fruchter, B. (1973). Fundamental statistics in psychology and education. Tokyo: McGraw Hill, Kogakusha.
7.   Singh, A. K. (1997). Tests, measurement research methods in behavioural sciences. Patna: Bharti Bhawan.
8.   Srivastava, D. N. (2005). Manovaigyani Nirdharan (2nd edition). Agra: Vinod Pustak Mandir.

PSB 506 : Practical based on course PSB 501, PSB 502, PSB 503, PSB 504, and PSB 505
                                                                        Credits: 2
(Any five of the following)
1. Colour preferences (paired comparison)
2. D. L. with lifted weights (constant stimuli)
3. Muller - Lyer illusion (average error)
4. Occupational stress
5. Personality test
6. Rating and ranking.
7. Signal detection
8. Test of Attitude
9. Two - point threshold (method of limits)
10. Value judgment (successive categories)

PSB 601 : (A) Social Cognition and Group Processes   **Credits: 2**

1. Social Cognition: Nature, types, and determinants. Self: Nature, functions and cultural differences.
2. Social perception: Forming impressions: Role of non-verbal cues. Group stereotypes and central traits. Models of information integration. Primary and recency effects. Attribution process and theories: Kelly and Weiner.
3. Groups: Nature and functions. Task performance social facilitation and social loafing. Deindividuation. Conformity and deviance. Communication and decision making in groups.
4. Prosocial behaviour: Cooperation. Helping behaviour: personal, situational and socio-cultural determinants. By-stander effect.
5. Leadership: Functions. Trait, situational and interactionist approaches. Leadership effectiveness. The charismatic leader.

Books Recommended
1. Allock, J. E., Carment, D. N., & Sadava, S. N. (1991). A textbook of social psychology. Scarborough, Canada: Prentice Hall.
2. Baron, R. A., & Byrne, D. (1998). Social psychology (8th Edition). New Delhi: Prentice Hall of India.
3. Singh, A. K. (1996). Adhunik samajik manovigyan ki roop rekha (3rd Edition). Varanasi: Moti Lal Banarasi Das.
4. Tripathi, L. B. (1992). Adhunik Samajik Manovigyan. Agra: National psychological corporation.
5. Worchel, S., & Cooper, J. (1983). Understanding social psychology. Illinois : Dorsey

PSB 601 : (B) Physiological Basis of Behaviour   **Credits: 2**

1. Sensory systems: Visual, auditory, somesthetic and chemical senses.
2. Motor systems: Pyramidal and extra pyramidal motor systems.
3. Ingestive Behavior: Regulation of hunger and thirst.
4. Sleep: Physiological and behavioral descriptions.
5. Emotion: Expression and neuroanatomy of emotion.

Books Recommended
1. Bloom, F. L., & Lazeron, A. (1996) Brain, mind and behaviour. New York: Freeman & Company.
2. Carlson, N. (2000). Physiology of behaviour. Boston: Allyn & Bacon.
3. Gazzaniga, M. S., Ivry, R. B., & Mngun, G. R. (2002). Cognitive neuroscience: The bilogy of the mind. New York: W. W. Norton and Company.
4. Kalat, J. W. (2001). Biological psychology. C.A.; Wadsworth.
5. Kolb, B. & Whishaw, I. Q. (2003). Fundamentals of human neuropsychology. New York: Worth Publishers.
6. Leukal, F. (1985). Introduction to physiological psychology. Delhi: Cas Publishers & Distributors.
7. Morgan, C. T. (1965). Physiological psychology (International student edition). New York: McGraw Hill.

8. Pinel, P. J. (2000). Biopsychology. Boston: Allyn & Bacon
9. Rosenzweig, M. R. (, Breedlow, S. M., and Leiman, A. L. (2002). Biological Psychology: An introduction to behavioural, cognitive, and clinical neuroscience. Sunderland, Masschusetts: Sinauer Associates.
10. Zaidel, D. W. (1994). Neuropsychology. New York: Academic Press.

PSB 602 : Learning and Memory   Credits: 3

1. Instrumental aversive conditioning and appetitive conditioning. Schedules of reinforcement. Generalization and discrimination.
2. Verbal learning: Materials, procedures, organization and transfer processes.
3. Memory: Encoding, storage, and retrieval systems. Sensory memory: Sperling's partial technique. Short term memory: Single and dual process theories.
4. Long term memory: Concept, theories: Interference and two factor theories.
5. Concept Learning: Types and methods. Empirical issues: Solution shifts. Incremental versus all or non principle.

Books Recommended
1. Anderson, J. R. (1995). Learning and memory: An integrated approach. New York: John Wiley.
2. D'Amato, M. R. (1970). Experimental psychology: Methodology, psychophysics and learning. New Delhi: Tata McGraw Hill.
3. Hulse, S. H., Egeth, H., & Deese, J. (1980). The psychology of learning, (5th edition). New York: McGraw Hill.
4. Matlin, M. W. (2003). Cognition (5th edition). New Delhi: Prism Book.
5. Singh, A. K. (1997). Ucchatar samanya manovigyan. Varanasi: Moti Lal Banarasi Das Publishers.
6. Singh, R. N. (1993). Ucchatar prayogik manovigyan. Varanasi: U. S. Publisher.

PSB 603 : Behavioural Disorders   Credits: 3

1. Anxiety, somatoform and dissociative disorders.
2. Psychotic Disorders: Schizophrenia, paranoid and mood disorders.
3. Mental Retardation: Classification, causes and rehabilitation.
4. Behavioural disorders due to brain damage/ dysfunction: Epilepsy, and dementia of Alzheimer's type (DAT),
5. Therapy: Psychoanalysis, behaviour, person - centered, family and group therapy.

Books Recommended
1. Carson, R. C., Butcher, J. N., & Mineka, S. (1998). Abnormal psychology and modern life (10th edition). New York: Longman.
2. Sue, R., Sue, D., & Sue, S. (1990). Understanding abnormal behaviour. Boston: Houghton Mifflin.
3. Kapil. H. K. (1985). Apsamanya manovigyan. Agra: Vinod Pustak Mandir.
4. Lamm, A. (1997). Introduction to psychopathology. New York: Sage.
5. Buss, A. H. (1999). Psychopathology. New York: John Wiley.

PSB 604 : Industrial and Organisational Psychology   **Credits: 3**

1. Work environment: Noise, atmospheric conditions. Illumination and performance.
2. Motivation: Major theories (Adams, Maslow, Vroom). Financial and non-financial incentives.
3. Job satisfaction. Determinants. Theories: Herzberg and Vroom. Industrial morale.
4. Supervision and leadership: Functions and approaches. Trait, behavioural and contingency models.
5. Human engineering: Man-machine system. Designs, displays, controls and action.

                                                        i. Books Recommended

1. Blum, M. L. & Naylor, J. C. (1968). Industrial psychology: Its theoretical and social foundations. New York: Harper and Row.
2. Gilmer, B.V.H. (1991). Industrial and organizational psychology. Tokyo: McGraw Hill, Kogakushra.
3. Krumm, P. (2001). Psychology at work: An introduction to industrial/ organizational psychology. New York: Worth Publishers.
4. Schultz, D. P., & Schultz, S. (2006) Psychology and work today: An introduction to industrial and organizational psychology. New Delhi: Pearson Education.
5. Wexley, K. N. & Yukl, G. A. (1987). Organizational behaviour and personnel psychology. Illinois: Richard Irwin.

PSB 605 : Human Assessment   **Credits: 3**

1. Human Assessment: Nature and scope. Administration, scoring and interpretation of tests. Tester's bias and extraneous factors. Norms.
2. Theoretical concepts of abilities: Spearman's two factors theory, Thurston's group factors theory and Guilford's structure of intellect.
3. Intelligence tests: Stanford Binet (4th ed.) and Weschler - Scales.
4. Personality: Traits and types. Measurement: Psychometric (16 P.F. and MMPI) and Projective Technique (Rorschach and TAT).
5. Statistics: Special methods of correlation: Biserial, point-biserial, tetrachoric, phi-coefficient, contingency coefficient. Analysis of variance (one way classification).

Books   Recommended
1. Anastasi, A., (2004). Psychological testing. New Delhi: Pearson Education.
2. Bhargava, M. (1982). Adhunik manovigyan mein mapan (5th Edition). Agra: National Psychological Corporation.
3. Freeman, F. S. (1962). Theory and practice of psychological testing. New York: Holt, Reinhart and Winston.
4. Garrett, H. E. (1969). Statistics in psychology and education. Bombay: Vakils, Peffer, Simans Pvt. Ltd.
5. Gregory, R. J. (2005). Psychological Testing: History, Principles, and Applications (4th edition). New Delhi: Pearson Education.
6. Guilford, J. P. & Fruchter, B. (1973). Fundamental statistics in psychology and education. Tokyo: McGraw Hill, Kogakusha.
7. Singh, A. K. (1997). Tests, measurement research methods in behavioural sciences. Patna : Bharti Bhawan.
8. Srivastava, D. N. (2005). Manovaigyani Nirdharan (2nd edition). Agra: Vinod Pustak Mandir.

PSB 606 : Practical based on course PSB 601, PSB 602, PSB 603, PSB 604, and PSB 605
Credits: 2

(Any five of the following)

1. Bender-Gestalt Test
2. Discrimination learning
3. Job satisfaction/ Industrial morale
4. Leadership- rating/ranking
5. Problem solving
6. Rorschach
7. Short - term memory
8. Subjective organization
9. Transfer of learning
10. Work motivation

PSB 607 : Project/ Field Study   **Credits: 4**

The students are required to conduct one project/ field work related to the following areas:
1. Social Cognition
2. Cognitive Psychology
3. Neuropsychology
4. Industrial and Organizational Psychology
5. Clinical Psychology
6. Counselling Psychology

B. Sc. (HONS.) STATISTICS

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Statistics

Faculty of Science

Banaras Hindu University

The B. Sc. (Hons.) Programme in Statistics shall be spread over three years; each year consisting of two semesters. The details of the distribution of courses in semesters, credits assigned to papers, full marks assigned, etc., are given as follows:

1. There shall be ONE THEORY paper and ONE PRACTICAL paper of 100 marks each in Semester – I, Semester – II, Semester – III and Semester - IV. The Theory paper and the Practical paper shall be of 4 credits and 2 credits respectively in each of these semesters.

2. The theory papers in each of the I, II, III and IV semesters shall be of THREE HOURS duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

3. The Practical paper in Semester – I and Semester - II shall be of THREE HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce.

4. The Practical paper in Semester – III and Semester – IV shall be of FOUR HOUR duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce.

5. There shall be FOUR THEORY papers and TWO PRACTICAL papers of 100 marks each in Semester - V and Semester – VI. Each Theory and Practical paper shall be of 3 credits in these semesters. Besides this, there shall be ONE PROJECT of 4 credits in Semester – VI.

6. The theory papers in each of the V and VI semesters shall be of THREE HOUR duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

7. The Practical paper in Semester – V and Semester – VI shall be of FOUR HOUR duration. In each Practical paper 80 marks will be assigned on the performance in practicals, 10 marks on practical record book and 10 marks on viva – voce.

8. The Project work shall be spread over the whole semester. A project be undertaken by a group of students. However, the project report shall be submitted by each member of the group separately. A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of total 100 marks assigned to the project, 60 marks will be assigned on the evaluation of the project report separately by both the examiners and 40 marks will be assigned on the oral presentation and viva – voce.

9. Besides the Core Courses in Statistics, the Department will offer TWO ANCILLARY THEORY Papers of 100 marks each; ONE in each of the Semesters – III and V. These Minor Elective papers will be of 3 credits each. The Ancillary courses will be offered by the students

of Mathematics and Biology streams of the Faculty who have not opted Statistics as a subject in any of the semesters.

10. The Ancillary Theory papers in Semester – III and Semester – V shall be of Three Hours duration consisting of eight full length questions in all out of which a student will be required to answer any five questions.

Semester-wise Distribution of Courses and Credits

SEMESTER - I

Course Code	Title	Credit
STB – 101	Statistical Methods and Probability	4
STB – 102	Practicals based on Course No. STB – 101	2
	Total	6

SEMESTER - II

Course Code	Title	Credit
STB – 201	Descriptive Statistics and Distribution Theory	4
STB – 202	Practicals based on Course No. STB – 201	2
	Total	6

SEMESTER - III

Course Code	Title	Credit
STB – 301	Statistical Inference	4
STB – 302	Practicals based on Course No. STB – 301	2
	Total	6

SEMESTER - IV

Course Code	Title	Credit
STB – 401	Sample Surveys and Design of Experiments	4
STB - 402	Practicals based on Course No. STB – 401	2
	Total	6

SEMESTER - V

Course Code	Title	Credit
STB – 501	Applied Statistics	3
STB – 502	Statistical Inference and Decision Theory	3
STB – 503	Programming with C	3

STB – 504	Operations Research	3
STB – 505	Practicals based on Course Nos. STB – 501 and STB – 502	3
STB – 506	Practicals based on Course Nos. STB – 503 and STB – 504	3
	Total	**18**

SEMESTER - VI

Course Code	Title	Credit
STB – 601	Numerical Methods	3
STB – 602	Demand Analysis, Analysis of Income Distribution and Queuing Theory	3
STB – 603	Elements of Stochastic Processes	3
STB – 604	Reliability	3
STB – 605	Practicals based on Course Nos. STB – 601 and STB – 603	3
STB – 606	Practicals based on Course Nos. STB – 602 and STB – 604	3
STB – 607	Project	4
	Total	**22**
	GRAND TOTAL	**64**

SEMESTER – I

STB – 101 : STATISTICAL METHODS AND PROBABILITY   Credits : 4

Types of data: Discrete and continuous data, Frequency and non-frequency data, Different types of scales, Primary data (designing a questionnaire and schedule), Secondary data (major sources including some government publication).

Construction of tables (with one or more factors), diagrammatic and graphical representation of grouped data, frequency and cumulative frequency distribution and their applications, histogram, frequency polygon, ogives, stem and leaf charts, box plot.

Concept of central tendency and its measures, partition values, dispersion and relative dispersion, moments, Sheppard's correction for moments (without derivation), skewness, kurtosis and their measures.

Random experiment: Trial, sample point, sample space, definitions of equally likely, mutually exclusive and exhaustive events, definition of probability, classical and relative frequency approach to probability, axiomatic approach to probability and its properties, merits and demerits of these approaches, total and compound probability, conditional probability theorems, independence of events, Bayes theorem and its applications.

Random Variable: Concept of discrete random variable, probability mass function and distribution function, joint probability mass function of several discrete random variables, marginal and conditional probability mass functions.

Continuous random variable: Probability density function, distribution function, joint density function of two continuous variables, marginal and conditional probability density functions.

Books for references:
1. Bhat B.R., Srivenkataramana T. and Rao Madhava K.S. (1996): Statistics, A
   Beginner's Text, Vol. I and II, New Age International (P) Ltd.
2. Snedecors G.W. and Cochran W.G. (1967): Statistical Methods, Iowa State University Press.
3. Mood A.M., Greybill F.A. and Bose D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
4. Spiegel M.R. (1967): Theory and problem of Statistics, Schaum's Publishing Series.
5. Goon A.M., Gupta M.K. and Das Gupta B. (1991): Fundamental of Statistics, Vol. I, World Press, Calcutta
6. Meyer P.L. (1970): Introductory Probability and Statistical Applications, Addision Wesley.
7. Parzen E. (1960): Modern Probability Theory and its Applications, Wiley Eastern.
8. Hogg R.V. and Craig A.T. 91972): Introduction to mathematical Statistics, Amerind Publishing Co.
9. Hoel P.G. (1971): Introduction to Mathematical Statistics, Asia Publication.
10. Rohtagi, V.K. (1967) An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
11. Croxton F.E., Cowden D.J. and Karlin S. (1973) Applied General Statistics.

STB – 102 : PRACTICALS BASED ON COURSE No. STB - 101   Credits : 2
            (The Practical Paper shall be of THREE HOURS duration. Out of total 100
   marks, 80 marks will be assigned to the performance in practicals, 10 marks on the
   practical record book and 10 marks on the viva – voce).

 Basic ideas of functioning of Windows and data entry in MS Excel will be given to the students.
   Students will be required to do practicals, listed below (based on the contents of the theory paper
     STB – 101), using MS Excel:
  1. Presentation of data by frequency tables, diagrams and graphs.
  2. Measures of central tendency, partition values,
  3. Measures of dispersion, relative measure of dispersion.
  4. Moments, measures of skewness and kurtosis.
  5. Evaluation of probability: using addition and multiplication theorems, conditional probabilities and Bayes theorem.

STB – 201 : DESCRIPTIVE STATISTICS AND DISTRIBUTION THEORY   Credits : 4

Bivariate data: Scatter diagram, product moment correlation coefficient and its properties, coefficient of determination, correlation ratio, interclass correlation, concept of error in regression, principle of least square, fitting of linear regression and related results, rank correlation.

Partial and multiple correlation in three variables, their measures and related results.
Theory of attributes: Independence and Association of attributes, various measures of association for two way and three way classified data.

Expectation of random variable and its properties, conditional expectation, moment in terms of expectation, moment generating function of a random variable, their properties and uses, probability generating function, Tchebycheff's inequality and its applications, convergence in probability and in distribution.

Discrete and continuous probability distributions and their properties including degenerate distribution.

Standard discrete and continuous distributions: Uniform, binomial, Poisson, geometric, negative Binomial, hypergeometric, normal, beta, gamma, bivariate Normal distributions.

Books for References
1. Goon A.M., Gupta A.K. and Das Gupta B. (1999): Fundamental of Statistics, Vol. I, World Press, Calcutta.
2. Mood A.M., Greybill, F.A. and Bose D.C. (1974): Introduction to the Theory of Statistics, McGraw Hill.
3. Hogg R.V. and Craig A.T. (1972): Introduction to Mathematical Statistics, Amerind Publishing Co.
4. Mukhopadhyay, P. (1996): Mathematical Statistics, New Central Book Agency.
5. Rohtagi V.K. (1967) : An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
6. Hoel P.G. (1971): Introduction to Mathematical Statistics, Asia Publishing House.

STB - 202 : PRACTICALS BASED ON COURSE No. STB - 201   Credits : 2

(The Practical Paper shall be of THREE HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

Elementary ideas of binary number system, hardware and software components of computer system, and DOS operating system will be given to the students.

The students will be required to do the practicals, listed below (based on the contents of the theory paper STB – 201), using MS Excel :

1. Product moment correlation coefficient, correlation ratio, interaclass correlation coefficient.
2. Fitting of curves by least square method.
3. Regression of two variables.
4. Rank correlation.
5. Partial and Multiple correlations and regressions.
6. Fitting of discrete and continuous distributions.

SEMESTER - III

STB – 301 : STATISTICAL INFERENCE   Credits : 4

Concept of random sample from a distribution, statistic and its sampling distribution, standard error of an estimate, standard errors of sample mean and proportion, sampling distribution of sum of Binomial, Poisson random variables and mean of normal distribution, requirement of a good estimator with examples.

Simple, composite null and alternative hypotheses, critical region, types of error, level of significance, p-values, size and power of a test, chi-square, t and f distributions and their properties (without proof), testing of equality of two means and two variances of two normal distributions, testing for the significance of sample correlation coefficient and testing the equality of means and variances of bivariate normal distributions.

Statement of weak law of large number and central limit theorem, use of central limit theorem for testing a single mean, single proportion equality of two means and two proportions, Fisher's Z transformation and its uses, Pearson's chi-square test for goodness of fit, test of independence of two attributes.

Definition of order statistics and their distributions, sign test, run test, median test, Spearmen's rank correlation test, Wilcoxon-Mann Whitney test, Kolmogorov, Smirnov one sample and two sample tests.

Books for References
1. Mood A.M., Greybill F.A. and Bose D.C. (1974) : Introduction to the Theory of Statistics, McGraw Hill.
2. Freund J.E. (2001) : Mathematical Statistics, Prentice hall of India.
3. Goom A.M., Gupta M.K. and Das Gupta B. (1991) : Fundamental of Statistics, Vol. I, World press, Calcutta.
4. Rohtagi V.K. (1967): An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
5. Rao C.R. (1973) : Linear Statistical Inference and its Applications, Revised edition, Weley Eastern.

6. Hoges J.L. and Lehmann E.L. (1964): Basic Concepts of Probability and Statistics, Holden Day.

7. Snedecor G.W. and Cochran W.G. (1967) : Statistical Methods, Iowa State University Press.

STB - 302: PRACTICALS BASED ON COURSE No. 301   Credits : 2

(The Practical Paper shall be of FOUR HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

Programming with FORTRAN : The students will be given basic introduction of FORTRAN , such as :

FORTRAN Character Codes, Constants, Variables, names, arithmetic, logic and relational operators, expression, Arithmetic, relational and logical expression, Rules for writing arithmetic expressions, commands for using FORTRAN compiler.

Writing FORTRAN programmes for simple mathematical expressions such as, factorial of a positive integer, summation of simple finite series, solution of some mathematical expressions.

The students will be required to do practicals, listed below (based on the contents of the theory paper STB – 301), using FORTRAN :

1. Test of significance based on t, chi-square and F.
2. Testing of significance of sample correlation coefficient.
3. Use of Z transformation.
4. Large sample tests for means and proportion, tests of goodness of fit and independence of attributes in contingency tables.
5. Sign, run, median, Wilcoxon – Mann Whitney non-parametric test.

STB – 303ANC : DESCRIPTIVE STATISTICS   Credits : 3

Nature and scope of Statistics: Measurement scales, primary and secondary data, Methods of Collection of primary data, methods of data representation, text, tabular, diagrammatic and graphical representation.

Frequency distribution and principles governing their representation, graphical representation of frequency distributions.

Measures of central tendency and their properties, uses and limitations, partition values : quartiles, deciles and percentiles.

Dispersion and its various measures with their properties and uses. coefficient of variation.

Central and raw moments up to fourth order. skewness, kurtosis and their measures.

Bivariate Data: Scatter diagram, correlation, product moment correlation coefficient, regression lines and their uses, rank correlation, concept of multiple correlation and partial correlation in case of three variables.

Concept of probability, classical and statistical definition of probability, additive and multiplicative theorems of probability, conditional probability and Baye's theorem.

Random variable : Elementary idea of probability mass function, probability density function and distribution function.

 Binomial, Poisson and normal distributions with their properties and applications.

Books for reference

   1. Goon, A.M., Gupta, M.K., Dasgupta, B. : Fundamental of Statistics Vol.-I
   2. Kapoor, V.K. and Saxena, H.C. : Mathematical Statistics
   3. Yul, G.V. and Kendall, M.G. : Introduction to the Theory of Statistics
   4. Kenny, J.F. and Keeping, E.S. : Mathematics of Statistics ,Vol.-I

SEMESTER - IV

STB – 401 : SAMPLE SURVEYS AND DESIGN OF EXPERIMENTS   Credits : 4

Concept of population and sample, need for sampling, complete enumeration versus sampling, Basic concepts in sampling, sampling and Non-sampling errors, Acquaintance with the working (questionnaires, sampling design, methods followed in field investigation, principal findings, etc.) of NSSO and other agencies under taking sample surveys.

Simple random sampling with and without replacement, estimation of population mean, population proportions and their standard errors. Stratified random sampling, proportional and optimum allocation, comparison with simple random sampling for fixed sample size.

Ratio, product and regression methods of estimation, estimation of population mean, evaluation of bias and variance to the first order of approximation, comparison with simple random sampling.

Systematic sampling (when population size (N) is an integer multiple of sampling size (n)). Estimation of population mean and standard error of this estimate, comparison with simple random sampling. Elementary idea of cluster sampling.

 Analysis of variance for one way and two way classifications, need for design of experiments, basic principle of experimental design: randomization, replication and local control, complete analysis and layout of completely randomized design, randomized block design and Latin square design.

Factorial experiments and their advantages, main and interaction effects in 2^2 and 2^3 factorial experiments.

Books for References

1. Cochran W.G. (1977) :Sampling Techniques, John Wiley and Sons, New York.
2. Sukhtme P.V., Sukhatme B.V., Sukhatme S. and Asok C. (1984) : Sampling Theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
3. Goon A.M., Gupta M.K. and Das Gupta B. (1986) : Fundamentals of Statistics, Vol. II, world Press, Calcutta.
4. Sampath S. (2000) : Sampling Theory and Methods, Narosa Publishing House, New Delhi.
5. Des Raj (2000) : Sample Survey Theory, Narosa Publishing House, New Delhi.
6. Murthy M.N. (1967) : Sampling Theory and Methods, Statistical Publishing Society, Calcutta.
7. Kish L (1965): Survey Sampling, John Wiley and Sons, New York.
8. Hansen M.H., Hurwitz W.N. and Madow W.G. (1975) : Sample Survey Method and Theory, Vol. I, Methods and Applications, Vol. II, New York and London, Wiley Publication.
9. Cochran W.G. and Cox G.M. (1957) : Experimental Design, John Wiley and Sons.
10. Das, M.N. and Giri J. (1986) : Design and Analysis of Experiments, Springer Verlag.
11. Kempthorne O. (1965) : The Design and Analysis of Experiments, Wiley Eastern.

STB – 402 : PRACTICALS BASED ON COURSE No. 401　　　　　　　Credits : 2

(The Practical Paper shall be of FOUR HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

Programming with FORTRAN : The students will be given basic introduction of FORTRAN statements, such as :

FORTRAN statements: Specification data, Format one – dimensional Array statements, Assignment statements, Arithmetic statement, simple forms of control statements: DO loops, DO-CONTINUE, STOP and END statements.

Writing FORTRAN programmes for mean, standard deviation, quantiles, raw and central moments, correlation and regression coefficients.

The students will be required to do practicals, listed below (based on the contents of the theory paper STB – 401), using FORTRAN :
1. Selection of sample and determination of sample size.
2. Simple random sampling and stratified random sampling.
3. Allocation problems in stratified random sampling
4. Ratio, Product, Regression method of estimation and comparison with simple random sampling.
5. Analysis of variance for one way and two way classifications.
6. Analysis of CRD, RBD and LSD.
7. Analysis of 2^2 and 2^3 factorial designs.

SEMESTER - V

STB – 501 : APPLIED STATISTICS   Credits : 3

Demographic Methods: Sources of demographic data, census, registration, ad hoc surveys, hospital records, demographic profiles of the Indian census.

Measurement of Mortality and Life Table: Crude death rate, Standardized death rates, Age-specific death rates, Infant Mortality rate, Death rate by cause, Complete life table and its main features, Uses of life table.
Measurement of Fertility: Crude birth rate, general fertility rate, age specific birth rate, total fertility rate, gross reproduction rate, net reproduction rate.

Index Numbers: Price relatives and quantity or volume relatives, Link and chain relatives composition of index numbers; Laspeyre's, Paasche's, Marshal Edgeworth's and Fisher's index numbers; chain base index number, tests for index number, cost of living index number.

Time Series Analysis: Economic time series, different components, illustration, additive and multiplicative models, determination of trend, seasonal and cyclical fluctuations.

Statistical process and product control: Quality of a product, need for quality control, basic concept of process control, process capability and product control, general theory of control charts, causes of variation in quality, control limits, sub grouping summary of out of control criteria. Charts for attributes : p chart, np chart, c-chart, V chart. Charts for variables: R,
 (X, R), (X, σ) charts.

Books for References
1. Mukhopadhyay, P. (1994) :Applied Statistics, new Central Book Agency Pvt. Ltd., Calcutta.
2. Srivastava O.S. (1983) : A Text Book of Demography, Vikas Publishing House, new Delhi.
3. Benjamin B. (1959): Health and Vital Statistics, Allen and Unuwin.
4. Goon A.M., Gupta M.K. and Das Gupta B. (1986): Fundamentals of Statistics, Vol. II, World Press, Calcutta.
5. Duncan A.J. (1974) : Quality Control and Industrial Statistics, IV Edision, Taraporewala and Sons.
6. Montomery, D.C. (1991): Introduction to the Statistical Quality Control, IInd Editions, John Wiley and Sons.
7. Brown R.G. (1963): Smoothing, Forecasting and Prediction of Discrete Time Series, Prentice Hall.
8. Chatfield C. (1980) : The Analysis of Time Series, IInd Edision Chapman and Hall.

STB – 502 : STATISTICAL INFERENCE AND DECISION THEORY   Credits : 3

Parametric model, parameter, random sample and its likelihood, statistics and its sampling distribution.

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Point estimation : properties of estimators, mean square and minimum mean square error estimator, unbiasedness and minimum variance unbiased estimator, Cramer-Rao lower bound, amount of information, consistency of estimators and sufficient conditions for consistency, relative efficiency of an estimator, asymptotic efficiency, sufficiency, factorization theorem (without proof), concept of complete sufficient statistics, Rao-Blackwell theorem.

Methods of estimation : moments, maximum likelihood, minimum chi-square, least square with examples, BAN and CAN estimators, point estimates of measures of location, dispersion, regression, correlation and other useful parameters.

Concepts of confidence interval and confidence coefficient, confidence intervals for the parameters of univariate normal, two independent normal distributions and exponential distributions.

Statistical hypotheses, critical region, size and power of a test, most powerful test, randomized and non randomized test, Neyman Pearson lemma and its applications, uniformly most powerful unbiased test, power likelihood ratio test and its applications, functions of UMP with simple illustration.

Elements of decision problems: Loss function, risk function, estimation and testing viewed as decision problems. Bayes rule.

Books for References
1. Freund J.E. (2001) : Mathematical Statistical, Prentice Hall of India.
2. Hogg R.V. and Craig A.T. (1978) : Introduction of Mathematical Statistics, Fourth Edition, Collier Macmillon Publishers.
3. Mood A.M., Graybill E.A. and Bose D.C. (1974) : Introduction to the Theory of Statistics, McGraw Hill.
4. Rao, C.R. (1973) : Linear Statistical Inference and its Applications, Revised edition Wiley Eastern.
5. Rohtagi V.K. (1967) : An Introduction to Probability Theory and Mathematical Statistics, John Wiley and Sons.
6. Goon A.M., Gupta M.K. and Dasgupta B. (1980) : An Outline of Statistical Theory, Vol. 2, The World Press Publishers Pvt. Ltd. Calcutta.
7. Kale B.K. and Sinha S.K. : Life Testing and Reliability.

STB - 503 : PROGRAMMING WITH C   Credits : 3

History and features of C language, components of C language, structure of a C program. Data type: Basic data types, enumerated data types, derived data types. Variable declaration, local, global, parametric variables, assignment of variables, numeric, character, real and string constants, arithmetic relation and logical operators, assignment operators, increment and decrement operators, conditional operators, Bitwise operators, type modifiers and expressions, writing and interpreting expressions, using expressions in statements. basic input / output.

Control Construct. I Control statements, conditional statements, if . . . . . . else, nesting of   if . . . . . . else, elself ladder, swith statements. Loops in C: for, while, do . . . . . . while loops

Control Constructs II

Break, continue, exit ( ), go to and label declarations.
One dimensional two dimensional and multidimensional arrays.
Storage classes: Automatic variables, External variables, Static variables, Scope and lifetime of declarations.

Functions, classification of functions, functions definition and declaration, assessing a function, return statement, parameter passing in functions, rewise on in Functions. Pointers (concept only).

Structure: Definition and declaration; structure (initialization) comparison of structure variable array of structures : array within structures, structures within structures, passing structures to functions, unions accessing a union member, union of structure, initialization of a union variable, uses of union. Introduction to linked list, linear linked list, insertion of a node in list, removal of a node from list.

Files in C. Defining and opening a file, input – output operation con a file, creating a file, reading a file.

Books for References
1. Balagurusamy E. :Programming in ANSI C Tata McGraw Hill.
2. Kanetkar Y.P.: working with C. BPB Publication.
3. Gottfried Byron S. : Theory and problems of Programming with CTMH.
4. Schildt, Herbest:: C The Complete Reference, III ED TMH.
5. Schildt, Herbert : C Made Easy, McGraw Hill.

STB – 504 : OPERATIONS RESEARCH   Credits : 3

Definitions and scope of operation research, different types of models in operations research – their construction and general method of solution.

Elements of linear programming problem (LPP): Canonical and standard forms, formulation of LPP, graphical method to solve two variable LPP, solution of LPP using simplex procedure, use of artificial variables in LPP, generation of extreme point solutions, principle of duality in LPP, statement and proof of duality theorem, simple problems based on duality theorem.

Allocation Models: Transportation problem (T.P.), different methods of finding initial feasible solution of a T.P., UV method of finding optimal solution of a T.P., solution of assignment problem using Hungarian method.

Inventory Control: Definitions of various costs involved in inventory control. Deterministic Economic Lot Size problems with and without shortages.

Theory of games: Two person zero-sum games, pure and mixed strategies, saddle point, maximin-minimax principle of rectangular games, games without saddle point, dominance and modified dominance principles, graphical solution of 2xN and Mx2 games, reduction of game problems to a L.P.P.

Books for References
1. Taha, H.A. (1999): Operations Research, Macmillan Publishing Company.
2. Hiller F.S. and Libermann G.J. (1995): Introduction to Operations Research, McGraw Hill.
3. Hadley G. (1965) : Linear programming, Addison Wesley.
4. Gass G.I. (1958): Linear Programming- Methods and Applications, McGraw Hill.
5. McKinsey J.C.C. (1952): Introduction to the Theory and Games, McGraw Hill Book Co.
6. Kanti Swaroop, Gupta P.K. and Singh M.M. (1985) : Operations Research, Sultan Chand and Sons.

STB – 505 : PRACTICALS BASED ON COURSE Nos . STB – 501 AND STB – 502   Credits : 3

(The Practical Paper shall be of FOUR HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

1. CDR, STDR, CBR, Age specific death rates, life tables, GRR, NRR, Logistic curve and related practicals.
2. Laspeyre's, Passche's, Fisher's index numbers.
3. Problems related to trend, seasonal and cyclical fluctuations.
4. Charts: p, np, c, R,   (X , R), (X, σ).
5. Practicals on   moment, maximum likelihood, Minimum chi-square, least squares methods of estimation.
6. Testing of hypothesis for mean, variance, correlations, etc.

STB – 506 : PRACTICALS BASED ON COURSE Nos. STB – 503 AND STB – 504 Credits : 3

(The Practical Paper shall be of THREE HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

The practicals will be based on the contents of Course Nos. STB – 503 and STB - 504.

STB – 507ANC : STATISTICAL INFERENCE, SAMPLING AND DESIGN OF EXPERIMENTS
Credits : 3

Elements of testing of hypotheses, null hypothesis, simple and composite hypothesis, two kinds of error, level of significance, size and power of tests, p-value, large sample tests for mean and proportions, chi-squire, t and f tests and their applications.

Concept and scope of sampling : Population, complete enumeration verses sampling, sampling frame, methods of sampling.

Simple random sampling with and without replacement, procedures of selecting a random sample from the population, estimation of population mean and population proportion and standard error of these estimates.

Stratified random sampling : proportional and optimum allocations, comparison with SRS.

Systematic Sampling, cluster sampling and two - stage sampling : sampling procedures and estimation of population mean under these schemes.

Design of experiment :Basic principles of design of Experiment, randomization, replication and local control.

Completely randomized design (CRD), Randomized block design (RBD), and Latin Squire Design (LSD) : Lay out and analysis of these designs with merits and demerits.

Factorial experiment and their advantages. Main effects, interaction effects and analysis of 2^2 and 2^3 factorial experiments.

Books for reference
1. Goon, A.M., Gupta, M.K. Dasgupta, B.: Fundamental of Statistics
2. Cochran, W.G. : Sampling Techniques
3. Sukhatme, P.V. Sukhatme, B.V. : Sampling Theory of Surveys with Applications

SEMESTER – VI

STB – 601 : NUMERICAL METHODS
Credits : 3

Finite differences of different orders, Δ, E and D operators, factorial representation of a polynomial, separation of symbols, sub-division of intervals, differences of zero.

Concept of interpolation and extrapolation: Newton Gregory's forward and backward interpolation formulae for equal intervals, divided differences and their properties, Newton's formula for divided

difference, Lagranges formula for unequal intervals, central difference formula due to Gauss, Stirling, Bessel, Laplace and Everett, concept of error terms in interpolation formula.

Inverse interpolation: Different methods of inverse interpolation.

Numerical differentiation.

Numerical Quadrature : trapezoidal rule, Simpson's one-third and three-eight rules, weddle's rule.

Summation of series: Series whose general term (i) is the first difference of a function (ii) is in geometric progression.

Numerical solutions of differential equations: Euler's method, Milne's method, Picard's method and Runge-Kutta method.

Books for References

1. Scarborough J.B.: Numerical Mathematical Analysis, Oxford University, Press and Oxford Book Co.
2. Saxena, H.C.: Calculas of finite Differences,
3. Freeman. H.: Finite Differences for Actuarial Students, Cambridge University Press.
4. Aitkinson U.: Eementary Numerical Analysis.
5. Sastry S.S.: Introductory Methods of Numerical Analysis, Fourth Edition, Prentice Hall of India.
6. Kunz, K.S.: Numerical Analysis, McGraw Hill.

STB – 602 : DEMAND ANALYSIS, ANALYSIS OF INCOME DISTRIBUTION
AND QUEUING THEORY   Credits : 3

Theory and analysis of consumer's demand, law of demand, price elasticity of demand, estimation of demand curves, forms of demand functions, Engel's curve, income elasticity of demand.

Analysis of income and allied distributions : Pareto distribution, graphical test, fitting of Pareto law, illustration, lognormal distribution and properties, Lorenz curve, Gini's coefficient.

Elements of queuing theory, characteristics of queues, Poisson process, distribution of inter-arrival time, definition of steady state condition, (M/M/1) : (∞ / FIFO) and (M/M/1) : (N/ FIFO models, birth and death process, (M/M/K) : (∞ / FIFO) and (M/M/K) : (N / FIFO) models.

Finite and infinite length models with associated distribution of queue length and waiting time, steady – state solutions of (M/E_k / 1) and (E_k / 1) queues, machine interface problem.

Books for References

1. Kanti Swaroop, Gupta P.K. and Singh M.M. (1985) : Operations Research, Sultan Chand and Sons.
2. Hiller F.S. and Libermann G.J. (1995): Introduction to Operation Research, McGraw Hill.
3. Taha H.A. (1999) : Operation Research, Macmillan Publishing Company.
4. Mukhopadhyay P. (1999): Applied Statistics, New Central Book Agency Pvt. Ltd., Calcutta.
5. Goon A.M., Gupta M.K. and Dasgupta B. (1986): Fundamentals of Statistics, Vol.II, World Press, Calcutta.
6. Croxton F.E. and Cowden, D.F.: Applied General Statistics.
7. Asthana B.N. and Srivastava S.S.: Applied Statistics in India.

STB – 603 : ELEMENTS OF STOCHASTIC PROCESSES   Credits : 3

Definition and examples of stochastic process: classification of general stochastic processes into discrete/continuous time, discrete/continuous state spaces, types of stochastic processes elementary problems, random walk, gambler's ruin problem.

Markov chains: Definition and examples of Markov chain, transition probability matrix, classification of states, recurrence, simple problems, basic limit theorem of Markov Chain (statement only):, stationary probability distribution, applications.

Continuous time Markov Chain: Poisson process and related inter-arrival time distribution, pure birth process, pure death process, birth and death process, problems.

Branching process: Definition and examples of discrete time branching process, probability generating function, mean and variance, probability of extinction problems.

Books for References
1. Karlin S. and Taylor H.M. (1995): A First Course in Stochastic Process, Academic Press
2. Hoel P.G., Port S.C. and Stone C.J. (1991): Introduction to Stochastic Process, Universal Book Stall.
3. Parzen E. (1962): Stochastic Process, Holden-Day
4. Cinlar E. (1975) : Introduction to Stochastic Processes, Prentice Hall.
5. Adke S.R. and Manjunath S.M. (1984) : An Introduction to Finite Markov Processes, Wiley Eastern.
6. Medli J. (1996) : Stochastic Processes, new Age International (P) Ltd.
7. Ross S.M. (1983) : Stochastic Process, John Wiley.
8. Taylor H.M. and Karlin S. (1999) : Stochastic Modeling, Academic Press.

STB – 604 : RELIABILITY   Credits : 3

Life testing and reliability theory : Basic concepts of life testing experiments, reliability, hazard function and their relationship.

Elementary notion of censored data, type I and type II censoring schemes, Poisson process.

Parametric distributions : Weibull, gamma, lognormal, exponential as life time distributions, point and interval estimation procedures for the above distributions.

Testing reliability hypothesis for exponential and Weibull distributions.

System reliability concepts : Parallel system, series system and k out of n system.

Elementary idea of reliability models for non – maintained systems.

Books for References

Bain, L. J. and Engelhardt, M. : Statistical Analysis of Reliability and Life Testing Models, Marcel Deckker.
1. Zack, S. : Introduction to Reliability Analysis : Probasbility Model and Statistical Methods, Springer Verlag.
2. Barlow, R. E. and Proschan, F. : Statistical Theory of Reliability and Life Testing : Probability Models, Holit Rinechart and Winston.
3. Gnedenko, Bylyayer and Solovyer : Mathematical Methods of Reliability Theory.
4. Kale, B. K. and Sinha, S. K. : Life Testing and Reliability.

STB – 605 : PRACTICALS BASED ON COURSE Nos. STB – 601 AND STB – 603 Credits : 3

(The Practical Paper shall be of FOUR HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

STB – 606 : PRACTICALS BASED ON COURSE Nos. SBT – 602 AND STB – 604   Credits : 3

(The Practical Paper shall be of FOUR HOURS duration. Out of total 100 marks, 80 marks will be assigned to the performance in practicals, 10 marks on the practical record book and 10 marks on the viva – voce).

STB – 607 : PROJECT Credits : 4

The project work shall be spread over the whole semester. A project be undertaken by a group of students. However, the project report shall be submitted by each member of the group separately.

A project report shall clearly state the problem addressed, the methodology adopted, the assumptions and the hypotheses formulated, any previous reference to the study undertaken, statistical analyses performed and the broad conclusion drawn. There shall be an external examiner and an internal examiner (preferably the supervisor of the student) for the evaluation of the project work. Out of total 100 marks assigned to the project, 60 marks will be assigned on the evaluation of the project report separately by both the examiners and 40 marks will be assigned on the oral presentation and viva – voce.

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B. Sc. (HONS.) ZOOLOGY

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

Offered By:

Department of Zoology

Faculty of Science

Semester-wise Distribution of Courses and Credits

	Semester –I	
Course Code	**Title**	**Credits**
ZOB101	**(A)** Systematics & Animal Diversity *(Credit -2)*, and **(B)** Animal Form & Function *(Credit-2)*	4
ZOB102	*Lab. exercises based on course ZOB101*	2
	Total	**6**

	Semester –II	
ZOB201	**(A)** Cell Biology *(Credit-2)*, and **(B)** Biochemistry *(Credit-2)*	4
Z0B202	*Lab. exercises based on course ZOB201*	2
	Total	**6**

	Semester –III	
ZOB301	**(A)** Comparative Physiology *(Credit-1.5)*, **(B)** Endocrinology *(Credit-1.5)*, and **(C)** Developmental Biology *(Credit-1)*	4
ZOB302	*Lab. exercises based on course ZOB301*	2
	Total	**6**

	Semester –IV	
ZOB401	**(A)** Genetics *(Credit-2)*, **(B)** Evolution *(Credit-1)*, and **(C)** Animal Behaviour *(Credit-1)*	4
ZOB402	*Lab. exercises based on course ZOB401*	2
	Total	**6**

	Semester –V	
ZOB501	Functional Anatomy & Economic importance of Non chordates	4
ZOB502	**(A)** Biochemistry *(Credit-2)*, and **(B)** Mammalian Physiology *(Credit-2)*	4
ZOB503	**(A)** Mammalian Endocrinology *(Credit-2)*, and **(B)** Developmental Biology *(Credit-2)*	4
ZOB504	*Lab. exercises based on course ZOB501*	2
ZOB505	*Lab. exercises based on course ZOB502*	2
ZOB506	*Lab. exercises based on course ZOB503*	2
	Total	**18**

	Semester –VI	
ZOB601	Functional Anatomy & Economic importance of Chordates	4
ZOB602	**(A)** Cell Biology *(Credit-1.5)*, **(B)** Genetics *(Credit-1.5)*, and **(C)** Evolution *(Credit-1)*	4
ZOB603	**(A)** Immunology *(Credit-1)*, **(B)** Microbiology *(Credit-1)*, **(C)** Environmental Biology	4

	(Credit-1), and **(D)** Biotechniques *(Credit-1)*	
ZOB604	*Lab. exercises based on course ZOB601*	2
ZOB605	*Lab. exercises based on course ZOB602*	2
ZOB606	*Lab. exercises based on course ZOB603*	2
Z0B607	Project work/ Field Study	4
	Total	**22**
	Grand Total	**64**

ZOB 101: SYSTEMATICS AND ANIMAL DIVERSITY &
ANIMAL FORM AND FUNCTION
(Credit 4)
Section A: Systematics and Animal Diversity
(Credit 2)

Hours of teaching

1. Systematics

   1.1. Definition of taxonomy and relationship with systematics   **1**

   1.2. Zoological nomenclature   **1**

      1.2.1. Binominal

      1.2.2. Trinominal

   1.3. Kinds of taxonomic characters   **2**

      1.3.1. Morphological

      1.3.2. Embryological

      1.3.3. Cytogenetical

      1.3.4. Biochemical

      1.3.5. Numerical

   1.4. Kinds of Zoological classification   **2**

      1.4.1. Components of classification

      1.4.2. Linnaean hierarchy

   1.5. Concepts of species   **2**

      1.5.1. Typological

      1.5.2. Nominalistic

      1.5.3. Biological

      1.5.4. Evolutionary

2. Animal Diversity

   2.1. Criteria for classification of multicellular animals   **4**

      2.1.1. Symmetry

      2.1.2. Early development: spiral and radial cleavage.

                           Protostomes and Deuterostomes

      2.1.3. Body cavities: acoelomates, pseudocoelomates, coelomates (schizo-
          and enterocoelomates).

      2.1.4. Homology and analogy

   2.2. Non–Chordates: General characters and classification of the following up   **6**

      to classes with examples showing distinctive / adaptive features

      2.2.1. Protozoans

      2.2.2. Poriferans

      2.2.3. Cnidarians

      2.2.4. Ctenophorans

2.2.5. Platyhelminths

2.2.6. Nematodes

2.2.7. Annelids

2.2.8. Arthropods

2.2.9. Molluscs

2.2.10. Echinoderms

2.3. Hemichordates: General characters and classification up to sub -classes   **1**

2.4. Chordates: General characters and classification of the following up to   **7**

    sub-classes with examples

2.4.1. Protochordates: Urochordates, Cephalochordates

2.4.2. Cyclostomes

2.4.3. Fishes

2.4.4. Amphibians

2.4.5. Reptiles

2.4.6. Birds

2.4.7. Mammals

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Section B: Animal Form and Function

(Credit 2)

</div>

      Hours of teaching

1. Nutrition & Digestion   **4**

1.1. Intracellular and extracellular digestion: food vacuole and gastrovascular cavity

1.2. Feeding mechanisms: suspension, deposit, cropping & sucking (herbivorous) and raptorial (carnivorous)

2. Gas exchange and internal transport   **5**

2.1. Structure and function of gills

2.2. Structure and function of trachea, book lungs and vertebrate lungs

2.3. Respiratory pigments and transport of gases

2.4. Types of circulatory systems

2.5. Pattern of circulation in non-chordates and chordates

3. Types of excretory organs in non-chordates and chordates   **4**

3.1. Open tubular: metanephridia

3.2. Closed saccular: protonephridia, Malpighian tubules and kidney

4. **Nervous system**

4

4.1. Patterns of nervous system in non-chordates

4.2. Organization of nervous system in vertebrates: central and autonomous system

5. Receptors and Sense organs   **4**

5.1. Phonoreception in fish and mammals

5.2. Photoreception in insects and mammals

6. Reproduction   **5**

6.1. Types of asexual reproduction: fission, regeneration and parthenogenesis

6.2. Sexual reproduction: primary and accessory sex organs

6.3. Parental care in amphibians

Books Recommended

1. Dalela & Sharma: Animal Taxonomy and Museology (1976, Jai Prakash Nath).
2. Kapoor: Theory and Practicals of Animal Taxonomy (1988, Oxford & IBH).
3. Simpson: Principles of Animal Taxonomy (1962, Oxford).
4. Roymahoney: Laboratory Techniques in Zoology (1966, Butterworths).
5. Mayer & Ashlock: Principles of Systematic Zoology (1991, McGraw Hill).
6. Boolotian & Stiles: College Zoology (10th ed 1981, Macmillan)
7. Campbell & Reece: Biology (7th ed 2005, Pearson)
8. Dorit, Walker & Barnes: Zoology (1991, Saunders)
9. Taylor,.Green & Stout : Biological Sciences (3rd ed. 2005, Cambridge)
10. Mader: Biology (9th ed. 2007, W.C. Brown)
11. Marshall & Williams: Textbook of Zoology, Vol. I (Parker & Haswell, 7th ed. 1972, Macmillan)
12. Miller & Harley: Zoology (6th ed. 2005, W.C. Brown)
13. Nigam: Biology of Non-chordates (1997, S Chand)
14. Nigam: Biology of Chordates (1997, S Chand)
15. Parker & Haswell: Text Book of Zoology, Vol. II (2005, Macmillan)
16. Purves et al: Life-the Science of Biology, (7th ed. 2004, Sinauer)
17. Starr: Biology, Concepts and Applications (1991, Wadsworth)
18. Tortora and Anagnostakos: Principles of Anatomy and Physiology (6th ed. 1986, Harper & Row).
19. Villee, Walker & Baranes: General Zoology (5th ed 1979, Saunders)
20. Wolfe: Biology – the Foundations (1987, Wadsworth)
21. Schmidt Nielson: Animal Physiology (5th ed. 2005, Cambridge)
22. Hoar: General and Comparative physiology (7th ed. 2005), Indian reprint.
23. Arms and Camp: Biology (4th ed. 1995)

LABORATORY EXERCISES
ZOB 102: SYSTEMATICS AND ANIMAL DIVERSITY &
ANIMAL FORM AND FUNCTION
(Credit 2)

Part A: Systematics and Animal Diversity

1. Identification of certain locally available fishes on the basis of their morphological characters.

2. Identification of the following species of *Drosophila* on the basis of their sex-combs.: *D. melanogaster*, *D .ananassae*, *D .bipectinata* and *D. malerkotliana.*

3. Zoological names of some common animals.

4. Cold anesthesia in fish.

5. Narcotization of leech/earthworm and pond snail.

6. Preservation of insects.

7. Fixation of fresh water protozoans.

8. Study of transverse sections/chart of the following:

    Sycon (as an example of Parazoa to show its structure, spicules and canal system), *Hydra* (as an example of diploblastic animal), *Fasciola* (as an example of triploblastic acoelomate animal), *Ascaris* (as an example of triploblastic pseudocoelomate animal), *Hirudinaria (*as an example of triploblastic schizocoelomate animal), Frog (as an example of triploblastic enterocoelomate animal) – by charts.

9. Study of salient features and classification up to classes of the following non-chordates with special emphasis on their adaptive characters:

    *Amoeba, Euglena, Plasmodium, Paramecium, Euplectella, Physalia, Corallium, Sea-Anemone, Hormiphora, Taenia, Ascaris (*male and female)*, Nereis* (including heteronereid stage), *Hirudinaria, Bonellia, Chiton, Mytilus,* Octopu*s, Peripatus, Limulus, Eupagurus, Sacculina, Asterias, Echinus, Holothuria, Ophiothrix, Antedon.*

10. Salient features and classification up to Orders of the following with special emphasis on their adaptive characters:

    Balanoglossus, Herdmania, Amphioxus *Lamprey, Trygon, Chimaera,* Lung Fish, *Uraeotyphlus, Ambystoma, Alytes, Hyla, Chameleon,* Tortoise, poisonous and non-poisonous snakes, Duck, Kiwi, Duck-billed Platypus.

Part B: Animal Form and Function

1. *Animal nutrition*

    1.1. Study and mounting of cephalic appendages of *Palaemon*

    1.2. Study and mounting of salivary glands of *Periplaneta americana*

    1.3. Dissection of digestive system of *Palaemon* and mounting of Hastate plate

    1.4. Dissection of digestive system of *Mystus*

    1.5. Demonstration of internal anatomy of *Pila*

2. *Gas exchange and internal transport*

    2.1. Mounting of heart and trachea of *Periplaneta americana*

    2.2. Dissection of afferent and efferent branchial arteries of *Mystus*

3. *Nervous system, receptors and sense organs*

3.1. Dissection of nervous system of *Palaemon*

3.2. Mounting of statocyst of *Palaemon*

3.3. Dissection of 5th, 7th, 9th and 10th cranial nerves of *Mystus*

4. *Reproduction*

4.1. Permanent preparation of gemmules of sponges

4.2. Study of the following through permanent slides/museum specimens:

Conjugation in *Paramecium,* Sporocyst of *Fasciola* with developing Redia, Cercaria and Metacercaria larvae, Trochophore larva, Nauplius and Zoea larvae, Bipinnaria, Auricularia and Pluteus larvae, Tornaria, Ammocoetes and Tadpole (frog); Axolotl

Semester II
ZOB 201: CELL BIOLOGY & BIOCHEMISTRY
(Credit 4)
Section A: Cell Biology
(Credit 2)

Hours of teaching

1. The Cell   **3**

1.1. Introduction to cell theory

1.2. Comparison of a generalized pro- and eukaryotic cell

1.3. Methods in Cell Biology: Elementary idea of microscopy and cell fractionation

2. Organization of cell   **8**

2.1. Extranuclear

2.1.1. Elementary knowledge of structure and function of plasma membrane

2.1.2. Introduction to endomembrane system (endoplasmic reticulum, Golgi complex, lysosome), peroxisome

2.1.3. Introduction to cytoskeleton

2.1.4. Structure and functions of mitochondria

2.2 Nuclear   **6**

2.2.1. Nuclear envelope, nucleolus and biogenesis of ribosome

2.2.2. Interphase chromatin and its compaction into metaphase chromosome

2.2.3. Introduction to polytene and lampbrush chromosomes

3. Cell reproduction   **6**

3.1 Basic features of cell cycle

3.2 Mitosis, mitotic spindle and chromosome movement

3.3 Process and phases of meiosis and its significance

4. Elementary idea of cell transformation and cancer   **2**

5. Introduction to the cellular basis of immunity   **1**

Section B: Biochemistry
(Credit 2)

Hours of teaching

1. General   **3**

1.1. Chemistry of living system: its scope and importance, chemical bonds and energy

1.2. Biomolecules: configuration and conformation

1.3. Properties of water as biological solvent

1.4. Introduction to metabolism

2. Amino acids 2

2.1. Structure and classification

2.2. Properties of peptide bond

3. Proteins 2

3.1 Functions and diversity

3.2 Structural organisation and conformation

4. Enzymes 3

4.1. General properties

4.2. Major classes of enzymes

4.3. Mechanism of enzyme action (binding to substrate, lowering of energy of activation, Km and Vmax)

5. Carbohydrates 3

5.1. Classification and nomenclature

5.2. Structure and conformation of monosaccharides

5.3. Reducing and non-reducing sugars

5.4. Oligosaccharides (disaccharides) and polysaccharides

6. Lipids 2

6.1. Biological significance and classification

6.2. Fatty acids

6.3. Formation of lipid bi-layer

7. Nucleic acids 11

7.1. Bases, nucleosides and nucleotides

7.2. DNA structure: DNA double helix (Watson and Crick model)

7.3. DNA and RNA as genetic material

7.4. DNA replication

7.4.1. Semi-conservative replication

7.4.2. Basic mechanism of replication (Prokaryotes)

7.5. Types of RNA

7.6. Transcriptional unit and basic concept of transcription (Prokaryotes)

7.7. Genetic code and basic mechanism of translation (Prokaryotes)

7.8. Introduction to recombinant DNA techniques and their application

Books Recommended

Cell Biology

1. Alberts *et al*: Essential Cell Biology (1998, Garland)

2. Alberts *et al*: Molecular Biology of the Cell (2008, Garland)

4. Karp: Cell and Molecular Biology (2008, John Wiley)

5. Lodish *et al*: Molecular Cell Biology (2008, Freeman)

6. Pollard & Earnshaw: Cell Biology (2002, Saunders)

7. Cooper and Hausman: The Cell A Molecular approach (2007, Sinauer)

Biochemistry

1. Boyer: Concepts in Biochemistry (3rd ed. 2006, Brooks/Cole)

2. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed, 2007, Worth),

3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)

4. Stryer: Biochemistry (5th ed. 2001, Freeman)

5. Conn, Stumpf, Bruening & Doi: Principles of Biochemistry (5th ed. 1987, Wiley)

LABORATORY EXERCISES
ZOB 202: CELL BIOLOGY & BIOCHEMISTRY
(Credit 2)

Part A: Cell Biology

1. Drawing of ultrastructure of cell and different organelles (from photographs provided)

2. Familiarization with the student's light microscope and stereobinocular microscope

3. Application of centrifuge – separation of sperm from other testicular cells by low speed centrifugation

4. Diversity of eukaryotic cells – methylene blue staining of buccal epithelium, sperm, neurons, striated muscle cells; Leishman staining of mammalian blood cells

5. Permeability of plasma membrane – effect of isotonic, hypotonic and hypertonic solutions on mammalian RBC

6. Staining of nucleolus (RNA) and chromatin (DNA) with methyl green-pyronin Y

7. Staining of mitochondria with Janus green in buccal epithelium

8. Mitosis in onion root tip

9. Meiosis in grasshopper testis

10. Demonstration of preparation of polytene chromosomes from salivary glands of *Drosophila melanogaster* larva

Part B: Biochemistry

1. Preparation of models of amino acids and dipeptides

2. Ninhydrin test for α-amino acids

3. To demonstrate catalase activity and its inactivation by heat

4. Benedict's test for reducing sugars

5. Iodine test for starch

6. Determination of acid value of oil

7. Preparation of models of nitrogenous bases, nucleosides and nucleotides

Semester III
ZOB 301: COMPARATIVE PHYSIOLOGY, ENDOCRINOLOGY & DEVELOPMENTAL BIOLOGY
(Credit 4)
Section A: Comparative Physiology
(Credit 1.5)

	Hours of teaching
1. Respiration	**3**
1.1. Types of respiration (cutaneous, branchial, tracheal and pulmonary)	
1.2. Respiratory pigments	
2. Circulation	**3**
2.1. Composition of blood	
2.2. Functions of blood	
3. Nutrition and Digestion	**3**
3.1. Mechanical and chemical digestion	
3.2. Basic concept of absorption	
4. Excretion: Mode of excretion of nitrogenous wastes: ammonotelism, ureotelism, uricotelism and guanotelism	**2**
5. Movement	**4**
5.1. Ameboid, ciliary, flagellar and muscular	
5.2. Basic concept of contractile proteins	
6. Neuronal transmission	**2**
6.1. Structure and type of neurons	
6.2. Membrane potential and nature of nerve impulse	
7. Environmental adaptations	**3**
7.1. Basic concept of thermal adaptation in poikilotherms and homeotherms	
7.2. Osmoregulation in marine, fresh water and terrestrial animals	

Section B: Endocrinology
(Credit 1.5)

	Hours of teaching
1. Introduction to endocrinology	**3**
1.1. Definition and classification of hormones	
1.2. Endocrine, paracrine and autocrine modes of hormone delivery	
1.3. Feedback mechanisms	
2. Structure and functions of endocrine glands in mammals	**14**
2.1. Pituitary	
2.2. Thyroid	
2.3. Parathyroid	
2.4. Adrenal	
2.5. Endocrine pancreas	

    2.6. Testis

    2.7. Ovary

3. Endocrine glands in insects   **2**

    3.1. The Pars Intercerebralis-corpus cardiacum-corpus allatum complex

    3.2. Prothoracic gland

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Section C: Developmental Biology

(Credit 1)

</div>

Hours of teaching

1. Historical perspective, aim and scope of developmental biology   **1**

2. Gametogenesis   **1**

    2.1. Spermatogenesis

    2.2. Oogenesis

3. Events in external and internal fertilization   **2**

4. Types of cleavage and fate map   **1**

5. Gastrulation in frog and chick up to the formation of three germ layers   **3**

6. Primary organizer in frog   **1**

7. Extra embryonic membranes in chick   **1**

8. Concept of competence, determination and differentiation   **2**

9. Concept of regeneration   **1**

Books recommended

Comparative Physiology

1. Nielson: Animal Physiology – Adaptation and Environment (5th ed. 2008, Cambridge)

2. Marshall and Hughes: Physiology of Mammals and Vertebrates (2nd ed. 1980, Cambridge)

3. Hoar: General and Comparative Physiology (3rd ed., 1987, Prentice Hall)

4. Prosser: Comparative Animal Physiology (4th ed. 1991, Satish Book)

Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)

2. Turner and Bagnara: General Endocrinology, 6th ed.1984, Saunders)

Developmental Biology

1. Alberts *et al*: Molecular Biology of the Cell (2008, Garland)

2. Balinsky: An Introduction to Embryology (1981, CBS)

3. Gilbert: Developmental Biology (8th ed., 2006, Sinauer)

4. Wolpert: Principles of Development (3rd ed. 2007, Oxford)

LABORATORY EXERCISES
ZOB 302: COMPARATIVE PHYSIOLOGY, ENDOCRINOLOGY & DEVELOPMENTAL BIOLOGY
(Credit 2)

Part A:Comparative Physiology

Determination of pulse rate at rest and after exercise

1. To observe capillary circulation in web of frog
2. Preparation of hemin crystals from blood of rat
3. To demonstrate activity of salivary amylase and effect of acid and
4. heat on its activity
5. Semi-quantitative test for detection of glucose by Benedict's method
6. Determination of presence of protein in a sample
7. To demonstrate knee-jerk reflex
8. To demonstrate existence of blind spot of eye
9. To determine the near point of eye

Part B: Endocrinology

1. Handling, sexing, numbering and maintenance of rat
2. General survey of endocrine glands in rat
3. Study of vaginal smear preparation of rat
4. Demonstration of the following surgical operations in rat
   Orchidectomy (b)   Ovariectomy
5. Study of histological slides of the following endocrine glands in rat: pituitary, thyroid, adrenal, endocrine pancreas, testis and ovary
6. Demonstration of endocrine glands in cockroach

Part C: Developmental Biology

1. Study of different types of eggs
2. Demonstration of sperm motility in rat
3. Study of eggs and tadpoles of frog from collected/preserved material
4. Study of frog development through models
5.1 Window preparation on hen's egg
5.2 Demonstration of chick embryonic development making window preparation of fertilized egg
6. Study of whole mount preparations of chick embryos of 16-18 , 24-28, 33-36 and 42-48 hrs of development

Semester IV
ZOB 401: GENETICS, EVOLUTION & ANIMAL BEHAVIOUR
(Credit 4)
Section A: Genetics
(Credit 2)

Hours of teaching

1. Elements of heredity and variation   **4**

1.1. Mendel and his experiments

    1.2. Principles of segregation and independent assortment and their chromosomal basis

    1.3. Test cross

    1.4. Application of laws of probability to Mendelian inheritance

2. Extension of Mendelism   **5**

    2.1. Dominance relationships (complete dominance, incomplete dominance and co-dominance

    2.2. Multiple allelism

    2.3. Lethal alleles

    2.4. Pleiotropy

    2.5. Epistasis

    2.6. Penetrance and expressivity

    2.7. Phenocopy

    2.8. Polygenic inheritance

3. Cytoplasmic and infective inheritance   **2**

4. Linkage

3

    4.1. Linkage and crossing over

    4.2. Cytological demonstration of crossing over in *Drosophila*

5. Sex chromosomes and sex-linkage   **2**

    5.1. Sex chromosome systems : XX/XO, XX/XY, ZZ/ZW and haploidy/diploidy types

    5.2. Sex Linkage

6. Structural and numerical alterations of chromosomes; meiotic consequences in   **3**
structural heterozygotes   **4**

7. Human Genetics   **4**

    7.1. Karyotype, banding, nomenclature of chromosome subdivisions and genetic map

    7.2. Genetic disorders

      7.2.1 Chromosomal aneuploidy (Down, Turner and Klinefelter syndromes)

      7.2.2 Chromosome translocation (chronic myeloid leukemia) and deletion ("cry of cat" syndrome)

      7.2.3 Gene mutation (cystic fibrosis)

    7.3. Genetic counseling

8. Introduction to applications of genetic engineering   **3**

    8.1. Molecular diagnosis of genetic disorders and gene therapy

    8.2. Crop and livestock improvement

Section B: Evolution

(Credit 1)

                  Hours of teaching

1. Concept of organic evolution   **1**

2. Evidence of Organic evolution from   **6**

    2.1. Comparative anatomy

    2.2. Comparative embryology

    2.3. Palaeontology

    2.4. Biochemistry and Genetics

    2.5. Zoogeography

3. Theories of organic evolution   **4**

    3.1. Lamarckism

    3.2. Darwinism

    3.3. Development and concept of synthetic theory

    3.4. Natural selection in action (industrial melanism, antibiotic and DDT resistance)

4. Evolution of man   **2**

Section C: Animal behaviour

(Credit 1)

1. Concepts and patterns of behaviour   **1**

2. **Instinct and learning**   **3**

    2.1. Innate behaviour

    2.2. Learned behaviour and types of learning

3. Genetic basis of behaviour   **1**

4. Control of behaviour   **2**

    4.1. Neural control

    4.2. Hormonal control

5. Social organization   **4**

    5.1. Communication

    5.2. Living in groups

    5.3. Evolution of sociality: eusocial organisation

6. Biological rhythms   **2**

Books Recommended

Genetics

1. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley,)

2. Gardner *et al*: Principles of Genetics (1991, John Wiley)

3. Griffith *et al*: An Introduction to Genetic Analysis (2005, Freeman)

4. Hartl & Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlet)

5. Russell: Genetics (2002, Benjamin Cummings)

6. Snustad & Simmons: Principles of Genetics (2006, John Wiley)

7. Lewin: Genes IX (2008, Jones & Bartlett)

Evolution

1. Moody: Introduction to Evolution (1978, Kalyani).

2. Savage: Evolution (1963, Holt, Reinhart and Winston)

3. Rastogi: Organic Evolution (1988, Kedarnath & Ramnath)

4. Strickberger: Evolution (2004, Jones & Bartlett)

Animal Behaviour

1. Drickamer & Vessey : Animal Behaviour – concepts, processes and methods (2nd ed. 1986, Wadsworth,)

2. Freeland: Problems in Practical Advanced Level Biology (1985, Hodder & Stoughton,)

3. Goodenough et al.: Perspectives on Animal Behaviour (1993, Wiley)

4. Grier: Biology of Animal Behaviour (1984, Mosby)

5. Lorenz: The Foundation of Ethology (1981, Springer)

6. Manning & Dawkins: An Introduction to Animal Behaviour (5th ed. 1998, Cambridge).

7. Mcfarland : Animal Behaviour, Psychology, Ethology and Evolution (1985, Pitman).

8. Slater: An Introduction to Ethology (1985, Cambridge).

LABORATORY EXERCISES
Z0B 402: GENETICS, EVOLUTION & ANIMAL BEHAVIOUR
(Credit 2)

Part A: Genetics

1. Application of probability in the law of segregation with coin tossing

2. Frequency of the following genetic traits in human: widow's peak, attached ear lobe, dimple in chin, hypertrichosis, colour blindness, PTC tasting

3. Study of mode of inheritance of the following traits by pedigree charts – attached ear lobe, widow's peak.

4. Familiarization with techniques of handling *Drosophila,* identifying males and females; observing wild type and mutant (white eye, wing less) flies, and setting up cultures.

5. Study of penetrance and expressivity using *wingless (wg)* mutant of *Drosophila.*

6. Demonstration of sex-linked inheritance in *Drosophila* making a cross between white eye and wild type flies *(criss-cross inheritance).*

7. Demonstration of lethal alleles using *Curly (Cy)* mutant in *Drosophila.*

8. Demonstration of multiple allelism by showing mutants of white eye series in *Drosophila.*

9. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides/photographs.

10. Study of human karyotypes and numerical alterations (Down syndrome, Klinefelter syndrome and Turner syndrome).

Part B: Evolution

1. Adaptive modifications in feet of birds and mouth parts of insects (from slides)

2. Embryological evidence of evolution (through charts)

3. Analogy and homology (wings of birds and insects, forelimbs of bat and rabbit)

4. Serial homology in appendages of *Palaemon*.

Part C: Animal Behaviour

1. Study of habitat selection in the first and third instar larvae of *Drosophila melanogaster.*

2. Habituation in earthworms/mosquito larvae.

3. Locomotory behaviour of dipteran larvae (Housefly/blowfly/fruitfly):

   3.1 Locomotion on different types of substrata (writing paper, plastic sheet and sand paper

   3.2 Effects of light intensity and light quality on the rate of locomotion

4. Study of individual and social behavioural patterns of a troop of monkey

5. Study of interspecific association between cattle and egrets

Semester V
Z0B 501: FUNCTIONAL ANATOMY AND ECONOMIC IMPORTANCE OF NON-CHORDATES
(Credit 4)

Hours of teaching

1. Protozoa   **8**

    1.1. Study of Euglena and Monocystis (locomotion, nutrition and reproduction)

    1.2. Parasitic protozoans of man: *Entamoeba, Giardia, Trypanosoma,*

       Leishmania (diagnostic characters, mode of infection and diseases caused)

    1.3. Soil protozoa and their role in agriculture.

2. Origin of Metazoans   **3**

    2.1. Germ layers, diplolblatic and triploblastic organization

    2.2. Theories on the origin of Metazoans

3. Porifera   **4**

    3.1. Study of *Leucosolenia* and *Sycon* (structure, skeleton and canal system)

    3.2. Sponge culture and its importance in industry and commerce

4. Cnidaria and Ctenophora   **7**

    4.1. Study of Obelia and *Aurelia (*structure and reproduction)

    4.2. Salient features of ctenophores and comparisons with cnidarians

    4.3. Coral reefs and coral in commerce and industry

5. Platyhelminthes   **5**

    5.1. *Fasciola* and *Taenia*: structure, reproduction, life-cycle and parasitic adaptations

6. Nemathelminthes   **4**

    6.1. Ascaris*:* structure, reproduction and life-cycle

    6.2. Nematode parasites of man: *Ascaris, Ancylostoma, Enterobius* and

       Wuchereria: diagnostic characters, mode of infection and diseases caused

7. Annelida   **6**

    7.1. Nereis*:* structure with special reference to reproduction

    7.2. Trochophore larva and its significance

    7.3. Earthworms and soil improvement

8. Arthropoda   **5**

    8.1. Palaemon*:* structure with special reference to reproduction

    8.2. Zoological importance of *Limulus*

    8.3. Prawn culture and its economic importance

9. Mollusca   **5**

    9.1. *Unio:* structure with special reference to reproduction

    9.2. Torsion and detorsion in gastropods

    9.3. Modification of foot in molluscs

    9.4. Utility of molluscs in food and ornaments.

    9.5. Pearl culture

10. Echinodermata   **5**

    10.1. Asterias: structure with special reference to water vascular system

10.2. Larval forms of Echinoderms and their significance

10.3. Origin and Evolution of Echinoderm Larvae

Books Recommended

1. Barnes: Invertebrate Zoology (4th ed. 1980, Holt-Saunders)

2. Barnes: The invertebrate (3rd ed. 2001Blackwell)

3. Barrington: Invertebrate Structure and Function (1967Nelson)

4. Moore: An introduction to the invertebrartes (2001Cambridge)

5. Ekambaranath Ayar: A manual of Zoology, Part I – Invertebrata, (1973, S. Vishwanathan)

6. Kotpal, Agarwal and Khetrapal: Modern Textbook of Zoology: Invertebrate, (1976, Rastogi)

7. Marshall: Parker and Haswell Textbook of Zoology, Vol. I (7th ed. 1972, Macmillan)

8. Nigam: Biology of Non-chordates (1985, S. Chand)

9. Jordon and Verma: Invertebrate Zoology (1995, S. Chand)

Z0B 502: BIOCHEMISTRY & MAMMALIAN PHYSIOLOGY
(Credit 4)
Section A: Biochemistry
(Credit 2)

Hours of teaching

1. Proteins   **4**

    1.1. Amino acids: Ionization, titration curve, pK and pI

        1.1.1 Reactions involving α amino group (Sanger and Edman's reactions)

    1.2. Primary structure

2. Enzymes   **5**

    2.1. Kinetics (determination of Km and Vmax using Michaelis-Menten and Lineweaver-Burk plots)

    2.2. Acid-base and covalent catalysis

    2.3. Concept of regulation of enzyme activity (inhibition,allosterism and effects of temperature and pH)

    2.4. Introduction to ribozymes and abzymes

3. Carbohydrates   **5**

    3.1. Structural polysaccharides

        3.1.1 Homopolymers (cellulose and chitin)

        3.1.2 Heteropolymers (peptidoglycans and glycoseaminoglycans)

    3.2. Carbohydrates as source of energy

        3.2.1 Glycolysis

        3.2.2 Krebs cycle

        3.2.3 Electron transport chain and ATP synthesis

4. Lipids : Structural and functional significance of triglycerides, phospholipids,   **3** cholesterol and prostaglandins

5. Nucleic acids   **7**

    5.1. Conformation of DNA (A, B and Z)

     5.2. Structure of nucleosomes

     5.3. Mechanism of DNA replication

     5.4. RNA

         5.4.1 Mechanism of transcription

         5.4.2 Processing of hnRNA

         5.4.3 Mechanism of translation

6. Genetic engineering   **2**

     6.1. Tools: Restriction enzymes, vectors

     6.2. Construction of recombinant DNA

Books recommended

1. Boyer: Concepts in Biochemistry (3rd Ed. 2006, Brooks/Cole)
2. Stryer: Biochemistry (5th ed. 2001, Freeman)
3. Murray *et al*: Harper's Biochemistry (25th ed. 2000, Appleton & Lange)
4. Lehninger, Nelson & Cox: Principles of Biochemistry (4th ed. 2007, Worth)
5. Conn, Stumpf, Bruening & Doi: Principles of Biochemistry (5th ed. 1987, Wiley)

<div align="center">

Section B: Mammalian Physiology

(Credit 2)

</div>

                                                 Hours of teaching

1. Respiration   **4**

     1.1. Mechanism and regulation of breathing

     1.2. Transport of oxygen and carbon dioxide

     1.3. Respiratory quotient

2. Circulation   **6**

     2.1. Buffer system in blood

     2.2 Blood groups

     2.3. Cardiac cycle and its regulation

     2.4. Haemostasis

3. Nutrition and Digestion   **3**

     3.1. Balanced diet

     3.2. Digestion and absorption of carbohydrates, proteins and fats

4. Excretion   **3**

     4.1. Nephron

     4.2. Urine formation

     4.3. Hormonal control of renal function

5. Nervous System   **5**

     5.1. Myelinated and non-myelinated nerve fibres

     5.2. Resting and action potential

     5.3. Initiation and conduction of nerve impulse

     5.4. Types of synapses and chemical transmission

6. Muscles   **5**

6.1. Types and functional diversity

6.2. Ultrastructure of skeletal muscle

6.3. Muscle proteins

6.4. Chemistry of muscle contraction

6.5. Elementary knowledge of muscle twitch, tetanus and fatigue, isotonic and isometric contractions

Books recommended

1. Ganong: Review of Medical Physiology (22nd ed. 2005, Lange Medical)

2. Guyton and Hall: A text book of Medical Physiology (11th ed. 2006, Saunders).

3. Keele & Neil: Samson Wright's Applied Physiology (13th ed. 1989, Oxford)

ZOB 503: MAMMALIAN ENDOCRINOLOGY & DEVELOPMENTAL BIOLOG
(Credit 4)
Section A: Mammalian Endocrinology
(Credit 2)

	Hours of teaching
1. Classification of chemical messengers	**1**

1.1. Hormones

1.2. Neurohormones and neurotransmitters

1.3. Pheromones

2. General mechanism of hormone action	**2**
3. Hypothalamo-hypophysial system	**7**

3.1. Structure of the hypothalamo-hypophysial system

3.2. Neurohypophysial hormones – oxytocin and vasopressin

3.3. Hormones of the adenohypophysis

3.4. Hypothalamic control of adenohypophysis

4. Biosynthesis, biological actions and regulation of secretion of hormones of following glands	**13**

4.1. Thyroid

4.2. Adrenal

4.3. Endocrine pancreas

4.4. Testis

4.5. Ovary

4.6. Pineal

5. Gastrointestinal hormones (gastrin, CCK, secretin and motilin)	**1**
6. Hormonal dysfunctions and diseases	**2**

6.1. Dwarfism and acromegaly

6.2. Goiter

6.3. Addison's disease

6.4. Diabetes mellitus

Section B: Developmental Biology
(Credit 2)

	Hours of teaching
1. Mechanism of fertilization	**3**
2. Cleavage, gastrulation and fate map	**8**
2.1. Comparison of cleavage in sea urchin, frog and chick	
2.2. Comparison of fate map of sea urchin, frog and chick	
2.3. Comparison of gastrulation in sea urchin, frog and chick	
3. Determination and differentiation	**9**
3.1. Morphogenetic gradients in sea urchin egg	
3.2. Mechanism of axis determination in amphibians and functions of the organizers	
3.3. Induction and determination during vertebrate eye formation	
3.4. Totipotency	
4. Mechanism of metamorphosis in frog	**2**
5. Development and functions of placenta in mammals	**2**
6. Embryonic stem cells	**2**

Books Recommended

Endocrinology

1. Hadley: Endocrinology (5th ed. 2000, Prentice Hall)
2. Turner and Bagnara: General Endocrinology (6th ed. 1984, Saunders)

Developmental Biology

1. Alberts et al.: Molecular Biology of the Cell, (5th ed. 2008, Garland)
2. Balinsky: An Introduction to Embryology (1981, CBS)
3. Gilbert: Developmental Biology (8th ed. 2006, Sinauer)
4. Wolpert: Principles of Development (3rd ed. 2007, Oxford)

LABORATORY EXERCISES
Z0B 504: FUNCTIONAL ANATOMY AND ECONOMIC IMPORTANCE OF NON-CHORDATES
(Credit 2)

1. Protozoa

1.1. Survey of pond water for study of free living protozoans
1.2. Culturing of *Paramecium* and *Euglena* and observation of their locomotion

2. Porifera

2.1. Study of canal systems (asconoid, syconoid, leuconoid) from prepared slides and models
2.2. Mounting of spicules
2.3. Study of the following museum specimens: *Leucosolenia, Sycon, Euplectella, Hyalonema, Spongilla, Cliona, Euspongia,*

3. Cnidaria

    3.1.   Study of the following through prepared slides: T.S. of *Hydra* through ovary and testis, *Scyphistoma* and *Ephyra*.

    3.2.   Study of the following museum specimens: *Physalia, Porpita, Vellala, Aurelia, Tubipora, Corallium, Gorgonia, Pennatula, Metridium, Fungia, Millepora.*

    3.3.   Study of coral and coral reefs from chart and specimen

4. Ctenophora

    4.1. Study of the following museum specimens: *Hormiphora, Pleurobranchia, Beroe*

5. Platyhelminthes

    5.1.   Study of the following from slides/specimen: *Dugesia, Polystomum, Schistosoma, Echinococcus, Fasciola, Taenia,* Miracidium, sporocyst, redia, cercaria, metacercaria, Hexacanth bladder worm

6. Nemathelminthes

    6.1. Study of the following from slide/specimen: *Ascaris* (male and female) T.S. of *Ascaris ,Wuchereria, Ancylostoma and Enterobius.*

7. Annelida

    7.1. Leech

        7.1.1   External features

        7.1.2   Dissections: Digestive, urinogenital and nervous systems

        7.1.3   Mounting of jaws and salivary glands

    7.2. *Nereis*: Permanent stained preparation of parapodium

    7.3. Study of the following museum specimens/slides*: Nereis, Aphrodite, Arenicola, Sabella, Acanthobdella, Branchellion, Bonellia*

    7.4. Trochophore Larva, T.S. of Leech through crop sac

8. Arthropoda

    8.1.   Scorpion

        8.1.1.   External features

        8.1.2.   Dissections: Digestive and nervous systems

        8.1.3.   Permanent preparation of book –lungs

    8.2.   Study of the following museum specimens/slides: *Daphnia, Cypris, Cyclops (male and female), Lepas, Balanus, Cancer, Julus, Scolopendra, Peripatus*, Lepisma, Cricket, beetle, grasshopper, termite, *Apis*, wasp, butterfly, moth.

    8.3.   Study of the following larval forms from slides: Nauplius, Zoea and Megalopa.

    8.4. Study of life cycle of silk worm from chart and model/specimen

    8.5.   Study of prawn culture from chart/model.

9. Mollusca

    9.1. *Unio*

        9.1.1   Dissection of nervous system

        9.1.2   Stained preparation of gill lamellla

    9.2.   Study of the following museum specimens: *Chiton, Cyprea, Patella, Aplysia, Doris, Vaginula, Achatina, Dentalium, Mytilus, Pecten, Teredo, Solen, Sepia, Loligo, Octopus.*

    9.3.   Study of pearl formation and its culture from chart/model

10. Echinodermata

    10.1 Study of the following museum specimen: Star fish, brittle star, sea urchin, sea cucumber, sea lily

    10.2 Study of the following larval form from slides: Bipinnaria, Brachiolaria, Auricularia, Ophiopluteus and Echinopluteus.

LABORATORY EXERCISES
ZOB 505: BIOCHEMISTRY & MAMMALIAN PHYSIOLOGY
(Credit 2)

Part A:Biochemistry

1. Determination of pK and pI values of glycine
2. Identification of amino acids in the mixture using paper chromatography
3. Estimation of protein by Biuret method
4. Determination of the activity of enzyme (Urease):
   4.1. Effect of [S] and determination of Km and Vmax
   4.2. Effect of temperature and
   4.3. Effect of time
5. Qualitative tests for identification of sugars

Part B:Mammalian Physiology

1. Counting of red blood corpuscles
2. Counting of white blood corpuscles
3. Determination of haemoglobin content
4. Measurement of blood pressure using sphygmomanometer
5. Determination of oxygen consumption (cockroach)
6. Demonsration of heart beat using kymograph showing auriculo- ventricular contraction and frequency (frog)
7. Demonstration of muscle contraction with the help of kymograph showing Twitch, clonus, tetanus and fatigue (frog)

LABORATOTY EXERCISES
ZOB 506: MAMMALIAN ENDOCRINOLOGY &
DEVELOPMENTAL BIOLOGY
(Credit 2)

Part A: Mammalian Endocrinology (Animal Model – Albino Rat)

1. Survey of endocrine glands and accessory sex organs

2. Study of estrous cycle by vaginal smear preparation

3. Surgical Techniques

    3.1. Ovariectomy

    3.2. Orchidectomy

    3.3. Adrenalectomy

4. Study of effects of orchidectomy/ovariectomy and replacement therapy on the seminal vesicle/uterus

5. Study of histological slides of the following:

    5.1. Pituitary

    5.2. Thyroid

    5.3. Endocrine pancreas

    5.4 .Adrenal

    5.5. Testis

    5.6. Ovary

    5.7. Uterus

    5.8. Seminal vesicle

Part B: Developmental Biology

1. Frog embryology

    1.1 Collection of spawn and identification of stages

    1.2 Study of developmental stages

2. Demonstration of early developmental stages of a freshwater snail

3. Permanent preparation of whole mounts of chick embryos of 24 -33 , 36 -48 and 48 -72 hrs

4. Window preparation on fertilized egg to study development of chick embryo

5. Study of development of chick embryo from permanent slides of sections through following regions

    5.1 Pharynx

    5.2 Heart

    5.3. Trunk

Semester VI

Z0B 601: FUNCTIONAL ANATOMY AND ECONOMIC IMPORTANCE
OF CHORDATES
(Credit 4)

Hours of teaching

1. Origin of vertebrates   **2**

2. Integument and its derivatives   **5**

    2.1. Structure of integument

    2.2. Scales, feathers, hair, beaks, claws, nails, hoofs, horns, antlers, glands

3. Endoskeleton   **5**

    3.1. General plan of neurocranium and dermatocranium.

    3.2. Jaw suspensorium

    3.3. Vertebrae

4. Digestive system   **7**

    4.1. Modifications in relation to feeding habits.

        4.1.1. Length and surface area

        4.1.2. Internal folds

    4.2. Supplementary diverticulae

    4.3. Oesophagus

    4.4. Stomach, its modifications in ruminant mammals

    4.5. Dentition

    4.6. Dental formula in mammals

5. Respiratory system   **5**

    5.1. Aquatic respiration

    5.2. Aerial respiration

        Accessory respiratory organs in fish

        5.2.2 Lungs

        5.2.3 Air-sacs in birds

6. Circulatory system   **5**

    6.1. Aortic arches

    6.2. Portal systems

    6.3 Lymphatic system

7. Nervous system   **5**

    7.1. Evolution of cerebral hemispheres and cerebellum

    7.2. Chemoreceptors

    7.3. Neuromast organs of lower vertebrates

8. Urinogenital system   **8**

    8.1. Excretory system

        8.1.1 Types and evolution of kidney tubules

        8.1.2 Urinary duct and bladder

    8.2. Reproductive system

        8.2.1 General plan of gonads

   8.2.2 Accessory reproductive organs

9. Economic importance

  9.1. Fish industry and economy.   **4**

    9.1.1 Fish preservation

    9.1.2 Fish by-products

  9.2. Amphibians as biological control agent   **1**

  9.3. Snake venom, its uses and antivenin production **1**

  9.4. Economic Importance of Birds   **2**

   9.4.1 Pollination

   9.4.2 Poultry

  9.5. Basic knowledge about dairy and livestock breeding **2**

Books Recommended

 1. Hildebrand: Analysis of Vertebrate Structure (1995, John Wiley)

 2. Kotpal: Modern Text Book of Zoology Vertebrates (2003, Rastogi)

 3. Nigam: Biology of Chordates (1983, S Chand)

 4. Romer & Parsons: The vertebrate Body (6^h ed. 1986, Saunders)

 5. Walter & Sayles: Biology of the Vertebrates (1959, Macmillan)

 6. Young: The Life of Vertebrates (1981 Clarendon)

 7. Young: The Life of Mammals (1975 Clarendon)

ZOB 602: CELL BIOLOGY, GENETICS & EVOLUTION
(Credit 4)
Section A: Cell Biology
(Credit 1.5)

                   Hours of teaching

1. Membrane transport   **2**

  1.1. Principles of membrane transport, Channel proteins, carrier proteins6

  1.2. Passive and active transport

2. Intracellular transport and protein sorting   **4**

  2.1. Signal peptides and protein targeting

  2.2. Entry and passage of proteins through endoplasmic reticulum

  2.3. Processing and sorting of proteins in Golgi Apparatus

  2.4. Endosomes and lysosomes

  2.5. Nuclear pore complex and nuclear transport

3. Mitochondria and energy transfer   **2**

  3.1. Mitochondria: structure, origin and genome

  3.2. Electron transport and oxidative phosphorylation

4. Cytoskeleton   **2**

  4.1. Organisation and functions

4.2. Microtubular organelles

5. Cell-cell communication: **3**

5.1. Cell junctions.

5.2. Cell adhesion and extracellular matrix.

5.3. General principles of cell signalling.

6. Cell proliferation   **3**

6.1. Events in different phases of cell cycle.

6.2. Genetic regulation of cell proliferation

6.3. Cell transformation and malignancy

6.4. Genetic basis of tumourigenesis

7. Interphase nucleus and chromosome organisation   **4**

7.1. Organisation of interphase nucleus

7.2. Higher order organisation of chromatin into chromosome

7.3. Centromere and telomere

7.4. Lampbrush and Polytene chromosomes: Structure and application in study of gene expression

Section B: Genetics

(Credit 1.5)

1. Gene mapping   **3**

1.1. 3-point test cross in *Drosophila*

1.2. Tetrad analysis in Neurospora

1.3. Elementary knowledge of modes of recombination in bacteria

2. Mutation and mutagenesis   **4**

2.1. Molecular basis of mutation

2.2. Spontaneous and induced mutations

2.3. DNA Damage and repair

2.4. Detection of mutations (Ames' Test, nutritional mutations in *Neurospora, ClB* technique in *Drosophila*)

3. Genetic determination of sex   **2**

3.1. *Drosophila*

3.2. Human

4 . Introduction to quantitative inheritance   **1**

5. Gene expression and gene regulation   **3**

5.1. Inducible (*lac*) and repressible (*trp*) operones in *E.coli*

5.2. Basic concept of transcription unit and regulation of gene activity in eukaryotes

6. Organization of human genome   **1**

7. Human genetic disorders   **2**

7.1. Metabolic (Phenylketonuria)

7.2. Triplet repeat expansion (Huntington)

7.3. Multifactorial (Diabetes mellitus)

8. Transgenic animals: strategies and applications   **1**

9. Elementary idea of transcriptome and proteome   **2**

10. Basic concept of mobile elements   **1**

Section C: Evolution
(Credit 1)

1. Evolution through ages   **3**
    1.1. Fossils and dating of fossils
    1.2. Geological column
    1.3. Evolution of horse

2. Process of evolution   **10**
    2.1. Genetic variations in population
    2.2. Hardy-Weinberg Equilibrium
    2.3. Evolutionary forces
    2.4. Isolating mechanisms
    2.5. Speciation: Allopatric and sympatric
    2.6. Molecular phylogenies
    2.7. Adaptive colouration and mimicry

Books Recommended:

Cell Biology

1. Alberts *et al*: Essential Cell Biology (1998, Garland)
2. Alberts *et al*: Molecular Biology of the Cell (2008, Garland)
3. Karp: Cell and Molecular Biology (2008, John Wiley)
4. Lodish *et al*: Molecular Cell Biology (2008, Freeman)
5. Pollard & Earnshaw: Cell Biology (2002, Saunders)
6. Cooper and Hausman: The Cell A Molecular approach (2007, Sinauer)

Genetics

1. Brooker: Genetics : Analysis and Principles (1999, Addison-Wesley)
2. Gardner *et al*: Principles of Genetics (1991, John Wiley)
3. Griffith *et al*: An Introduction to Genetic Analysis (Freeman, 2005)
4. Hartl & Jones: Essential Genetics : A Genomic Perspective (2002, Jones & Bartlet)
5. Russell: Genetics (2002, Benjamin Cummings)
6. Snustad & Simmons: Principles of Genetics (2006, John Wiley)
7. Lewin: Genes IX (2008, Jones & Bartlett)

Evolution

1. Moody: Introduction to Evolution (1978, Kalyani).
2. Savage: Evolution (1963, Holt, Reinhart and Winston).
3. Rastogi: Organic Evolution (1988, Kedarnath & Ramnath).
4. Strickberger: Evolution (2004, Jones & Bartlett).

ZOB 603: IMMUNOLOGY, MICROBIOLOGY, ENVIRONMENTAL BIOLOGY & BIOTECHNIQUES

(Credit 4)

Section A: Immunology

(Credit 1)

	Hours of teaching
1. Introduction to immunity	**1**
2. Cells and organs of immune system	**2**
2.1. Types of immune cells: lymphoid and myeloid	
2.2. Primary and secondary lymphoid organs and lymphatic system	
3. Humoral immunity	**5**
3.1. Antigen	
3.2. Immunoglobulins: types, structure and function	
3.3. Generation and diversity of antibodies	
3.4. Complement system	
4. Cell mediated immunity	**4**
4.1. Structural organization of MHC complex	
4.2. Antigen processing and presentation	
4.3. Functions of T-cells	
5. Introduction to immunological disorders	**1**

Section B: Microbiology

(Credit 1)

1. **Introduction**
   1
2. **Microbial diversity**
   4
   2.1. Viruses
   2.2. Archaea
   2.3. Bacteria
   2.4. Eukaryotic microorganisms
3. **Techniques in microbiology**
   2
   3.1. Culture and growth of microorganisms
   3.2. Classification of bacteria based on staining of microbes
4. **Host-parasite relationship**
   2
   4.1. Beneficial and harmful interactions of microbes with human
   4.2. Virulance factors and toxins
5. **Applied microbiology**
   4
   5.1. Useful microbial products: antibiotics, amino acids, bioinsecticides and biopolymers
   5.2. Biodegradation

5.3. Diagnostic microbiology

Section C: Environmental Biology
(Credit 1)

1. General concepts   **4**

1.1. Introduction to environmental biology

1.2. Major ecosystems of the world

1.3. Energy flow in ecosystem

1.4. Productivity, food chain and food web

2. Populations and communities   **3**

2.1. Population characteristics: density, natality, mortality and growth curve

2.2. Nature, structure and attributes of biological communities

3. Pollution   **2**

3.1. Sources and impact of environmental pollutants – air, water and soil

3.2. Global environmental changes – greenhouse gases and their effects

4. Natural resources   **4**

4.1. Soil, water, mineral resources and their conservation

4.2. Biodiversity – benefits, hotspots, threats and conservation

4.3. Human impact on natural resources

Section D: Biotechniques
(Credit 1)

1. Principles and uses of analytical instruments   **4**

1.1. pH meter

1.2. UV-visible spectrophotometer

1.3. Centrifuges (clinical, high-speed and ultra-centrifuge)

1.4. Geiger Muller and scintillation counters

2. Microtomy and Microscopy   **5**

2.1. Tissue preparation

    2.1.1. Fixation

    2.1.2. Block preparation

    2.1.3. Microtomy (paraffin and frozen tissue sectioning)

2.2. Types of Microscopes

    2.2.1. Bright field

    2.2.2. Dark-field

    2.2.3. Phase contrast

    2.2.4. Fluorescence

    2.2.5. Confocal

    2.2.6. Scanning and transmission electron microscopes

3. Cell and tissue culture techniques   **2**

3.1. Culture media

3.2. Sterilization : room, media and glasswares

3.3. Types of animal cell culture

3.4. Cell viability testing

3.5. Cryopreservation

4. Separation techniques   **2**

4.1. Chromatography

4.2. Electrophoresis

Books Recommended

Immunology

1. Abbas et al: Cellular and Molecular Immunology (2001, Saunders)

2. Alberts et al: Molecular Biology of the Cell (5th ed. 2008, Garland)

3. Kuby: Immunology (2003, Freeman)

4. Roitt and Delvis: Roitt's Essential Immunology (6th ed. 2006, Blackwell)

Microbiology

1. Madigan and Martinko: Brock Biology of Microorganisms (2006, Prentice Hall)

2. Prescott, Harley and Klein: Microbiology (1999, McGraw)

Environmental Biology

1. Cunningham and Cunningham: Environmental Science (2003, McGraw Hill)

2. Odum: Fundamental of Ecology (1971, Saunders)

3. Raven, Berg and Jhonson: Environment (1993, Saunders)

4. Ricklefs: Ecology (1990, Freeman)

5. Sharma: Ecology and Environment (2003, Rastogi)

6. Turk and Turk: Environmental Science (1998, Saunders)

Biotechniques

1. Boyer: Modern Experimental Biochemistry (1993, Benjamin-Cummings,)

2. Pearse: Histochemistry - Theoretical and applied, Volume I-III (1980-1993, Churchill-Livingstones)

3. Plummer: An Introduction to Practical Biochemistry (1989, McGraw Hill)

4. Wilson & Walker: Experimental Biochemistry (2006, Cambridge)

LABORATORY EXERCISES
ZOB 604: FUNCTIONAL ANATOMY AND ECONOMIC IMPORTANCE
OF CHORDATES
(Credit 2)

1. Lower chordates

1.1. Amphioxus

1.1.1. External features

1.1.2. Mounting of oral hood, velum and pharyngeal wall

1.1.3. Study of the following slides: *T.S. through oral hood, midgut diverticulum, pharyngeal region, gonads and post oral region of intestine*

1.2. Study of the following permanent slides specimens: *Pyrosoma, Salpa, Doliolum*

2. Vertebrates

2.1. Integument and its derivatives

2.1.1. Mounting of cycloid and ctenoid scales

2.1.2. Mounting of chromatophores of fish

2.1.3. Study of different types of feather: Contour, filoplume and down feathers

2.2. General anatomy of *Mystus*/*Cirrhinus*, *Calotes*, *Columba*, *Funambulus* and comparative study of the following systems:

2.2.1. Vascular system

2.2.1.1. Heart and afferent and efferent branchial vessels of a bony fish (*Mystus*/*Cirrhinus*)

2.2.1.2. Arterial and venous systems of *Calotes* and *Funambulus*

2.2.2. Respiratory system

2.2.2.1. Accessory respiratory organs of *Clarias*, *Heteropneustes* and *Ophiocephalus*

2.2.2.2. Air sacs in *Columba* (demonstration only)

2.2.2.3. Sense organs: Pecten and columella of *Columba* (demonstration only)

3. Histology: Study of permanent slides of the following tissues and organs of mammals:

3.1. Tooth

3.2. Tongue

3.3. Oesophagus

3.4. Stomach

3.5. Intestine

3.6. Pancreas

3.7. Liver

3.8. Spleen

3.9. Kidney

3.10. Cartilage

3.11. Bone

4. Classification and distinctive features of the following:

4.1. Cyclostomata: *Petromyzon*, *Myxine*

4.2. Chondrichthyes: *Scoliodon*, *Sphyrna*, *Torpedo*, *Pristis*

4.3. Osteichthyes: *Protopterus, Lophius, Exocetus, Hippocampus, Syngnathus, Tetradon, Diodon, Amia, Anabas, Ophiocephalus, Clarias, Heteropneustes, Catla, Labeo,Wallago*

4.4. Amphibia: *Ichthyophis, Axolotl larva, Amphiuma, Pipa, Xenopus, Rhacophorus*

4.5. Reptilia: *Chameleon, Draco, Heloderma, Uromastix, Varanus, Calotes, Hemidactylus, Iguana, Mabuya, Alligator, Crocodylus, Natrix, Naja, Vipera, Crotalus*

4.6. Aves: *Apterys, Struthio, Aptenodytes, Francolinus, Tytoalba, Dinopium, Milvus, Corvus, Pavo, Eudynamys, Passer, Psittacula, Anas, Grus*

4.7. Mammalia: *Ornithorhynchus, Tachyglossus, Macropus, Manis, Erinaceus, Pteropus, Lemur, Loris, Bradypus, Phoca, Lutra, Equus cabalus, Camelus, Capra, Bos*

LABORATORY EXERCISES
ZOB 605: CELL BIOLOGY, GENETICS & EVOLUTION
(Credit 2)

Part A: Cell Biology

1. Use of phase contrast optics by observing live sperm in physiological saline
2. Demonstration of use of fluorescence microscope (DNA and RNA fluorescence) and familiarity with confocal microscope
3. Familiarity with scanning and transmission electron microscopes (show photograph and visit Department of Metallurgy)
4. Familiarity with tissue culture (visit plant and animal tissue culture labs.)
5. Demonstration of gel electrophoresis
6. Preparation of polytene chromosomes from *Drosophila* larvae
7. Use of colchicine in arresting anaphase movement (onion root tips)
8. Metaphase chromosome preparations from bone marrow of mouse/rat
9. Meiosis in grasshopper testis
10. Study of permanent slides to understand the following:
    10.1. Constitutive heterochromatin (C-band)
    10.2. Semiconservative DNA replication (BrdU-labelling)
    10.3. Detection of S-phase cells in a random population (autoradiography)
    10.4. Transcription in polytene chromosome puffs (autoradiography)
    10.5. Chromosome organisation (G-banding)

Part B:Genetics

1. Simulation of principles of segregation and independent assortment using coloured beads. Application of law of probability and chi-square test.
2. Mono and dihybrid crosses in *Drosophila.*
3. Study of sex-linkage – reciprocal crosses between red and white eyed flies.
4. Study of pattern of inheritance in human population of the traits Rolling of tongue and interlocking, and of the sex-influenced trait long vs short second finger in relation to the fourth finger (apply Hardy-Weinberg law).
5. Study of mutants in *Drosophila* (Bar eye, white eye, yellow body, sepia eye, curled wing, dumpy wing, vestigial wing and sepia eye-curled wing and curled wing-ebony body-sepia eye.
6. Genotype analysis in the pedigree chart of the Victorian family affected with haemophilia
7. Preparation of flow charts to depict steps involved in the following:
   7.1 Production of transgenic mouse for a chosen gene
   7.2 Gene therapy for a chosen human disease

Part C: Evolution

1. Natural selection – experiment using red and white eyed *Drosophila* flies
2. Isolating mechanism – Demonstration of hybrid sterility in *Drosophila: D. bipectinata* and *D. malerkotliana.*
3. Genotypic analysis of blood groups in human population to estimate allele frequencies by Hardy -Weinberg equation
4. Fossils – One representative fossil each from Foraminifera, Brachiopoda, Trilobita, Ammonites, Echinodermata.
5. Models of Chordate fossils – *Brontosaurus, Dimetrodon, Archaeopteryx, Dinoceras.*
6. Evolution of Horse – through models

LABORATORY EXERCISES
ZOB 606: IMMUNOLOGY, MICROBIOLOGY, ENVIRONMENTAL BIOLOGY & BIOTECHNIQUES
(Credit 2)

Part A: Immunology

1. Study of lymphoid organs and retro-orbital bleeding
2. Separation of macrophages from mice and their identification on the basis of non specific esterase staining
3. Enumeration of apoptotic cells by trypan blue exclusion test
4. Demonstration of antigen-antibody reaction by immunodiffusion
5. Demonstration of direct ELISA

Part B: Microbiology

1. Preparation of culture media, sterilization
2. Culturing methods (bacterial plating, making stab, slant and growing liquid culture)
3. Bacterial growth curve
4. Gram staining
5. Methylene blue reductase staining

Part C: Environmental Biology

1. Estimation of productivity of pond ecosystem by light and dark bottle experiment using Winkler's method
2. Estimation of grasshopper population density by capture-recapture method
3. Estimation of percent frequency, abundance and dominance of producers and consumers in grass land by quadrat sampling method
4. Determination of carbonate and nitrate in soil samples
5. Determination of free CO_2 in different samples of pond water
6. Visit to local/out station animal park and submission of field report

Part D: Biotechniques

1. Preparation of a buffer and determination of pH using pH meter
2. Demonstration of polyacrylamide gel electrophoresis
3. Demonstration of functioning of spectrophotometer
4. Demonstration of use of bright field, phase contrast, dark field, fluorescence, confocal and electron microscopes

5. Tissue fixation, paraffin block preparation, sectioning and stained slide preparation
6. Visit to tissue culture labs (Department of Botany and Cytogenetics Lab, Dept Zoology)

ZOB 607 PROJECT WORK/FIELD STUDY
(Credit 4)

The project work/field study will consist of biological experiments/field study conducted under the supervision of a group of teachers (2-3), submission of a written report, presentation of the work and viva-voce.

Appendix: Supplementary sources for Laboratory Exercises

1. Frog Anatomy: Pro Dissector (CD); Source – www.prodissector.com
2. Frog Physiology: PhysioEx 4.0 (CD); Source – www.physioex.com
3. Anatomy of pigeon/rat/dogfish: The Vertebrate Dissection Guide Series (CD); Source – Learning Development Center, University of Portsmouth. Email – Idc@port.ac.uk; www.port.ac.uk/departments/Idc
4. Anatomy of earthworm: The dissection works (CD); Source – www.scienclass.com
5. Anatomy of earthworm: Earthworm dissection (CD); Source – www.neosci.com
6. Anatomy of shark: Shark dissection and anatomy (video); Source – www.neosci.com
7. Cockroach dissection: source – www.ento.vt.edu
8. Mammalian Physiology – The biopac lab; Source – www.biopac.com

B.Sc. (Hons.) Ancillary Subjects

Sl. No.	Course Code	Title	Credit
1.	BSC 01A	Biology I	3
2.	BSC 02A	Biology II	3
3.	BSC 03A	Chemistry	3
4.	BSC 04A	Computer Science	3
5.	BSC 05A	Elements of Earth Science	3
6.	BSC 06A	Mathematics	3
7.	BSC 07A	Physics	3
8.	BSC 08A	Statistics I	3
9.	BSC 09A	Statistics II	3

BSC 01A: BIOLOGY I

Section		Topics	Hours
Section A			
I.		**Properties and origin of life**	**1**
II.		**Diversity of Life**	**2**
	1.	Purpose and principles of classification of organisms	1
	2.	Major groups of living systems	1
III.		**Cell structure and function**	**10**
	1.	Organization of cell (prokaryotic and eukaryotic); differences between a plant and animal cell; structure and function of cell membrane, nucleus, chloroplast, mitochondria, endoplasmic reticulum, Golgi complex and lysosome	6
	2.	Elementary structure of chromatin and chromosome	1
	3.	Cell cycle, mitosis, meiosis and its significance	3
IV.		**Biomolecules and Metabolism**	**13**
	1.	Basic structure and function of carbohydrates, lipids, proteins and nucleic acids	7
	2.	Properties of enzymes and elementary knowledge of enzyme action	2
	3.	Breakdown of carbohydrates –glycolysis, Krebs cycle and oxidative phosphorylation	4
		TOTAL	**26**
Section B			
I.		**Microbial diversity** : Salient features of bacteria and viruses	**1**
II.		**Plant diversity** : Salient features (life cycle excluded) of algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms	**3**
III.		**Plant Physiology**	**5**
	1.	Plant-water relations: absorption and movement of water, transpiration	1
	2.	Photosynthesis : Light and dark reactions	2
	3.	Effects of auxins, gibberellins, cytokinins, abscisic acid and ethylene on plant growth	2
IV.		**Ecology**	**4**
	1.	Ecosystem : Components, types, flow of matter and energy in ecosystem	2
	2.	Environmental issues : Climate change, ozone hole, pollution (air, water, soil) and biodiversity loss	2
		TOTAL	**13**

BSC 02A: BIOLOGY II

Section		Topics	Hours
Section A			
I.		**Genetics & Molecular Biology**	**13**
	1.	Mendelian laws of inheritance, linkage, crossing-over; chromosomal basis of inheritance	5
	2.	Flow of genetic information – replication, transcription and translation in prokaryotes	5
	3.	Concept of sex determination in mammals	1
	4.	Genes, diseases and syndromes – sickle cell anemia, chronic myeloid leukemia, Downs syndrome	2
II.		**Biology and Human Welfare**	**7**
	1.	Basic concepts of cancer and AIDS	2
	2.	Applications of plant tissue culture	1
	3.	Useful microbial products - Dairy products and beverages	1
	4.	Genetic engineering : Vectors and gene cloning, transgenic plants and animals	3
III.		**Evolution**	**6**
	1.	Concept and evidences of organic evolution, Theory of natural selection	2
	2.	Mechanism of evolution by natural selection (examples – industrial melanism, antibiotic resistance in bacteria)	2
	3.	Human evolution : bipedalism and increase in brain size; cultural evolution	2
		TOTAL	**26**
Section B			
I.		**Animal Diversity** : Salient features of various phyla	**2**
II.		**Development in Animals :** Gametogenesis, fertilization and early embryonic	**3**

		development (in frog as a model organism)	
III.		**Animal Physiology (taking human as model):**	**8**
	1.	Physiology of digestion	1
	2.	Mechanism of breathing	1
	3.	Heart, respiratory pigments and gas transport	2
	4.	Basic concept of urine formation	1
	5.	Elementary knowledge of endocrine organs and hormones	1
	6.	General concept of immunity	1
	7.	Structure of neuron; transmission of nerve impulse	1
		Total	**13**

Books Recommended:

1. Campbell & Reece (2005) Biology, Pearson
2. Chaudhary & Pandey (2005) Environmental studies. Apex
3. Gangulee, Das & Dutta (2002) College Botany (Vol I), New Central Book Agency
4. Gangulee, & Kar (2002) College Botany (Vol. II), New Central Book Agency
5. Gupta (2005) Microbiology, Cell Physiology and Biotechnology, Rastogi
6. Singh *et al* (2005) Text book of Botany, Rastogi
7. Verma et al (2008) Cell biology, Genetics, Molecular biology, Evolution and Ecology, S Chand
8. Biology for class XI, NCERT Text books
9. Biology for class XII, NCERT Text books

BSC 03A: Chemistry

Basic Aspects of Chemistry:

1. Chemistry as the basic of universe. Elements and their union leading to formation of molecule (bonding) and supramolecule (binding).

2. Photosynthesis and respiration. Bio-molecules (proteins and enzymes) and macromolecules (addition and condensation polymers).

3. Thermodynamic parameters (A, H, U, S, G); Equilibrium and non-equilibrium processes and their manifestation in day to day life.

4. Oxidation, reduction and standard redox potential with special reference to rusting and metallurgy of iron. Lead storage batteries, and cadmium cells.

5. Basic techniques of Chemistry: Refluxing, Distillation, Crystallization, Melting Point, and Chromatography.

6. Petroleum products: General idea about their origin. Important fractions of petroleum and their applications in daily life.

Books recommended:

1. *Nelson Science: Chemistry, 2nd ed., John Hofman & Phil Stone.*
2. *Bringing Chemistry to life, R.J.P. Williams & J.I.R. Fraust da Silva.*
3. *Elementary Organic Spectroscopy: Principles and Chemical Application, 4th ed., Y.R. Sharma, S. Chand Publication, New Delhi (2007).*
4. *The Chemistry and Technology of Petroleum, 4th ed. James G. Speight CRC Press, Taylor and Francis Group.*

BSC 04A: Computer Science

Introductory course in Computer Programming:

Introduction: Computers and problem solving, Algorithms, Types of Algorithms, Flow Chart, Problem solving and programming using principles of Top-down modular design, Abstraction mechanisms, Stepwise refinement, Introduction to Major Programming Paradigms.

Evolution of Programming Languages: Low level, Middle level and High level languages. Introduction to Compiler, Interpreter and Assembler.

Introduction to C Programming language: Data types, Instructions and its types, Storage classes, Operators and Hierarchy of operators, Expressions in C, Control and Repetitive statements, break, continue. Functions: Library functions and User defined, Local and Global variables, parameter passing, Arrays, String, Structure.

BSC 05A: Elements of Earth Science

Meaning and scope of Earth Science; Origin of Solar system, basins and atmosphere; Minerals & Rocks: Processes of formation, types and characteristics; Structure and composition of Earth; Earth's internal processes and effects: Thermal, gravitational and magnetic fields, mechanical properties and rheology, Earthquakes, Volcanism, Isostasy, Plate Tectonics, Mountain building.

Atmosphere: structure and composition, temperature, pressure, winds and precipitation; Hydrological cycle; Oceans: physical properties of seawater and movements of ocean waters; Geomorphic processes; Energy resources; Elements of Structural geology.

BSC 06A: Mathematics

Differential Calculus, Integral Calculus and Differential Equations:

Functions and their graphs. Differentiation and Integration of simple functions. Maxima and Minima. Definite Integral with applications. Differential Equations (simple types only), their solutions and applications.

Matrices: Matrices. Basic operations, Determinants, Inverse of a matrix, Solution of system of linear equations using matrices and determinants.

BSC 07A: Physics

Mechanics and General Properties of Matter:

Elasticity: Strain and stress, elastic limit, Hooke's law; Moduli (Young's, Bulk, Rigidity) and Poisson's ratio, Surface tension: Surface tension and surface energy, angle of contact, capillary action, Flow of liquids and gases: Streamline and turbulent flow, equation of continuity, Bernoulli's theorem, Torricelli's theorem; Coefficient of viscosity, Reynold's number and critical velocity, Stoke's law; Turbulence and chaos.

Thermal Physics:

Thermodynamics: Laws of thermodynamics and interpretation; derivation from first principles; Entropy and disorder, free-energy and chemical potential. Brownian motion: Elementary ideas of Brownian motion, equipartition energy; Random Walk and Stochastic processes (additive and multiplicative), Diffusion: Mean free path and drift speed.

Optics:

Light: Fermat's principle of least time, reflection and refraction.

Geometrical optics: Focal length of a spherical surface and lens; magnification; compound lenses; resolving power.

Physical optics:

(i)   Interference: Young's double-slit experiment and mathematical formulation

(ii) Diffraction: Fraunhoffer and Fresnel diffraction; Grating

(iii) Refractive index, dispersion and absorption

(iv) Polarization, birefringence and Kerr effect; Polarizers; Optical activity.

Radiation Effects on Biological Systems:

Electromagnetic spectrum, Effects of visible, ultraviolet and high energy radiation on biological systems, concept of radiation dose.

Books recommended:

1. *University Physics: Sears and Zemansky.*
2. *The Feynman Lectures on Physics (Vols. 1 and 2): R.P. Feynman, R.B. Leighton and M. Sands.*
3. *Fundamentals of Optics: F.A. Jenkins and H.E. White.*
4. *Biological Physics: Nelson.*

BSC 08A: Statistics – I

Descriptive Statistics

Nature and scope of Statistics: Measurement scales, primary and secondary data, Methods of Collection of primary data, methods of data representation, text, tabular, diagrammatic and graphical representation.

Frequency distribution and principles governing their representation, graphical representation of frequency distributions.

Measures of central tendency and their properties, uses and limitations, partition values: quartiles, deciles and percentiles.

Dispersion and its various measures with their properties and uses, coefficient of variation.

Central and raw moments up to fourth order, skewness, kurtosis and their measures.

Bivariate Data: Scatter diagram, correlation, product moment correlation coefficient, regression lines and their uses, rank correlation, concept of multiple correlation and partial correlation in case of three variables.

Concept of probability, classical and statistical definition of probability, additive and multiplicative theorems of probability, conditional probability and Baye's theorem.

Random variable: Elementary idea of probability mass function, probability density function and distribution function.

Binomial, Poisson and normal distributions with their properties and applications.

BSC 09A: Statistics – II

Statistical Inference, Sampling & Design of Experiments

Elements of testing of hypotheses, null hypothesis, simple and composite hypothesis, two kinds of error, level of significance, size and power of tests, p-value, large sample tests for mean and proportions, chi-squire, t and f tests and their applications.

Concepts and scope of sampling: Population, complete enumeration verses sampling, sampling frame, methods of sampling.

Simple random sampling with and without replacement, procedures of selecting a random sample from the population, estimation of population mean and population proportion and standard error of these estimates.

Stratified random sampling: proportional and optimum allocations, comparison with SRS.

Systematic sampling, cluster sampling and two – stage sampling: sampling procedures and estimation of population mean under these schemes.

Design of experiment: Basic principles of design of Experiment, randomization, replication and local control.

Completely randomized design (CRD), Randomized block design (RBD), and Latin Squire Design (LSD): Lay out and analysis of these designs with merits and demerits.

Factorial experiment and their advantages. Main effects, interaction effects and analysis of 2^2 and 2^3 factorial experiments.

B.Sc. (Hons.) Compulsory Courses

Sl. No.	Course Code	Title	Credit	Semester
1.	BSC 01C	Environmental Studies	1	I*
2.	BSC 02C	Ethics in Science	1	III/IV**
3.	BSC 03C	History of Science in Ancient India	1	III/IV**
4.	BSC 04C	Philosophy of Science	1	III/IV**
5.	BSC 05C	Science Communication	1	III/IV**

* BSC 01C will be studied by all Semester I students

** Faculty will offer any two of therse courses in each of the Semesters III and IV and each student will study one of these courses in each of these semesters

BSC 01C: ENVIRONMENTAL STUDIES

The multidisciplinary nature of environmental studies

Definition, scope and importance, Need for public awareness.

Natural Resources -

Renewable and non-renewable resources:

Natural resources and associated problems.

(a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people, (b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. (c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. (d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging salinity, case studies. (e) Energy resources: Growing energy needs, renewable and non- renewable energy sources, use of alternate energy sources, case studies, (f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.

Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem :- (a) Forest ecosystem, (b) Grassland ecosystem, (c) Desert ecosystem, (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Biodiversity and its conservation

Introduction – Definition: genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity : consumptive use, productive use, social ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-spots of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Environmental Pollution

Definition, Causes, effects and control measures of :- (a) Air pollution, (b) Water pollution, (c) Soil pollution, (d) Marine pollution (e) Noise pollution, (f) Thermal pollution, (g) Nuclear hazards, Solid waste Management : Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Diaster management : floods, earthquake, cyclone and landslides.

Social Issues and the Environment

From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people : its problems and concerns, Case studies, Environmental ethics : Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies, Wasteland reclamation,

Consumerism and waste products, Environment Protection Act., Air (Prevention and Control of Pollution) Act., Water (Prevention and Control of Pollution) Act, Wildlife Protection Act., Forest Conservation Act., Issues involved in enforcement of environment legislation, Public awareness.

Human Population and the Environment

Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/ AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Field work

Visit to a local area to document environmental assets-river/forest/grassland/ hill/ mountain, Visit to a local polluted site – Urban/ Rural/ Industrial/ Agricultural, Study of common plants, insects, birds, Study of simple ecosystems-pond, river, hill slopes, etc.

<u>Books recommended:</u>

1. *Agarwal, K.C. 2001, Environmental Biology, Nidi Publ. Ltd. Bikaner.*
2. *Brunner R.C., 1989, Hazardous Waste Incineration, Me Sray Hill Inc.*
3. *Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworh, M. T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai.*
4. *Down to Earth, Centre for Science and Environment, New Delhi*
5. *Gleick, H.P. 1993, Water in crisis. Pacific Institute for Studies, Dev., Environment & Security, Stockholm Env. Institute, Oxford Univ. Press.*
6. *Heywood, VH. & Watson, R.T. 1995, Global Biodiversity Assessment Cambridge Univ. Press.*
7. *Jadhav, H & Bhosale, V.M. 1995, Environment Protection and Laws, Himalaya Pub. House, Delhi.*
8. *Mckinney, M.L. & School, R.M. 1996, Environmental Science systems & Solutions, Web enhanced edition.*
9. *Odum, E.P. 1971, Fundamentals of Ecology, W.B. Saunders Co. USA.*
10. *Rad M.N. & Datta, A.K. 1987, Waste Water treatment, Oxford & IBH Publ. Co. Pvt. Ltd.*
11. *Sharma B.K. 2001, Environmental Chemistry, Goel Publ. House, Meerut.*
12. *Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Black well Science.*
13. *Trivedi R.K. Handbook of Environmental Law, Rules, Guidelines, Compliances and Standards, Vol. I ad II, Enviro. Media.*
14. *Wagner K.D., 1998 Environmental Management, W.B. Saunders Co. Philadelphia, USA.*
15. *Kudesia, V.P. 1997, Air Pollution, Pragati Prakashan, Merrut.*
16. *Rao, M.N. and H.V.N. Rao 1998, Air Pollution, McGraw Hill Publisher, New Delhi.*
17. *Cunnigham W.P. and Saigo 1999, Environmental Science, McGraw Hill Publisher, New Delhi.*
18. *Singh J.S., S.P. Singh and S.R. Gupta, 2006 Ecology, Environment and Resource, Conservation, Anamaya Publisher, New Delhi.*
19. *Santra, S.C. 2003, Environmental Science, New Central Book Agency Pvt. Ltd., Kolkatta.*
20. *Rai, G.D., 2003, Non Conventional Energy Sources, Khanna Publishers, New Delhi.*
21. *Raven, P.H., Berg, L.R.W. and Johanson, G.B. 2006, Environment Saunders College Publishing, U.S.A.*

BSC 02C: ETHICS IN SCIENCE

1. Science as a social, cultural and human pursuit; ethical issues in science; science as a social force: interrelationship of science with technology and market. **2**

2. How ethical issues arise in science: examples from different fields e.g., bio-technology, medical science, defense research and development, environmental issues, space research, etc. **3**

3. Social and moral responsibilities of science and scientists. **2**

4. Ethical issues in science research and reporting: Objectivity and integrity, fairness in credit sharing; the problem of plagiarism, international norms and standards. **2**

5. Scientific temper and virtues; scientific community and its culture. **2**

6. Desired value temper of scientists: truthfulness, simplicity, humility, freedom from egoity, open-mindedness; attitude of service, advancing social and human well-being. **2**

Books recommended:

1. *A.N. Tripathi, "Human Values", New Age Int Publishers, 2008.*
2. *J.N. Kapur, "Ethical Values for Excellence in Education and Science", Wishva Prakashan, New Delhi, 1996.*
3. *D. Callahan and S. Bok, "Ethics Teaching in Higher Education", Plenum Press, New York, 1996.*
4. *David B. Resnik, "The ethics in science: An Introduction" Publisher: Routledge, May 1998.*

BSC 03C: HISTORY OF SCIENCE IN ANCIENT INDIA

1. Importance and sources of history of science; Science in ancient civilization. **2**

2. Evolution of science, technology and civilizations. **1**

3. Contributions in fields of: **8**

   a. Astronomy and Physical sciences

   b. Chemical science and Applied Chemistry

   c. Mathematical sciences

   d. Agricultural, Medical and Biological sciences

4. Resurgence of science in pre-independent India. **2**

Books recommended:

1. *Bose, D.M. et. al: Concise History of Science in India (New Delhi, INSA, 1971).*
2. *Chattopadhyaya, D.: History of Science and Technology in Ancient India, (Firma KLM Pvt. Ltd., Calcutta, 1986).*
3. *Raina, A.K., et. al: Science and Tradition, (IIAS, SHIMLA, 2000).*
4. *Kutumbia, P.: Ancient Indian Medicine.*
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BSC 04C: PHILOSOPHY OF SCIENCE

1. What is science? Knowledge and truth; hypothesis, theory and law **3**
2. Scientific reasoning and methods in science **3**
3. Scientific temper **2**
4. Explanation in science **2**
5. Scientific change and scientific revolutions **2**
6. Originality, plagiarism **1**

Books recommended:
1. *Rudolf Cannap: "An introduction to Philosophy of Science" Edited by Martin Gardner, Published by: Baric Books Inc., New York, 1966.*
2. *Godfrey-Smith: Theory & Reality: An Introduction to the Philosophy of Science: (2003) Univ. Chicago Press.*
3. *Ladyman James: Understanding Philosophy of Science: (2001) Routledge, London.*
4. *D.D. Bandiste: A Manual on Philosophy of Science: on the lines of 2002 syllabus of UGC/LCPR, BR Publishing Corporation, India.*
5. *Samir Okasha: Philosophy of science: A very short Introduction: Oxford Univ. Press (2002)*
6. *I.M. Copy: An Introduction to logic. Prentice Hall, 13th Edition.*

BSC 05C: SCIENCE COMMUNICATION

1. Introduction and overview of principles of science communication **1**
2. Importance of science communication **1**
3. Communication among peers: reviews, research papers, books, periodicals; preparation of a manuscript; the peer-review process **5**
4. Communication through electronic and print media; internet and search of relevant information **2**
5. Communication of science to public; popularization of science **2**
6. Socio-legal issues in science communication: intellectual property rights, patents, originality, integrity, plagiarism. **2**

Books Recommended:
1. *A. Wilson: Handbook of Science Communication; (Publ. 1998), Institute of Physics Publishing, Bristol, Philadelphia.*
2. *Science Communication: Theory & Practice; Stocklmayer, Gore MM, Bryant C (Eds.) (2002), Springer*
3. *Laszis P: Communicating Science: A practical Guide: (2006), Springer.*