

**UNIVERSITY OF ALLAHABAD**  
**INFORMATION AND GUIDELINES FOR**  
**COMBINED RESEARCH ENTRANCE TEST (CRET)**

**Academic Session: 2016-17**

**SCHEDULE:**

The schedule of CRET-2016 has been as under:

**Form available Online at**

<https://www.digialm.com/EForms/html/form4394/index.html> OR Admission-2016 link of [www.allduniv.ac.in](http://www.allduniv.ac.in) and

**Start date of registration and submission ONLINE** : **25/04/2016**

**Last date of Registration ONLINE** : **09/05/2016**

**Last date to deposit Fees and form Submission ONLINE** : **10/05/2016**

**Downloading of Admit Cards Online only** : **21/05/2016**

**Date of Entrance Test** : **25-30 May, 2016. The exact date will be declared later on**

**Declaration of Result** : **On or before 15/06/2016.**

The University of Allahabad shall conduct COMBINED RESEARCH ENTRANCE TEST-2016 (CRET-2016) **ONLINE** at different centres (at least one centre in each State/Union Territory in India) for admission to the degree of Doctor of Philosophy (D.Phil.) (hereinafter referred to as D.Phil. Programme) of the University of Allahabad for the session 2016-17 in the subjects specified in SECTION 2 of this Bulletin.

As laid down in the Ordinance LVI of the First Ordinance of Allahabad University (made under Section 29 of the University of Allahabad Act, 2005) candidates for admission to the degree of D. Phil. Programme must hold a Master's degree (or a degree recognized by the University as equivalent thereto) in a relevant subject from the University, or any other University or an Institution recognized by it, and must fulfill other prescribed conditions of eligibility.

Regular teachers of the University of Allahabad and of any institution maintained by it or admitted to its privileges and international Students are exempted from appearing at CRET for admission to D. Phil. Programme. All other candidates for admission to the D. Phil. Programme in the concerned subjects are required to appear at CRET-2016 after applying and registering their candidatures through the ONLINE APPLICATION AND REGISTRATION PROCESS at the website <https://www.digialm.com/EForms/html/form4394/index.html> OR Admission-2016 link of [www.allduniv.ac.in](http://www.allduniv.ac.in) and remitting the admissible Test Fee in the prescribed manner.

The details and instructions in respect of CRET-2016, the procedure applicable to the teachers and international Students exempted from CRET-2016 and relevant information on the D.Phil. Programme are set out in the following sections of this Bulletin.

- **SECTION 1 : GENERAL INFORMATION**
- **SECTION 2 : PROVISIONS IN RESPECT OF THE SUBJECTS FOR CRET-2016**
- **SECTION 3 : THE ONLINE APPLICATION AND REGISTRATION PROCESS, SCHEDULE AND TEST FEES FOR CRET-2016**
- **SECTION 4 : THE STRUCTURE OF CRET-2016**
- **SECTION 5 : GENERAL INSTRUCTIONS**
- **SECTION 6 : INTERVIEW**
- **SECTION 7 : IMPORTANT INSTRUCTIONS TO THE CANDIDATES**

### **SECTION 1**

#### **GENERAL INFORMATION**

- 1.01 Subject to the exceptions specified in para 1.09 (of this Section), all candidates seeking admission to the D.Phil. Programme of the University of Allahabad for the session 2016-17, in the subjects listed in para 2.02 (of Section 2), shall have to qualify in the COMBINED RESEARCH ENTRANCE TEST (CRET-2016) to be conducted by the Allahabad University On Line at different centres all over India..
- 1.02 **Level I** of CRET-2016 Test will consist of two papers of only objective type questions and will be held on a single meeting as under:

<b>Paper</b>	<b>Marks</b>	<b>Number of Questions</b>	<b>Duration</b>
<b>I</b>	225	75	01 Hour (09:30 A.M. to 10:30 A.M.)
<b>II</b>	375	125	02 Hour (10:30 A.M. to 12:30 A.M.)

- **Paper-I** shall be of general nature, intended to assess the Teaching/Research aptitude of the candidate. It will primarily be designed to test reasoning ability, comprehension, divergent thinking and general awareness of the candidate. The question will be based on Teaching aptitude, Research aptitude, Reading Comprehension, Communication, Reasoning (including Mathematical), Logical Reasoning, Data Interpretation, Information and Communication Technology (ICT), People & Environment and Higher Education System.
  - **Paper-II** shall be based on the aptitude of subject selected by the candidate.
- The **Level 2** Test shall entail an interview and may include Presentations, group discussions or other modes of appraisal and shall be administered by the Doctoral Programme Committee of the Department / Institute / Centre concerned, one observer and one Vice Chancellor Nominee.
- 1.03 Candidates who have qualified the National Eligibility Test (NET) conducted by the University Grants Commission (UGC) / Council of Scientific and Industrial Research (CSIR) shall be exempted from the **Paper I of Level I** Test of CRET examination conducted by the University of Allahabad. Provided further, If the candidate desires to appear at Level 1 of the CRET examination he / she is allowed to appear in **Paper I of**

**Level I** of CRET examination, but his eligibility shall be determined only on the basis of the marks obtained by him/her in the CRET examination.

- 1.04 The following categories of candidates shall be exempted from the **Level 1** Test:
- 1.04.1 All the candidates selected by the University Grants Commission (UGC)/ Council of Scientific and Industrial Research (CSIR) for Junior Research Fellowship (JRF), subject to the validity norms of the respective fellowship. However, such candidates who have been selected for Junior Research Fellowship (JRF) are desirous of appearing at Level 1 of the CRET-2016 examination, they are allowed to appear in CRET-2016 examination conducted by University of Allahabad. Provided further the eligibility of such candidates shall be determined only on the basis of the marks obtained by him/her in the CRET examination.
- 1.04.2 Candidates for D.Phil. in the Department of Earth and Planetary Sciences with M. Tech. in Geology/Applied geology or Geo-Physics (or equivalent subjects).
- 1.04.3 Candidates for D.Phil. in the Department of Earth and Planetary Sciences with M.Sc. in Geology/Applied Geology or Geo-Physics (or equivalent subjects) who have valid GATE score before the last date of applying for CRET and have a GATE Score of not less than 75%.
- 1.04.4 Serving Army, Navy and Air force Officers with not less than 15 years of service and holding the rank of Colonel in the Army, or equivalent rank in the Air Force/Navy, who are applying for D.Phil. in the Department of Defence and Strategic Studies are exempted from Level 1 and be separately assessed at level 2 against a specified number of vacancies.
- 1.05 There shall be negative marking in objective-type questions. For every correct answer 3 marks will be awarded and for each wrong answer 1 mark will be deducted.**
- 1.06 Please refer to University website [www.allduniv.ac.in](http://www.allduniv.ac.in) for reservation rules.
- 1.07 There shall be category-wise minimum qualifying marks for the paper 1 and Paper 2 of level 1 Test, separately for each Test and also on the aggregate total score of the two Papers, as follows

## **MINIMUM QUALIFYING MARKS**

### **For General and OBC Category candidates:**

Paper 1 of Level 1 will be qualifying for Paper 2 of Level 1 and Paper 2 of Level 1 will be qualifying for Level 2. But for Level 2, marks of Paper 2 of Level 1 will only be considered. In order to qualify Paper 1 of Level 1, 40% marks are essential. Similarly, to qualify for Level 2, 40% marks in Paper 2 of Level 1 is necessary. However, if a candidate fails to score 40% marks in Paper 1 of Level 1 or in Paper 2 of Level 1, he/she shall be eligible for Level 2 provided that the total marks in Paper 1 and Paper 2 of Level 1 is 50%. **The merit in “Paper 2 of Level 1” will only be considered for Level 2.**

### **For SC / ST / PH category candidates:**

Paper 1 of Level 1 will be qualifying for Paper 2 of Level 1 and Paper 2 of Level 1 will be qualifying for Level 2. But for Level 2, marks of Paper 2 of Level 1 will only be considered.

In order to qualify Paper 1 of Level 1, 35% marks are essential. Similarly, to qualify for Level 2, 35% marks in Paper 2 of Level 1 is necessary. However, if a candidate fails to score 35% marks in Paper 1 of Level 1 or in Paper 2 of Level 1, he/she shall be eligible for Level 2 provided that the total marks in Paper 1 and Paper 2 of Level 1 is 40%. **The merit in “Paper 2 of Level 1” will only be considered for Level 2.**

- 1.08.1 A candidate who fails to secure the minimum qualifying marks in the respective social categories (i.e. UR, OBC, SC and ST) in Paper 1 of Level I Test, or have failed to secure minimum qualifying marks Paper 1 and Paper 2 of Level I separately shall stand disqualified for level II.
- 1.08.2 A list of eligible candidates for the Level 2 Tests shall be drawn up, in according with the considerations specified in sub-para 1.08.4, from amongst the following categories of candidates fulfilling the eligibility Criteria (vide para 1.12)
  - 1.08.2.1 Candidate exempted from Level 1 (vide para 1.04 and its subparagraphs).
  - 1.08.2.2 Candidate exempted in the Paper 1 of Level 1 test who obtained the prescribed minimum qualifying marks for the concerned category in the Paper 2 of Level 1 Test (vide para 1.07)
  - 1.08.2.3 Candidates who obtain the aggregate minimum qualifying marks for the concerned category on the total score in the Paper 1 and Paper 2 of Level 1 Test (vide para 1.07)
- 1.08.3 A LIST OF ELIGIBLE CANDIDATES for the Level 2 Test shall be announced by the CRET-2016 Committee on the basis of the following considerations:

Vacancies in any Department/Institute/Centre/unit in any session will depend on the number of approved research supervisors of the subject/unit/centre concerned. As such, CRET 2016 Committee shall determine the number of vacancies as intimated by the respective Head/Coordinator of the Department/Centres in the respective subject/unit/centre concerned. The number of candidates (from amongst those qualifying for Level 2 Test on the basis of the On-Line test and those exempted from the Level 1 Test) to be called for the Level 2 Test in the respective subject/unit/centre shall be determined on the basis of the vacancies as intimated by the respective Head of the Department/Director/Coordinator concerned. The list of such candidates (i.e. the List of Eligible candidates for the Level 2 Tests) shall include the candidates referred to in sub-sub-para 1.08.2.1 and the candidates drawn from those referred to in sub-paras 1.08.2.2 and 1.08.2.3, taken together in accordance with their merit position in the percentage scores for the Written Test, subject to the provisions of reservation of different social categories (i.e. SC, ST and OBC). (vide para 1.05). Thus, admission to D.Phil. Programme in a unit shall be finalized in the context of the availability of seats (vacancies) under the approved supervisors in the concerned Unit/Department and the Reservation rules. Accordingly, the University reserves the right to determine the admissions to the D.Phil. programme in each unit as per relevant provisions of First Ordinances of Allahabad University (Ordinance LVI) and the Reservation Policy.

- 1.08.4 Against each vacancy two candidates will be qualified for Level 2. Further all JRF (UGC / CSIR) qualified candidate will be eligible for Level 2.

- 1.09 Regularly appointed teachers of the University of Allahabad (including University Institutes and Independent Centres of the University of Allahabad) or of any Constituents Institute or Constituent College of the University of Allahabad, desirous of admission to the D.Phil. programme in their respective subjects, should submit, on or before June 15, 2016, their application on the Application Form available in the Office of the Registrar, University of Allahabad, prescribed for the D.Phil. Programme, in the manner specified in the proviso to clause 1(c) of the **Ordinance LVI** (The Doctor of Philosophy Programme) of the First Ordinances of the University of Allahabad, to the Registrar, University of Allahabad. The Registrar shall record these Forms and forward them to the Head of the concerned Department (in the case of teachers of a Department of the University or of a Constituents College) or to the Director of the concerned Institute (in the case of teachers of a University Institute or a Constituent Institute).
- 1.10 International Students seeking admission to the D.Phil. Programme should contact the international Students Advisor of the University, who shall issue appropriate instructions to such of them who fulfill the qualifications for being considered for admission to the D.Phil. Programme. The cases of International Students are subject to the provisions of the third proviso to clause 1 (a) (iii) of the Ordinance LVI of the First Ordinances of the University of Allahabad. The process and schedule for the admission of International Students may be different from that for the candidates qualifying CRET-2016 and the teachers referred to in para-1.09.
- 1.11 All candidates (except the regularly appointed teachers and international students referred to in paras 1.09 and 1.10), including candidates exempted from the Paper 1 of Level 1 Test (vide para 1.03) or the Paper 1 and Paper 2 of Level 1 Test (vide para 1.04), should apply to the Director, Admissions-2016 through the **ONLINE APPLICATION AND REGISTRATION PROCESS** from the website <https://www.digialm.com/EForms/html/form4394/index.html> OR Admission-2016 link of [www.allduniv.ac.in](http://www.allduniv.ac.in), in accordance with the instructions set out in SECTION-3.
- 1.12 All candidates, **including candidates exempted in the Paper 1 of Level 1 Test** (vide para 1.03) **or the Paper 1 and Paper 2 of Level 1 Test both** (vide para 1.04), shall be required to fulfill the following **ELIGIBILITY CRITERIA** for appearing in CRET-2016 and for admission to the D.Phil. Programme.
- 1.12.1 A minimum score at the Post-graduate Examination of 55% marks (or the equivalent Letter Grade/Grade Point under the seven point Letter Grade Scale), laid down by the UGC in **the case of General candidates and 50% marks (or the equivalent Letter Grade/Grade Point) in the case of OBC(Noncreamy Layer)/SC/ST/PH candidates.**

**NOTE :**For the purposes of Criterion 1.12.1, **the percentage of marks obtained by the candidate shall not be rounded-off to the next higher integer.**

- 1.12.2 A minimum average score in the entire academic career of 54% marks (or the equivalent Letter Grade/Grade Point) in the case of General/OBC candidates; or

49% marks (or the equivalent Letter Grade/Grade Point) in the case of SC/ST/PH candidates.

**NOTE :** For the purposes of Criterion 1.12.2, the average percentages score of the candidates shall not be rounded-off to the next higher integer.

1.12.3 Not more than one III division (or equivalent Letter Grade/Grade Point) in the academic career before graduation.

1.12.4 A candidate having III division (or equivalent Letter Grade/Grade Point) at the graduate and post-graduate examinations shall not be considered for admission to D.Phil. Programme.

**A candidate who does not fulfill the aforesaid Criteria 1.12.1 to 1.12.4 shall not be eligible to apply for and to appear in CRET-2016 and to be admitted to the D.Phil. Programme.**

1.13 The rules and procedures for admission/registration and matters applicable to the D.Phil. students shall be governed by the Ordinance LVI (The Doctor of Philosophy Programme) of the First Ordinances of the University of Allahabad and other relevant Ordinances, Regulations and rules of the University of Allahabad.

1.14 With effect from the Session 2016-17, all admissions to the D.Phil. Programme shall initially be on PROVISIONAL basis and the admitted candidates shall be required to attend and attain the minimum requisite standards and shall be required to complete the Pre-Doctoral Programme offered by the respective Department/Unit/Centre. The course fee for the Pre Doctoral Programme may be chargeable to the Contingency Grant of candidates in receipt of a Fellowship/Scholarship/other stipend.

1.15 Final admission to the D.Phil. Programme shall be granted to the candidates only upon the successful completion of the Pre-Doctoral Programme of the duration of one Semester.

1.16 Under the provisions of clauses I(c) and 4(a) of the Ordinance LVI of the First Ordinances of the University of Allahabad. All candidates admitted to the D.Phil. Programme are required to pursue a course of research of duration of not less than twenty-four months, in residence within the territorial area of the University (i.e, the area within a radius of 16 kilometers from the Convocation (Senate) Hall of the University).

1.17 Under the provisions of clause I(c) of the Ordinance LVI of the First Ordinances of the University of Allahabad an employed candidate (other than a teacher referred to in para 1.09) shall not be considered for admission to the D.Phil. Programme except upon submitting a 'No Objection Certificate' from his/her employer to the effect that the candidate, If posted within the territorial area of the University, shall be permitted to report for research work to the Department/Institute/Centre concerned and to attend course-work and other academic activities there or at other location or if posted outside or transferred from, the said area, shall be granted leave of absence for the requisite period to fulfill the requirement of residence within the area.

- 1.18 A candidate takes up employment after joining the D.Phil. Programme shall be required to immediately give information in writing to the effect to the Head/Director/Co-ordinator of the Department/Institute/Centre where he/she is enrolled, and his/her admission shall be subject to the provisions of clause 1 (c) referred to in para 1.17. In case the candidate conceals such information, or fails to present the prescribed 'No Objection' Certificate of the employer for continuing in research, or defaults on any other applicable condition in this regard, he/she shall not be entitled to continue in the D.Phil. Programme and his/her admission to the D.Phil. Programme shall stand terminated.
- 1.19 No candidate admitted, to and enrolled in the D.Phil. Programme shall be entitled to continue in, or accept, any remunerative assignment during the period of enrolment in the Programme, other than a Fellowship/Scholarship/other stipend awarded for pursuing the Programme. This provision shall not apply to the remuneration being drawn by the teachers referred to in para-1.09 or by the employed candidates referred to in para 1.17.
- 1.20 No candidate admitted to and enrolled in the D.Phil. Programme shall be entitled to continue in, or join any other Degree course or any whole-time Diploma/Certificate course of the University of Allahabad or of any other University/Institution. However, he/she may be permitted (or required) to join a part-time or add-on Diploma/Certificate course, in accordance with the provisions of Ordinance LVI of the First Ordinances of the University of Allahabad and other relevant Ordinances of the University.

## **SECTION 2**

### **PROVISIONS IN RESPECT OF THE SUBJECTS FOR CRET-2016**

2.01 CRET-2016 shall be conducted in the **Subjects** mentioned in para.2.02

#### **2.02 SUBJECT WISE AVAILABLE SEATS FOR CRET-2016**

<b>S.No</b>	<b>Subject</b>	<b>Number of Seats*</b>
<b>1.</b>	Agricultural Botany	01
<b>2.</b>	Agricultural Chemistry	02
<b>3.</b>	Ancient History	06
<b>4.</b>	Anthropology	09
<b>5.</b>	Arabic	04
<b>6.</b>	Atmospheric & Ocean Studies	10
<b>7.</b>	Behavioural and Cognitive Sciences	03
<b>8.</b>	Biochemistry	06
<b>9.</b>	Bioinformatics	04
<b>10.</b>	Biotechnology	10
<b>11.</b>	Botany	11
<b>12.</b>	Chemistry	10
<b>13.</b>	Commerce and Business Administration	29
<b>14.</b>	Computer Application (IPS)	03

15.	Defence and Strategic Studies	06
16.	Development Studies	06
17.	Earth and Planetary Sciences	08
18.	Economics	20
19.	Education	10
20.	English	20
21.	Environmental Science	04
22.	Fine Arts	04
23.	Food Technology	04
24.	Geography	07
25.	Hindi	10
26.	History (Medieval and Modern)	11
27.	Home Science	02
28.	Law	18
29.	Material Science	10
30.	Mathematics	20
31.	Music and Performing Arts	06
32.	Nutritional Science	03
33.	Persian	02
34.	Philosophy	05
35.	Physical Education	04
36.	Physics	26
37.	Political Science	05
38.	Psychology	05
39.	Sanskrit	12
40.	Sociology	04
41.	Statistics	06
42.	Urdu	09
43.	Zoology	12

\* The number of seats may vary at the time of admissions.

- 2.03 The University reserves the right to withdraw any of the subjects specified in para 2.02 from CRET-2016 without assigning any reason.
- 2.04 A candidate is entitled to appear for the Level 1 Testat CRET-2016 in only one subject being the subject in which he/she has passed the Post-Graduate examination or (where such subject is not included in the list given in para 2.02) in a subject that is admissible in this regard, on account of having been recognized by the University of Allahabad' as equivalent to the subject of the candidate at the Post-graduate examination or as having a variation merely in name and not in substance from the latter.

**NOTE:**



- i. The candidate is advised to satisfy himself/ herself of the admissibility of the subject of his/her Post-Graduation for the purposes of appearing with a particular Subject at CRET-2016.
  - ii. In case any question arises regarding the admissibility of the subject of a candidate at the Post Graduate examination for the purposes of appearing with a particular Subject at CRET 2016, the CRET -2016 Committee shall take a final decision on the recommendation of the Doctoral Programme Committee concerned, and such decision shall be binding on the candidate.
- 2.05 A candidate eligible to appear at the Level 2 Test of CRET-2016 and desirous of pursuing research in an inter-disciplinary area in which an approved D.Phil. Programme is offered by a Department/Centre/unit or an Institute, shall be allowed to pursue such inter-disciplinary D.Phil. Programme only if the CRET-2016 Committee and the relevant Doctoral Programme Committee (DPC) have permitted to pursue such D.Phil. Programme. In such a case, the candidate shall be required to submit, in original, the Certificate of Eligibility, issued by CRET-2016 Committee (vide para 4.09), along with other requisite documentation to such DPC for the concerned Inter-disciplinary area.
  - 2.06 Before applying for CRET 2016 and appearing at any level, thereof, candidate must satisfy himself/herself that he/she fulfills the prescribed minimum eligibility criteria for admission to the D.Phil. Programme of the University of Allahabad, as specified in para 1.12, and that the subject opted by the candidate is appropriate to him/her, vide para 2.04, or is approved for purposes of admission to the D.Phil. programme in the inter-disciplinary area as opted by the candidate (vide para 2.05).
  - 2.07 If a candidate fails to mention, in his/her On-line Application Form, the subject in which he/she wants to appear for CRET-2016, or indicates in the said Form a subject not specified in para 2.02, or not admissible to him/her under para 2.04, the Application Form shall be liable to be rejected. Where a candidate appears in CRET-2016 (at any Level) in a subject that is not admissible to him/her, his candidature shall be liable to be rejected.
  - 2.08 The details entered by the applicant in the form will be verified at Level 2. If it is found at any stage that a candidate has appeared in CRET-2016 (at any Level) in a subject that is not admissible to him/her in terms of para 2.04, his candidature shall be liable to be rejected and he/she shall not be entitled to claim any relief or other concession in that regard.
  - 2.09 At any stage of the admission process, the University of Allahabad reserves the right to cancel the candidature if the application is not meeting the requisite criteria,

### **SECTION 3**

#### **THE ONLINE APPLICATION AND REGISTRATION PROCESS, SCHEDULE AND TEST FEES FOR CRET-2016**

- 3.01. A candidate who fulfils the minimum Eligibility Criteria (vide para 1.12), and seeks to appear in CRET-2016 in a Subject that is available and is also admissible to him/her (vide paras 2.02 and 2.04), must complete, and submit through the Internet, as per modality and schedule set out in the following paras, the prescribed ON-LINE APPLICATION / REGISTRATION FORM for appearing for the Level 1

(Paper 1 and Paper 2) and Level 2 Test (as the case may be) at CRET-2016 in the concerned / admissible Subject (vide para 2.04), and must remit, within due time, the prescribed Test Fees to the University of Allahabad in the manner described in para 3.09.

**NOTE:** The candidate is strongly advised to familiarize himself / herself with the SCHEDULE for different processes/stages of CRET-2016, which is set out in **para 3.05**.

3.02 The On-line Application / Registration Form for CRET-2016 shall be accessible only during the dates specified in the Schedule (vide para 3.05) at <https://www.digialm.com/EForms/html/form4394/index.html> OR Admission-2016 link of [www.allduniv.ac.in](http://www.allduniv.ac.in)

The candidate has to **fill** and **submit** the form **ONLINE**, in accordance with the instructions given in the said Website and also summarized in this Section.

**NOTE:** The Form shall not be accessible at the Website after the last date of **accessibility** given in the Schedule.

3.03 Before proceeding to fill and submit the On-line Application / Registration Form for CRET -2016, the candidate is strongly advised to carry out the following tasks for his/her own convenience:

3.03.1. Take a Print-out of this Bulletin (Information and Guidelines) and read it carefully.

3.03.2. Take a Print-out of the CRET-2016 Syllabus of the Subject in which he / she desires, and is eligible, to appear.

3.03.3 Read thoroughly the Instructions for the filling and submission of the Online Form.

3.03.4. Review and ensure the correctness of the details of his/her academic record at the High School and Intermediate (or equivalent) and the Graduation and Post graduation level, for purposes of making required entries in the On-line Form.

3.03.5 Get his/her latest Passport-size Color Photograph and his signature scanned by Computer, so that the scanned Photograph and Signature can be submitted with the On-line Form. The original of the scanned Photograph should be carefully preserved for submission to the CRET-2016 Committee in the manner specified in para 3.12.

3.03.6 Though it is not mandatory, it is advised that if the candidate does not already have an e-mail address (e-mail ID), he/she should create for himself/herself a valid email ID, in order that the CRET-2016 Committee may send him / her significant instructions or information (as per need) by e-mail.

3.04 As pointed out in para 2.04, the candidate is entitled to appear in only one Subject at CRET-2016. The candidate is also prohibited from submitting more than one On-line Application / Registration Form for CRET-2016. In case the candidate submits more than one On-line Form, all the Forms submitted by him shall stand cancelled.

**3.05. The SCHEDULE for different processes Ist stages of CRET-2016 is as follows:**

<b>1</b>	<b>Online Registration Start Date</b>	<b>25/04/2016</b>
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2	Last date of Registration ONLINE	09/05/2016
3	Last date to deposit Fees and form Submission ONLINE	10/05/2016
4	Admit Cards download date	21/05/2016
5	Date and Time of CRET-2016 LEVEL 1 TEST	25-30 May 2016. The exact date is entrance test will be declared later on.
6	Declaration of Results of Level 1 Test	On or before 15/06/2016

**3.06 The TEST FEES prescribed for different categories of candidates for CRET-2016 areas follows:**

**GENERAL / OBC : ₹ 1200/-**

**SC /ST / PH : ₹600/-**

It should be noted that the Test Fees shall not be refunded or carried over in case the application of the candidate is rejected, or his / her candidature is cancelled at any stage, or he / she does not appear wholly or partially for CRET-2016.

**NOTE: There is no provision for the withdrawal by a candidate of his / her application / candidature for CRET-2016 once he / she has submitted the Form or, pursuant to the same, remitted the Test Fees.**

## **SECTION 4**

### **THE STRUCTURE OF CRET-2016**

**4.01 LEVEL 1 TEST:** This test is of objective type questions and it will consist of two Papers-Paper 1 and Paper 2. Negative Marking for wrong answers is applicable as mentioned in para 1.05 for Level 1 Test.

**4.01.1 Paper1: General Awareness, Academic and Research Aptitude:** This Section of the paper will comprise of 75 multiple choice questions all of which are to be attempted. Each question will carry 3 marks. Duration of this Section will be 01:00 hour.

**4.01.2 Paper 2: Subject Proficiency in the CRET-2016 subject applied for:** This Paper will comprise of 125 multiple choices type objective questions of the subject opted by the candidate. All questions are to be attempted. Each question carries 3 marks. Duration of this Section will be 02:00 hours.

**4.01.3** Test for Paper 1 and Paper 2 of Level 1 will be in continuation. Candidates will not be allowed to leave the examination room in between the two Sections. Immediately

after completion of Paper 1 duration, i.e. 1:00 hour, the questions for Paper 1 will be locked on the computer and simultaneously question booklet Paper 2 will be opened on the computer. Total duration of Level 1 Test (Paper 1 and Paper 2) is 3 hours.

- 4.01.4 The candidates exempted from Paper 1 of level will enter the examination hall at the time of Paper 2 of level 1. These applicants will get a total time of 02:00 Hours.

## **SECTION 5**

### **General Instructions**

- 5.0 The University reserves the right to declare the number of eligible candidates in each subject in accordance with the relevant Ordinances and the present reservation policy of the University. However, admission to D. Phil. Programme will be finalized on the basis of the availability of seats and supervisors in the concerned Department/Centre/Institute.
- 5.01 The list of eligible candidates for Level 2 (Interview) by the concerned DPC shall be sent to the concerned Department/Centre/Institute. The eligible candidates (including JRFs/CSIR qualified candidates) shall contact the concerned Department/Centre/Institute for further instructions and final selection for admission to its D.Phil. Programme.
- 5.02 A Certificate of Eligibility issued by the Director, CRET-2016 to the eligible candidates, shall be sent together with the list of eligible candidates to the concerned Department for distribution to the students. This will support the eligibility of the candidate for admission to D.Phil. Programme of the concerned/allied subject and shall be submitted in original with the prescribed Application Form for admission to D.Phil. of the University to be filled and submitted for Level 2 (Interview) to the concerned DPC.
- 5.03 No weightage of NET/JRF shall be admissible to the candidates on their Written Subject Test score of CRET-2016. All eligible candidates including JRFs will be treated at par for the Level 2 Test.

## **SECTION 6**

### **LEVEL 2 (INTERVIEW)**

- 6.0 Candidates found eligible for Level-2 (Interview) shall be required to contact the concerned/allied Departments/Centre/institute. They shall fill the form prescribed by the University of Allahabad, for admission to its D.Phil. Programme and appear before the DPC of the subject for interview and other formalities as desired by the concerned DPC. Their admission shall be finalized by concerned DPC depending on the availability of seats and supervisors.
- 6.02 A candidate desirous of pursuing inter-disciplinary research shall be permitted to apply for Level 2 of CRET-2016 in any one of the allied subjects for whom the Certificate of Eligibility shall have to be submitted in original with the prescribed application form.

## **SECTION 7: IMPORTANT INSTRUCTIONS TO THE CANDIDATES**

- 7.01 Every candidate MUST CARRY HIS/HER ADMIT CARD for being permitted to appear at the concerned test(s) of CRET-2016.
- 7.02 Every candidate must sit on his/her computer system as per the roll number allotted.
- 7.03 No candidate shall be allowed to enter the Examination Hall after 15 minutes of the commencement of the Test.
- 7.04 No candidate will be allowed to leave the Examination Hall till the end of the Test.
- 7.05 Calculators/mobile phones/pagers etc. shall not be allowed within the premises of the examination centre.
- 7.06 All candidates are required to retain the admit cards after the test for presenting it at the time of Level 2 (Interview) before the concerned DPC and final admission to the D.Phil, programme of the University.
- 7.07 Eligible candidates in Paper 2 of Level 1 are required to collect Eligibility Certificate from the concerned department/centre/institute. The certificate has to be submitted in original along with the prescribed Application/Registration form for Level 2 (Interview).

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**SYLLBUS OF VARIOUS SUBJECTS OF CRET-2016**

## INDEX of SUBJETCS

S.No	Subject	S.No	Subject
1.	Agricultural Botany	23.	Food Technology
2.	Agricultural Chemistry	24.	Geography
3.	Ancient History	25.	Hindi
4.	Anthropology	26.	History (Medieval and Modern)
5.	Arabic	27.	Home Science
6.	Atmospheric & Ocean Studies	28.	Law
7.	Behavioural and Cognitive Sciences	29.	Material Science
8.	Biochemistry	30.	Mathematics
9.	Bioinformatics	31.	Music and Performing Arts
10.	Biotechnology	32.	Nutritional Science
11.	Botany	33.	Persian
12.	Chemistry	34.	Philosophy
13.	Commerce and Business Administration	35.	Physical Education
14.	Computer Application (IPS)	36.	Physics
15.	Defence and Strategic Studies	37.	Political Science
16.	Development Studies	38.	Psychology
17.	Earth and Planetary Sciences	39.	Sanskrit
18.	Economics	40.	Sociology
19.	Education	41.	Statistics
20.	English	42.	Urdu
21.	Environmental Science	43.	Zoology
22.	Fine Arts		

### (01) AGRICULTURAL-BOTANY

- Historical, symptomology, properties and nature of plant viruses, modes of transmission of plant viruses, serology and mutations in plant viruses. General principal of control of virus diseases in plants. A knowledge of the common virus diseases of potato, tobacco, Hibiscus crcurbits, beans and banana.
- A knowledge of more important bacterial diseases with special reference to crown gall, citus canker, fire blight of pear, sugarcane stripe and bacterial wilt of crops.
- History of Mycology, Taxonomy and nomenclature of fungi Origin of phylogeny of fungi. Different systems of classification and their basis. Physiology of fungi, structure and life history of the chief representatives of fungi.
- Cell division: Mitosis and meiosis, chromosomal aberrations, use of chromosomal aberration in genetical studies. Morphology and chemistry of the chromosome.
- Polyploidy: Nature and classification of polyploidy cytology and genetics of polyploids.

- Heredity and environment, laws of heredity. Linkage, crossing over and mapping of chromosomes. The nature of the gene. Physical structure of the gene, interaction, penetrance and expressivity, position effect, pleiotropism, allelism, multiple alleles and pseudo alleles.
- Gene in population, quantitative inheritance and cytoplasmic inheritance.
- Determination of sex, evolution of sex in flowering plants.
- Mutation: Nature and cause, factors affecting mutation. Genetics of sterility and incompatibility. Genetics of species and race formation.
- History of plant breeding, its present status and scope. Mode of reproduction in crop plants. Hybridization and its application.
- Plant introduction and its utility in crop improvement. General methods of crop improvement.
- Regional soils of India in relation to crops and their production.
- Characteristics of root systems. Drought resistance, chemical control of water relations.
- Concept of water requirement of crops and the critical period of water requirement of plants and its significance in crop production.
- Formation of arid soils and types of arid soils. Control of alkalinity and salinity.
- Growth, methods of growth analysis, control of growth by hormones, mechanism of action of growth regulators, control of differentiation, flowering, dormancy and senescence.
- Physiology of flowering, photoperiodism and vernalization.
- Origin, history, breeding and production technology of important fruits such as mango, banana, citrus, guava, papaya, grape, pineapple, litchi, pomegranate, ber, apple, pear, and walnut with special reference to climate, soil, propagation, cultivars, nutrition, irrigation and other orchard management practices.
- Origin, history, breeding and production of important vegetables, spices and condiments like tomato, brinjal, chillies, radish, turnip, carrot, beans, peas, onion, potato, okra, cucurbits, coriander, garlic, etc. with special reference to climate, soil, seed production including development of hybrids, cultivars, nutrition, irrigation and other management practices.
- History of gardening in India. Styles of gardening, their principles and practices with special reference to Nughal, Japanese and English gardens. Garden parts (features), their materials and methods of development including garden ornaments. Classification and utilization of ornamental trees, shrubs, climbers, herbaceous, perennials, annuals and foliage plants. Preparation and management of Bonsai. Home gardens. Production of important flower crops like orchids, marigold, chrysanthemum, rose, jasmine, dahlia, with reference to climate, soil, propagation, cultivars, planting methods, nutrition, irrigation etc. Prolonging, storage and vase life of cut flowers and their utilization.
- A study of the botany of important weeds associated with the crops plants of the region. Methods of preventing introduction and spread of weeds. Principles and procedures of weed control.
- Concept of crop ecology and its scope in agronomic pursuits. Plant succession, units of vegetation, competition and invasion, reaction and stabilization, factors of habitat and development.
- Light – a factor in geographical distribution, heating, chemical, quantitative and qualitative effects. Latitude and length of day, photoperiodic periods, photoperiodism and plant adaptations. Utilization of artificial light.
- Soil microorganisms and their role in production. Principles and practices of dry farming; special problems in dryfarming. Mixed-cropping and strip cropping in agriculture in India. Agronomic practices in relation to soil acidity and alkalinity.
- Floral biology, mode of reproduction, sporogenesis, pollination, fertilization, embryogenesis, fruit and seed development. Apomixis, parthenocarpy, polyembryony and somatic embryoids. Seed structure of monocot and dicot. Chemical composition of seeds.

Seed dormancy – types, causes, mechanisms in induction and release, factors affecting, methods to overcome dormancy, and significance in agriculture.

- Principles of seed processing. Seed drying- principles and methods. Pre-cleaning, grading, treating and packaging.
- Need for storage. Storage behaviour of orthodox. Factors affecting seed storage and role of moisture, temperature, RH. and moisture equilibrium. Storage structure. Methods of stacking and their impact. Germplasm storage.
- Detailed study of photosynthesis and role of carbon assimilation in crop production.
- Respiration, respiratory substrates, factors affecting respiration, aerobic and alcoholic fermentation and their interrelationships, metabolisms of organic acids.
- Metabolism of fats.
- Physiological basis of purning, lodging unfruitfulness and yield. Factors affecting: root ratio.
- Special physiological problems connected with crops like sugarcane, cotton, hemp, wheat, tobacco, rice, groundnut etc.
- Frequency distribution, mean, median and mode, standard, normal and binomial distribution. Correlation- partial and multiple regression, coefficient. Tests of significance- t, f and chi – square tests.
- Chromosomal crossing over, linkage maps, double crossing over coincidence and interference; test crosses, evidence that crossing over is associated with chromosomal exchange factors affecting crossing over polyploids, and inversions. Male drosophila crossing by breakage of chiasmata chiasmata terminalization, multiple allelism, pseudoalleles, position, mutation rates, mutator genes, radiation and chemical-induced mutations. Mechanism of induction of chromosomal structural changes paramutation.
- Structure and replication of DNA and RNA, DNA theory as the classical basis of heredity. Recombination in microorganisms structure of gene. Molecular aspects of chromosome structure. Molecular aspects of mutation and recombination Genetic code and genetic control of protein synthesis. Control of differentiation.
- Breeding for disease and pest resistance, host parasite relationship, concept of horizontal and vertical resistance. Polyploidy in plant breeding, breeding behaviour of aneuploids, autopolyploids, allopolyploids and role in induced polyploids, Macro- and micromutations and plant breeding. Breeding for drought resistance, lodging resistance, dwarfing genes plant type rainfed conditions saline resistance and cold resistance. Release of new varieties, multiplication and distribution, seed certification, seed labeling and testing maintenance of pure seed stocks. Statistical methods and experimental designs for plant breeding experiments. Cytogenetics and improvement work done in India on wheat, rice sugarcane, cotton, potato and mustard. Frequency distribution, mean, median and mode. Tests of significance-t, f and chi-square tests. Experimental designs, basic principles. Completely Randomized, Randomized block. Latin square, split plot.
- Black tip of mango, chlorosis and sun scald.
- Physiology of penetration and infection in fungi Pathogen factors in the physiology of disease- toxins, enzymes and other metabolites Factors governing resistance and susceptibility of the host of disease.
- Influence of environmental factors on plant diseases Epiphytotic and conditions necessary for its establishment. Physiological specialization in parasitic fungi. Forecasting of plant disease.
- A detailed study of important bacterial, viral, mycoplasma and fungoid diseases of wheat barley; oat rice, pea, gram, maize, jowar, bajara potato, tobacco, colocasia, chilli, brassica and allied plants, groundnut, linseed, cotton sugarcane, mango guava, papaya, apple, peach, pear, cucurbits and banana.



- A study of the economically important flowering parasites.
- Orobanche, Cuscuta, Striga, Loranthus and Biscum.
- Important Nematode diseases of plants.
- Quarantines and prohibitions; general idea of quarantine regulations in force in India and Uttar Pradesh.
- Crop rotation, field sanitation, eliminations of alternate hosts; chemical eradication.

## (02) AGRICULTURAL-CHEMISTRY

### Elements in soil and plants

Periodic Classification of elements: electronic configuration, Valency; Oxidation and reduction; ionic equations; essential plant elements (nutrients), Free radical; Isotopes  
Chemistry of important compounds and elements essential for plants and

Code-02

Animals Viz, N.P.K., Mg, Na, Fe, Al, Mo, Cu, Zn, B, I, C, I, V, As, Cr, Ni, Co, Cd, Hg, P, S, Se. The chemistry of silicates, clay minerals etc. Complex compounds, uses of complexants in agriculture.

### Elements used as fertilizers

Macro- Nutrients: and production and consumption of fertilizers; fertilizer industry in India. Chemistry and technology of NPK fertilizers. detailed account of individual NPK fertilizers; Soil

amendments, Methods of fertilizer applications. Mixed fertilizers; new trends in fertilizer use  
Macro-Nutrients; Cu, Zn, Mn, Fe, B and Mo, used as fertilizers Their action in soils.

### Theoretical aspects of analytical chemistry

A general information about electrolytic dissociation, solubility product, common ion effect, activity coefficient and pH.

Principles of volumetric analysis, acid base, titration, redox potential and precipitation

Complexometric titrations adsorption indicators. Accuracy and precision in quantitative analysis. General principles of gravimetric analysis Chromatography. Instrumental methods, methods of analysis Principles involved in colorimetry, flame photometry, turbidimetry, and X-ray

diffraction techniques.

Conductometric and potentiometric methods of analysis.

Electron Microscopy and infra-red spectroscopy, Radio-tracer technique principle, methodology,

labeling and assay of isotopes.

### Application of physical chemistry of soils

Theory of dilute solutions: Osmosis, Colloidal State, soil as a colloid. Properties of colloids, colloidal behaviour of proteins, milk and zeolites. Adsorption as a surface phenomenon. Various

equations of adsorption. Fixation of nutrients on soil and clay mineral surface, Law of mass action, chemical affinity and chemical equilibrium. Elements of crystal structure. Redox-process,

redox processes in soils.

### Soil physical properties,

Mechanical composition of soils, Stoke's law Methods of mechanical analysis. Relationship between mechanical analysis and physical properties of soil.

Soil water, forms of soil water, methods of measuring moisture, soil water plant relationships. Availability of moisture. Soil structure, texture, tilth and tillage. Soil air, soil temperature. Effect of physical properties on nutrient availability.

### **Phytobiochemistry**

Chemistry, Classification and synthesis of major constituents of plants viz. carbohydrates, fats

and proteins (structures not required).

Amino-acids and their importance, R.N.A. and D.N.A. Enzymes- general composition, nomenclature, their actions. Factors affecting enzymatic activity. Biological importance of vitamin A, B-Complex, C, etc. (structures not required).

Plant acids, their biosynthesis and distribution. Plant pigments carotenoids and chlorophylls.

Metabolism of carbohydrates, fats and proteins in plants, Krebs's cycle. Fermentation, ATP, ADP

& AMP. Ripening in plants. Phytohormones Hydroponics Tissue culture. Absorption of nutrients by plants.

### **Chemistry of soils**

Soil forming factors and minerals, weathering of rocks. Formation and development of soil profile. Chemical composition of soils, Process of soil formation viz. Laterization, podsolization,

gleization, salinization, Kankar formation, peat formation and soil colour development.

Clay minerals, separation and identification of clay minerals.

Cation and anion exchange. Fixation of nutrients. Soil organic matter, humus its nature, properties and fractionation. Clay-humus complexes

Soil survey; types of soil survey, land-use, classification. Soil monoliths, soil cartography.

Soil erosion, factors affecting erosion. Methods of controlling soil erosion, soil conservation.

Soil classification, Detailed study of various classification, 7th approximation. Classification of

Indian Soils. Problem soils- Acid, Saline and Alkali soils; their development, amelioration and

reclamation. Management of water-logging soils. The Quality of irrigation waters used in India.

### **Soil microbiology**

Soil population. Soil medium for growth and activities of micro-organisms, Occurrence and distribution of Micro-organisms in soils. Classification of micro-organisms, Soil bacteria, Autotrophic and heterotrophic bacteria sulphur oxidizers, nitrifying and iron-oxidizing organism Cellulose and complex carbohydrates decomposing bacteria.

Nitrogen Cycle in Soil. Decomposition of plant residues, Soil algae, nitrogen fixation by blue green algae. Soil fungi an elementary study, *Antibiotic* and growth promoting substances.

Soil inoculation, preparation of bacterial fertilizers.

Role of microorganisms on the nutrient availability. Reclamation of alkali soils by sulphur oxidizing organisms.

### **Agrochemicals**

A. Basic concepts and use of:

B. Insecticides - Chlorinated hydrocarbons, organic phosphorus compounds: Biological insecticides, Carbamates Arsenics, chlorides etc.

C. Herbicides - Phenoxy compounds, Fluorosilicates substituted ureas.

D. Fungicides - Heavy metal compounds, glyoxal derivatives compounds, guanidines.

E. Rodenticides - General cyanides, phosphides, strychnine barium carbonate.

F. Nematocides - Carbamates and others.

G. Fumigants- Diethylene dichloride and dibromide

Insecticide of botanical origin, Plant growth regulators, antibiotics. Formulation of pesticides and the chemistry of adjuvants for pesticides. Trends in the development of pest control and allied chemicals, Biochemistry of the action of important pesticides, chemistry and residual control in the field of pesticides. Scope of pesticides, chemistry and residual control in the field of pesticides. Scope of pesticides in India. Persistence and control.

### **Environmental chemistry of soils**

Distribution of elements evolution of earth. Origin and occurrence of clay minerals. Transformations of clay minerals under various conditions. micropedology, Microchemical methods used for investigation of soil Concept of soil fertility. Factors affecting soil fertility; Nutrients essential for plant growth, Mechanism of nutrients occurrence in soils and plants and their functions, forms, availability and deficiency symptoms of micro and macro nutrients. Factors affecting N,P and K availability in soils. Phosphate potential. Soil fertility evaluation. Soil testing, Lime requirement, gypsum requirement, Soil testing for advisory purposes. Cation exchange in soils. Exchange capacity of soils, Equations of cation exchange fixation of cation. Anion exchange. Fixation of anions. Soil. Soil pollution.

## **(03) ANCIENT HISTORY**

### **Ancient India (from earliest times to A. D. 1200)**

**Sources :** Literary, Archaeological and Foreign accounts (Greek Chinese and Arab).

**Concepts, Ideas and Terms:** Rta, Sabha and Samiti, Yajna, Varna, Ashramas, Rna Sanskaras, Purusharthas, Agraharas, Kara/Vishti, Arthashastra Saptanga, Stupa, Chaitya, Nagar, Dravida, Vesara Mathura/Gandhara Schools of Art.

**Prehistoric Archeology:** Paleolithic, Mesolithic, Neolithic and Chalcolithic. Indus Valley Civilization: Characteristics features, Origin, Geographical, Extent, Chronology, decline/Survival.

**Iron Age:** Antiquity, Second Urbanization. Iron and Megaliths.

**Vedic Period:** Early and Later Vedic; Society, Economy, Political Institutions, Religious and Philosophical ideas.

**Early State Formation:** The Mahajanapadas; Rise of Magadha from Bimbisara to Mahapadma

Nanda, Alexander's Invasion, bases and features of Monarchical states; Nature of the Republics.

**The First Empire:** Magadhan expansion in the times of Chandragupta Maurya – Administration, society and economy in the Mauryan period; Asoka, his Dharma; Decline of the Mauryan Empire.

### **Age of Political Fragmentation C. 200 BC – AD 300**

Sungas and Kanvas, Indo-Greeks, Sakas, Kushanas: Kanishka I (date and achievements), Western Kshtrapas, Kharavela.

**Deccan and South India:** The Satavahanas, Tamil States of the Sangam Age, Administration, economy, Sangam Literature and Culture.

**Age of the Imperial Guptas**

The Guptas and the Vakatakas: Political History: Administration, Economic conditions: Coinage of the Guptas, Landgrants, Decline of Urban centres.

**History of the Early Medieval India**

Harsha and the Regional States : Harsha and his military campaigns, Education and Educational

Institutions – Nalanda, Vikramashila and Vallabhi sanskrit literature.

Gurjara–Pratiharas, Kalachuin–Chedis, Paramaras

Arab Contacts – Ghaznavi Conquest, Alberuni

Palas and Senas

Pallavas and Chalukyas of Badami

Chalukyas of Kalyana and Cholas Administration and local government,

Society, Economy and Culture during the Early – Medieval Period: Feudalism, trade guilds, position of women, educational institutions – Nalanda, Vikramashila; growth of Vaishnavism and Saivism; art and architecture.

**Research in Ancient History**

Scope and value of History: Objectivity and bias in history; history and its auxiliary branches; area of research proposed. Sources – Primary/Secondary in the proposed area of research.

Modern Historical writing in the proposed area of research.

**Area Specific : Section A**

**(Socio – Economic History) Earliest times to 1200 AD**

Sources, Social and economic life in Indus valley civilization, society and economic life in the Vedic Pd. Mauryan pd. Society and Economy from the 2<sup>nd</sup> century B.C. to the 3<sup>rd</sup>, 4<sup>th</sup> Century A.D.

(a) Society and Economy in the Gupta Period, Varnashram system, Caste System, Slavery, Sanskaras, Purusharthas, Position of women, Education.

(b) Agriculture, Industry and Industrial guilds and labour.

(c) Trade and commerce, Mercantile guilds, Taxation and Revenue system, Rural and urban settlements.

(d) Feudal system, Social and Economic changes during early medieval period.

(e) Transition from Antiquity to the early middle Ages, Feudalism social and economic changes during the early medieval period.

**Area Specific : Section B**

**(Ancient India Art & Architecture)**

(a) Historiography, Approaches and Sources, Research Methodology in Ancient Indian Art & Architecture, the meaning of Art: Study of content of Art.

(b) Interplay of Regions, Artists and Patron, Margi and Desi Arts, Representing gender, Rituals.

(c) Evolution and History of Architecture; Harappan, Mauryan, Rock–cut Architecture, Stupa Architecture, Temple Architecture: Gupta temples, Orissa, Khajuraho, Chalukyas, Rarstruktas, Pallario, Cholas.

(d) Indian and Western Aesthetics.

(e) Sculptural Art of the Mauryas, Shungas, Satavahanas, Kushanas, Guptas, Chandelas, ... ..

Orissa, Pallava and Chola.

(f) Origin and Development of Indian Iconography: Bodhisattva, Buddha, Adinath, Paraswanath, Mahavira, Vishnu, Shiva, Shakti, Surya,

(g) Terracotta Art, Indus, Mauryan, Shunga, Kushana, Gupta, early medieval Regional traditions.

(h) Paintings: Pre–Historic, Classical Painting traditions, Ajanta and Bagh.

**Area Specific : Section C  
(Ancient Indian Religion and Philosophy)**

(a) Sources,

(b) Foundations of Religious systems: Harappan, Vedic and Sangam.

(c) Sun Worship, Saivism, Vaishnavism, Jainism and Buddhism.

(d) Rituals, Yajna, Educational rites, Puranic Anuthana, Tirtha, Dana, Shraddha.

(e) Philosophy of the Upanishads, Jain Philosophy, Buddhist Philosophy, Philosophy of Sankara and Gita.

(f) Shaktism, Tantricism, Ascetic tradition and Bhakti.

(g) Shankaracharya, Ramanujam and Lobayat.

**Area Specific : Section D  
(Archaeological Studies)**

(a) Hunting and gathering – Paleolithic and Mesolithic in India.

(b) Beginning of Agriculture – Neolithic and Chalcolithic in India.

(c) Indus valley Civilization origin, extent, date, characteristics, decline, survival.

(d) Antiquity of Iron, second urbanizations iron and megaliths.

(e) Archaeological Methods and Techniques: Exploration, excavations and conservation of artifacts; dating techniques; importance of stratigraphy in archaeology.

**(04) ANTHROPOLOGY**

**1. Social-Cultural Anthropology**

**(i) Fundamental:**

**Unit 1** Meaning and scope of social- cultural Anthropology and its relations with other branches of Anthropology, Social Sciences, Life Sciences and Medical Sciences.

**Unit 2** Social Organization: **Family:** Typology and Functions, Household and Domestic group, Processual analysis of Domestic group. **Marriage:** Definition, types and forms-preferential Prescriptive and Proscriptive forms.

**Unit 3 Kinship: Kin Types:** consanguine, affinal; **Kin group:** lineage, clan, moiety and phratry; Principle and types of descent and residence; Kinship terminology: Morgan and Murdock: **Kinship behavior:** Joking and Avoidance relationship, Couvade, Avuculate, Amitate, Tecknonymy.

**Unit 4 Economic Anthropology:** Formalist and Substantivist approaches, Mode of exchange-Reciprocal, Redistributive and Market, Kula Potlatch.

**Unit 5 Political Anthropology:** State and stateless society, difference between primitive and modern law, Theories of origin of state.

**Unit 6 Anthropology of Religion:** Theories relating to origin of religion Animism, Animatism, Naturism, Functional theory of Durkheim, Psychological theory of Malinowski, Frazer's concept of magic, religion and Science. Totemism. Organization of religious belief and practices

**(ii) Anthropological Thoughts:**

**Unit 1 Anthropological notion of Culture:** Society, Culture and Civilization

**Unit 2 Evolutionism:** Critical appraisal of 19th century Evolutionism; Contribution of: E.B. Tylor, L.H. Morgan, J. Frazer, H. Spencer, J.F. Mc Lennan, H.S. Maine, J.J. Bachofen.

**Unit 3 Neo-Evolutionism:** Contribution of V.G. Childe, J.H. Steward, L.A. White, M. Harris, Shalin and Service.

**Unit 4 Diffusionism:** Critical appraisal of British, German and American Schools

**Unit 5 Structure Functionalism:** Contributions of A.R. Radcliff Brown and E.E. Evans Pritchard

**Unit 6 Functionalism:** Contribution of B. Malinowski

**Unit 7 Culture and Personality:** Contributions of M. Mead, R. Benedict, R. Linton, A. Kardiner, and Cora-du-Bois. Recent trends in Psychological Anthropology

**Unit 8 Structuralism and Neo-Structuralism:** C. Levi-Strauss, and E.R. Leach

**Unit 9 Contribution of Indian Anthropologists:** M.N. Srinivas, L.P. Vidyarthi, S.C. Roy, D.N. Majumdar and N.K. Bose

**Unit 10 Recent Trends:** New Ethnography and Post Modernism in Anthropology

**(iii) Research Methods:**

**Unit 1 Scientific Method:** Characteristic; Basic Terms; Techniques, Methodology, Primary and Secondary Data; Social Survey & Social Research

**Unit 2 Fieldwork tradition in anthropology:** Its relationship with the development of anthropological theories

**Unit 3 Approaches:** Emic-etic, Macro-micro  
**Unit 4 Methods:** Ethnography, Comparative method, Participant Observation, Genealogical method, Case study, Survey

**Unit 5 Techniques of Data Collection:** a) Primary sources: Observation, Interview, Key informant, Schedules and Questionnaires, Life history, Focused Group Interview, RRA, PRA, Audio-Visual Recording (b) Secondary sources: Census, National Sample Survey, Documents and Records, Maps, National and International reports (UNDP, World Bank, UNICEF, etc.)

**Unit 6 Hypothesis; Research Design; Statistical Methods.**

**2. Physical/ Biological Anthropology**

**Unit 1 Introduction:** Meaning, Scope and Branches of Physical Anthropology; Relations with other branches of Anthropology and with Biological, Social and Medical Sciences.

**Unit 2 Primatology:** General Characters of Order Primate, Primate Classification, Man's place in the animal kingdom, Comparative Anatomy of Man and Apes; Hominid Evolution: Erect Posture and Bi-pedalism.

**Unit 3 Human Origin and Evolution:** Theories of Organic Evolution, Lamarckism; Darwinism and Synthetic theory.

**Unit 4 Emergence of Man:** Primate Evolution with reference to Skull, Jaw, Limbs, Dentition and Brain. Earliest primates of Oligocene, Miocene and Pliocene- Aegyptopithecus, Propliopithecus, Dryopithecus, Proconsul. Ramapithecus, Australopithecus, Homo erectus, Neanderthal, Homo sapiens: Cro- Magnon and Grimaldi and Hominisation Process.

**Unit 5 Human Genetics:** Methods for studying genetic principles in Man- Family studies, Twin Studies, Pedigree Analysis, DNA technology; Meiosis and Mitosis; Linkage and crossing-over; Mutation- gene mutation, mutation rate, genetic hazards of radiation, chemical mutagenesis; Human Chromosomal aberrations- Numerical: Turner's syndrome, Klinefelter's syndrome, Triplo-X, Triploial-X, Tetra-X, Down's syndrome, Patau's syndrome, Edward's syndrome, Sturge-Weber's syndrome, Triploidy and Tetraploidy, and Structural: Cri-du-chat syndrome and Philadelphia chromosome; Mendelian genetics in Man, Inheritance Pattern of Autosomal, Sex-linked, Codominant traits, Lethal factors, Polygenic and Multifactorial traits; Inborn Errors of Metabolism- Biochemical Pathways (one gene one enzyme hypothesis) and heredity of Phenylketonurea, Alkaptonurea, Galactosemia, Albinism.

**Unit 6 Population Genetics:** Hardy Weinberg Law, Genetic polymorphism, Inbreeding and Genetic Load.

**Unit 7 Applications of Human Genetics:** Genetic Screening, Genetic Counseling and Genetic Engineering.

**Unit 8 Applied Physical Anthropology:** (i) Anthropology of Sports, (ii) Nutritional Anthropology, (iii) forensic Anthropology.

**Unit 9 Introduction to Human Biology:** Meaning, Scope and Development of Human Biology

**Unit 10 Human Growth and Development:** Growth from Conception to Maturity and Senescence, Factors Affecting growth and Theories of Ageing

**Unit 11 Nutrition and Growth:** Nutritional Requirements for Normal Growth from Infancy to Old Age. Under nutrition and Malnutrition, Nutritional Adaptation in Man

**Unit 12 Human Adaptation:** Physiological Adaptation to Heat, Cold and High Altitude

**Unit 13 Demography:** Population Structure and Composition, Demographic Processes: Fertility, Mortality and Migration, Demographic Theories.

**Unit 14 Race:** Concept of Race, Basis of Racial Classification, Racial Classification of Indian population, Negrito Element in India and Racism

**Unit 15 Population Variation in Qualitative Traits:** Hb and its Variants, G6PD, Transferin,

ABH Secretion and Lewis Antigen, Histocompatibility, Antigen and Thalassaemia

**Unit 16 Genetics of Blood Group:** Genetic markers- ABO, MNSs and Rh blood group systems, Red Cell Enzymes- Red cell acid phosphate, phosphoglucomutase, adenylate kinase, adenosine deaminase and lactate dehydrogenase, Blood groups and diseases- Erythroblastosis fetalis, smallpox and malaria, Gene mapping- Blood groups, HLA, Sex-linked characters

**Unit 17 Dermatoglyphics:** History, Identification, Topography; Fingerprints Pattern— Identifications, Inheritance, Pattern intensity, Furuhashi and Dankmeijer's index; Palmar Dermatoglyphics – Configurational areas, Main-line formula and index, Transversality, Inheritance, Palmar flexion creases and main types; Sole Prints - Configurational areas, Main-line formula and index, Transversality, Inheritance; Toe Prints – Pattern, Identification, Inheritance; Dermatoglyphics and Diseases, Dermatoglyphics and Paternity disputes

### 3. Archaeological Anthropology

**Unit 1 Definition, Aim and Genesis of the Sub-Field:** Relationship to other branches of anthropology, Earth Sciences, Physical sciences and Social sciences, Environmental Archeology, Ethno-Archeology, Settlement Archaeology, New Archaeology.

**Unit 2 A Brief Outlines on the Origin of Earth and Life:** Geological time scale, Pleistocene epoch- Chronology, environmental episodes as seen in Geomorphological features.

**Unit 3 Dating Methods:** Absolute and Relative dating, Stratigraphy, River terraces, Obsidian hydration, Dendrochronology, thermo luminescence dating, Pollen dating, Varve analysis, Uranium dating, Potassium-argon method, Fluorine dating, C-14 Amino Acid racemization.

**Unit 4 Tools and Technology:** Raw material and sources, tool making Techniques and Tool Types.

**Unit 5 Lithic Cultures of Europe:** Sites, Tool Types and Salient features

**Unit 6 Paleolithic Culture in India:** Sites, Tool Types and Salient features.

**Unit 7 Mesolithic Culture in India:** Sites, Tool Types and Salient features.

**Unit 8 Neolithic Culture in India:** Sites, Tool Types and Salient features.



**Unit 9 Megalithic Culture in India:** Sites, Tool Types and Salient features.

**Unit 10 Indus Valley Civilization:** Main features, Town planning, economy, Polity, Religion,  
Art and Craft, Script and Causes of end.

**Unit 11 Beginning of Iron Age and Second Urbanization:** Economic and Social implications

of Iron technology; Black and Red ware culture – Noh, attranji, Khera, Ahikshatra;  
Painted Grey Ware (PGW) Culture – Distribution, Economy and Society; Northern  
Black polished (NBP) ware culture – first cities in the Ganga valley and emergence  
of  
the Mauryan Empire

#### **4. Indian Anthropology and Developmental Anthropology**

**Unit 1 Indian People:** Racial, Ethnic, Linguistic and Religious elements (composition) and Distribution of People in India; Unity and diversity in Indian society and culture.

**Unit 2 Basis of traditional Indian social structure and Life cycle:** Varna, Ashram, Purushartha, Dharma, Karma, Sanskar, Caste system and Joint Family.

**Unit 3** Impact of Buddhism, Jainism, Islam and Christianity in India:

**Unit 4 Indian Village:** Myth or reality; Jajmani System; Impact of new technology and Urbanization- changing agrarian social structure; Village Studies in India

**Unit 5 Tribal societies:** Definition and identification of tribe/scheduled tribe; Classification and distribution of tribes based on economic, Cultural, Linguistic and racial classification, Tribe Caste Continuum; Tribal Absorption/Assimilation/Integration.

**Unit 6 Constitutional provisions for scheduled castes/scheduled tribes:** Tribal Policy and governance in British India, Evolution of Tribal Development policy and Programs, Tribal Movements.

**Unit 7 Growth of Anthropology in India.**

**Unit 8 Socio-cultural change:** Sanskritisation, Parochialisation, Universalisation, Great-Little Traditions, Sacred Complex, Nature-Man-Spirit Complex, Westernization, Industrialization, Urbanization and Globalization.

**Unit 9 Problems of Tribes in India:** Land Alienation, Indebtedness, Health and Nutrition, Deforestation and Migration.

**Unit 10 Development:** Meaning and Evolution of the concept, Indices and Measurements of Development theories and Models

**Unit 11 Applied, Action and Development Anthropology:** Meaning, Scope and the Emerging Trends, Contributions of Anthropology to the Development Studies, Moral/Ethical issues and Limitations of Development Anthropology

**Unit12 Policy and Planning:** Concept of Planning, Formulation of Policy and Plan Strategy, Participatory Approach in Development Planning, Conflict in People Centered and Programme Centered Paradigms

**Unit13 Approaches to Development:** Governmental Approach, Missionary Approach, NGO's Approach, Philanthropist Approach, Social Workers Approach, and Anthropological Approach

**Unit14 Role of Values and Institutions in Development:** Caste, Religion and Culture-Bailey, Milton Singer and Madan

**Unit15 Rural Development in India:** Historical Background, Special Programmes and Poverty Alleviation Programs, Land Reforms and Panchayati Raj

**Unit16 Development of Scheduled Castes and Scheduled Tribes:** Special Component Plans, Constitutional Provisions and Safeguards, Protective Legislation; Structure of Tribal Development Administration; Evolution of Tribal Sub Plans; Problems and Prospects of Tribal Development.

**Unit 17 Sustainable Development.**

### (05) ARABIC

#### 1. History of Arabic Language and literature : تاريخ اللغة العربية و آدابها :

(الف) الشعر القديم

(١) المعلقات السبع

(٢) حسان بن ثابت

(٣) جرير

(٤) الأخطل

(٥) ابن زيدون

(٦) بشار بن برد

(٧) الفرزدق

(٨) أبو العلاء المعري

(٩) ابن المعتز

(١٠) ابن الرومي

(ب) النثر القديم

(١) القرآن المجيد

(٢) الحديث النبوى

(٣) الجاحظ

(٤) بديع الزمان الهمداني

(٥) الحريري

(٦) عبد الحميد الكاتب

(٧) ابن العميد

(٨) القاضي الفاضل

(ج) الشعر الحديث:

(١) احمد شوقي

(٢) حافظ ابراهيم

(٣) خليل مطران

(٤) محمود سامي البارودي

(٥) معروف الرصافي

(٦) نازك الملائكة

(٧) صلاح عبد الصبور

(٨) جميل صدقي الزهاوي

(د) النثر الحديث

(١) مصطفى لطفى المنفلوطى

(٢) خليل جبران جبران

(٣) طه حسين

(٤) عباس محمود العقاد

(٥) سيد رشيد رضا

(٦) يوسف ادريس

(٧) أحمد امين

(٨) على طنطاوى

(٩) يحيى حقى

(١٠) احسان عبد القدوس

## 2.Principles of Literary Criticism:

مبادئ النقد الادبى

(الف) القديم

(١) قدامة بن جعفر

(٢) ابن قتيبة

(٣) ابن رشيق

(٤) عبد القاهر الجرجاني

(ب) الحديث

(١) عبد القادر المازنى

(٢) طه حسين

(٣) شوقي ضيف

(٤) ميخائيل نعيمة

(٥) محمد مندور

## 3.General Knowledge

المعلومات العامة

### [CORE GROUP]

Classical Arabic Prose & Poetry. Study of the Following Poets:

(١) الشعرو النثر العربى القديم (دراسة الشعراء المذكورين ادناه)

(الف) الشعر

(١) امرؤ القيس

(٢) نابغة الذبياني

(٣) فرزدق

(٤) جرير

(٥) الأخطل

(٦) عمر بن أبي ربيعة

(٧) أبو نواس

(٨) بشار بن برد

(٩) جميل بثينة

(ب) النثر

□ الخطابة (قبل الاسلام، العصر الاسلامي، الاموي)

(١) قس بن ساعدة الأيادي

(٢) سحبان وائل

(٣) علي بن أبي طالب

(٤) حجاج بن يوسف

(٥) زياد بن ابية

(٦) طارق بن زياد

□ الجاحظ

□ ابن المقفع

□ المقامات

الأدب العربي الهندي (دراسة المؤلفين والكتب) : Indo-Arabic Literature

(الف) النثر

(١) الشيخ عبد الحق محدث دهلوي

- (٢) ملا محمود الجونفوري  
 (٣) سيد غلام علي آزاد البلگرامي  
 (٤) شاه ولي الله الدهلوي  
 (٥) عبد الحي الحسني  
 (٦) سيد ابو الحسن علي الندوي  
 (ب) الشعر  
 (١) فضل حق الخير آبادي  
 (٢) فيض الحسن السهارنفوري  
 (٣) انور شاه الكشميري  
 (٤) نواب صديق حسن خان  
 (٥) ذو الفقار علي الديوبندي  
 (٦) شاه ولي الله الدهلوي

#### Important Works of Indo-Arabic Literature

#### الأعمال الهامة في الأدب العربي - الهندي

- (١) تحفة المجاهدين  
 (٢) سبحة المرجان  
 (٣) نزهة الخواطر  
 (٤) رجال والهند السند  
 (٥) رجال الفكر والدعوة  
 (٦) ماذا خسر العالم بانحطاط المسلمين

Modern Arabic Language & Literature: Study of the Following Poets and Authors :

اللغة العربية و الادب العربي الحديث: ( دراسة الشعراء و الأدباء المذكورين ادناه)

(الف) النثر

(١) جبران خليل جبران

(٢) مصطفى لطفى المنفلوطى

(٣) طه حسين

(٤) أحمد امين

(٥) توفيق الحكيم

(٦) نجيب محفوظ

(٧) محمد حسين هيكل

(٨) عباس محمود العقاد

(٩) رفاعة الطهطاوى

(١٠) مصطفى صادق الرافعى

(ب) الشعر

(١) محمود سامى البارودى

(٢) احمد شوقى

(٣) خليل مطران

(٤) حافظ ابراهيم

(٥) ايليا ابو ماضى

(٦) نازك الملائكة

(٧) ابو القاسم الشابى

(٨) عمر ابو ريشة

: Major Reference Works:

أهم المراجع

- (١) سيرة بن هشام
- (٢) تاريخ الطبري
- (٣) طبقات بن سعد
- (٤) فهرست بن نديم
- (٥) كتاب الأغاني
- (٦) معجم الأدباء
- (٧) فتوح البلدان
- (٨) وفيات الأعيان
- (٩) مقدمة بن خلدون
- (١٠) العقد الفريد
- (١١) كتاب البخلاء
- (١٢) البيان والتبيين
- (١٣) الأدب الكبير
- (١٤) الأدب الصغير

: Tafsir and Hadith Literature: (دراسة الأعمال التالية)

- (١) التفسير الكبير
- (٢) تفسير الكشاف
- (٣) تفسير جلالين
- (٤) في ظلال القرآن
- (٥) المنار
- (٦) الصحيحان
- (٧) نظام القرآن
- (٨) أخبار الأخيار



## History Of Islamic Civilisation:

## تاريخ التمدن الاسلامى

- |            |                                |
|------------|--------------------------------|
| احمد امين  | (١) فجر الاسلام                |
| احمد امين  | (٢) ضحى الاسلام                |
| احمد امين  | (٣) ظهر الاسلام                |
| عبد الحى   | (٤) الثقافة الاسلامية فى الهند |
| جرجى زيدان | (٥) تاريخ التمدن الاسلامى      |

## : Literary Genres, Movements and Institutions :

## لأجناس الأدبية و الحركات و المؤسسات

- (١) كتب فى السيرة النبوية
- (٢) الموشحات
- (٣) الحركة الرمزية
- (٤) ادب المهجر
- (٥) الرابطة القلمية
- (٦) العصبة الاندلسية
- (٧) مدرسة الديوان
- (٨) حركة ابولو

: Rhetoric and Prosody:

علم البلاغة و العروض:

(١) البحر الطويل

(٢) البحر الكامل

(٣) الفصاحة

(٤) البلاغة

(٥) علم المعاني

(٦) علم البيان

(٧) علم البديع

: Principles of Literary Criticism:

مبادئ النقد الأدبي

(١) تطور الشعر العربي

(٢) تطور النثر العربي

(٣) تطور القصة في الأدب العربي

(٤) المسرحية القصة القصيرة والرواية

## [ ELECTIVE / OPTIONAL ]

Elective-I : Functional Arabic

الإنشاء

Elective-II : Arabic Criticism :

تاريخ النقد العربي

Elective-III : Migration Literature

أدب المهجر

Elective-IV : History of Arabic Literature

تاريخ الادب العربي

Elective-V : Arabic Studies in India

الدراسات العربية في الهند

**(06) ATMOSPHERIC AND OCEAN SCIENCES**

Mathematical modeling, Probability density function, Noise (Red, White) distribution, Curve fitting, Statistical Methods, Significance tests, Knowledge of programming and algorithms, Operating systems, Numerical Analysis, Ordinary and Partial Differential Equations, Fundamentals of Atmosphere and Ocean systems, Weather and Climate, Composition and

structure of atmosphere, Momentum Equations, Thermodynamics of the atmosphere, Radiation Laws, Heat budget, Properties of seawater, Temperature, Salinity, Density, Indian Monsoon, ENSO, Methods of research and good laboratory practice

## **(07) BEHAVIOURAL AND COGNITIVE SCIENCES**

### **General Issues and Foundations of Cognitive Science**

Information processing approach, Marr's levels of processing, Representations, Dynamical approaches, Situated and Embodied cognition, Modularity, Culture and Cognition, Cognitive Development, Different methodologies used in Cognitive science, Reaction Time measurement and analysis, Signal detection theory, Eye tracking

### **Research Methods**

Qualitative vs quantitative methods, Scientific Method, Purpose of statistics, Different kind of Variables, Probability, Distributions, Sampling, Experimental Designs (Independent samples design, Repeated measure design), Validity (Validity in Experiments and other research design, types of validity), Quasi – experiments, Analysis: Correlations, t-tests, nonparametric tests, ANOVA (factorial, mixed), Introduction to Regression

### **Computing**

Basics of programming, algorithmic problem solving, data structures, associative structures, Basic algorithms (sorting, searching, etc)

### **Cognitive Neuroscience**

Functional organization of the cortex, Methods (Electroencephalography/ 'Event related potentials, functional magnetic resonance imaging), Cognitive neuroscience of perception, language, learning and memory, motor systems, emotions, and hemispheric lateralization.

### **Computational Models of Cognition**

Introduction to Computational Modeling, Types of learning mechanisms and learning rules, Introduction to neural networks, Probabilistic reasoning, Production Systems, Cognitive Architectures

### **Perception and Attention**

Principles of perception, Different theoretical approaches to perception (Gibson, Helmholtz, Gestalt, etc), Color Perception, Perceptual organization, Object recognition, Motion and Time perception, Selective Attention, Sustained Attention, Divided Attention, Executive Control.

### **Learning and Memory**

Principles of classical conditioning and operant conditioning, Theories of Learning, Reinforcement schedules, Skill Acquisition and Performance, Sensory memory, Working Memory, Models of Semantic Memory, Autobiographical Memory, Retrieval, Forgetting, Implicit learning and memory.

### **Psycholinguistics**

Introduction to Linguistics, Biological basis of language, language evolution, Design features of language, Foundations of Psycholinguistics, Methodological considerations, History, Current approaches, domains of study, Links with other disciplines, Levels of linguistic

analysis: Phonology-phonetics, syntax, semantics, morphology, pragmatics, Word Recognition, Sentence processing, Language Acquisition, Bilingualism, Language-Vision interaction

### **Decision Making**

Heuristics and Biases, Bounded rationality, Theories of utility and Paradoxes, Choice under uncertainty, Neuroeconomics of individual and collective decision making, Game theory, Computational Models of decision making.

### **Philosophy of Mind**

Different views on mind-brain relationship, functionalism, eliminative materialism, fundamental issues on self and consciousness, representationalism, phenomenological approaches. Language and thought.

### **Suggested Readings:**

- Baddeley, A. (2003). *Human Memory: Theory and Practice*.  
 Churchland, P. *Matter and Consciousness*. Cambridge: MIT Press.  
 Coolican, H. (2009). *Research Methods and Statistics in Psychology*. Hodder Education.  
 Cormen, T., Leiserson, C., Rivest, R. & Stein, C. (2002), *Introduction to Algorithms*. Prentice Hall of India, 2002.  
 Gazzaniga, M.S. (2009). *The Cognitive Neurosciences*, 4th Edition, MIT Press,  
 Harley, T. (2008), *The Psychology of Language*. Psychology Press.  
 Kerlinger, F. N & Lee, H. B. (2000). *Foundations of Behavioural research*. Australia: Wadsworth Thomson Learning.  
 Mazur, J. E. (2006), *Learning and Behaviour*. NJ: Pearson Prentice Hall.  
 Polk, T., & Seifert, C. (2004), *Cognitive Modelling*, MIT Press.  
 Russell, S., & Norvig, P. (2003). *Artificial Intelligence: A Modern Approach*, Second Edition, Prentice Hall of India.  
 Solso, R. L. *Cognitive Psychology*. India: Pearson Education  
 Eysenck, M. & Keane, M. *Cognitive Psychology: A Student's Handbook*. Psychology Press.  
 Palmer, S. E. *Vision Science: Photons to Phenomenology*. Cambridge: MIT Press.  
 Ward, J. (2006). *The Student's Guide to Cognitive Neuroscience*. Hove: Psychology Press  
 Yegnanarayana, B. (2009). *Artificial Neural Networks*, Prentice Hall of India.

## **(08) BIOCHEMISTRY**

### **BIOPHYSICS, ANALYTICAL AND PREPARATION TECHNIQUES IN BIOCHEMISTRY:**

**Electrochemistry:** pH, Buffers, Enzyme Electrode, Biosensors.

**Energetic and Thermodynamics considerations:** Laws of Thermodynamics, Gibbs Free, Energy, Biological Order. Coupled Reactions, Ion–Electrochemical potentials. Entropy, Low–and–High Energy Compounds, Energy Inter conversions.

**Biophysical Techniques Principles and Application to Biological Problems:** Atomic Absorption and Emission Spectroscopy, NMR, EPR Spectroscopy, ESR Spectroscopy, Mass Spectroscopy, X–Ray Diffraction, Circular Dichroism, MALD–TOF, FRAP.

**Centrifugation Techniques:** Differential, Zonal, Density gradient and Ultracentrifugation.

**Chromatography:** Adsorption Partition, Ion–Exchange, Reverse–Phase, Covalent, Gel Filtration. Affinity Chromatography, HPLC, FPLC, Chromatofocusing.

**Electrophoretic Techniques:** Paper and Gel Electrophoresis (Agarose–and SDS) 2–D Gel Electrophoresis, Pulsed–Field Gel Electrophoresis, Isoelectric Focusing.

**Immunological Techniques:** Gel Diffusion, Immunoelectrophoresis, Ouchterlony, ELISA, Immunoblotting, Fluorescent Immunoassays.

**Photometry:** Principles and Instrumentation of a Sample and Double– beam Spectrophotometer, Application of Colorimetry, Spectrophotometry (Visible, UV and IR), Fluorimetry.

**Microscopy:** Principles and application of Light, Phase–contrast and Electron Microscopy (TEM, SEM and Immune electron–Microscopy {IEM}).

**Radioisotopic Tracer Techniques:** Detection and measurement of isotopes, GM and Scintillation Counters, Autoradiography, Fluorography, Applications in biological problems.

## CHEMISTRY OF BIOMOLECULES:

**The molecular logic of life:** The identifying characteristics of living matter The chemical unity of diverse living systems.

**Biomolecules:** Their meaning and importance in the functional organization of the cell. Information and non informational biomolecules.

**Carbohydrates:** Structure, properties classification, function and biological importance. Mono–, di–oligo and polysaccharides. Chain and ring structures. Optical isomerism. Homopolysaccharides, glycolipids, proteoglycans, mucopolysaccharides, peptidoglycans, hemicelluloses, lignins Bioactive carbohydrates.

**Lipids:** Structure properties, classification function and biological importance. Storage lipids. Structural lipids in membranes Phosphoglycerides, Plasmalogens (Lecithins, PE, PS Phosphatidylinositols), Sphingomyelins, Ceramides, Glycolipids, Prostaglandins. Lipids as signaling molecules, cofactors and pigments. Phosphatidylinositol–based lipids in cell signaling.

**Proteins:** Classification and functional diversity of proteins. Amino acids–classification and properties. Overview of Protein structure Primary, Secondary, Tertiary and Quaternary structures. Protein denaturation. Sequencing, Protein folding, Structure– function relationship.

**Nucleic acids:** Structure of nucleotides and formation of polynucleotide chain. Structure and function of DNA and RNA. Watson Crick model of DNA. Various forms of DNA. Nucleic acid chemistry. Cofactor functions of nucleotides.

**Plant–based polyphenols:** Classification, structure and biological activity.

**Vitamins:** Chemistry and Function

**Hormones:** Chemistry and Classification.

## **PHYSIOLOGY AND ENDOCRINOLOGY OF THE HUMAN BODY:**

**Functional organization of the human body and homeostasis:** Intracellular and extracellular division of body fluids, the concept of homeostasis and feedback control systems. **Cell:** Structure and function. Major transport mechanisms through the cell membrane.

**Nerve–impulse transmission system:** Sensory and motor nerves, major levels of nervous system function, Central and autonomic nervous system. Generation of nerve impulse: Membrane potentials, action potentials, transmission of nerve impulse, synapse, neurotransmitters.

### **Sleep Biology:**

**Digestion and absorption in the Gastrointestinal tract:** Digestion and absorption of carbohydrates, fats and proteins. Endocrine control of digestive and absorptive processes. **Blood:** Composition of blood. Functions of Erythrocytes. Homeostasis, Blood group substances, transfusion and tissue transplant.

Role of Leucocytes in body's fight against infection. Elements of the immune response. Humoral and cell mediated immunity. Immunoglobulins. Principles of vaccination.

### **The Cardiac cycle and ECG:**

#### **Circadian Rhythms**

**Regulation of acid–base balance:** Role of buffers in blood, respiratory control, renal controls.

### **Transport and exchange of respiratory gases:**

**Body fluids:** Extracellular, intracellular, Osmotic principles in maintenance of fluid balance.

**Principles of Urine formation:** Glomerular and tubular function. Mechanisms for control of urine composition.

**Principles of endocrinology:** Chemical control of metabolism.

**Hormones in the regulation of metabolism:** Target organs and feedback controls.

**Hormones:** Pituitary, Thyroid, Adreno cortical hormones, Insulin and Glucagon, functions and clinical implications. Sex hormones. Hormones in pregnancy. Hormonal control of lactation. Breast milk production and its role in contraception. Growth factors Mechanism of hormone action, signaling pathways, G proteins, second messengers, lipids as signaling molecules.

### **Control of water and electrolyte metabolism:**

**Parathormones:** Calcitonin. Vitamin D. Role in calcium metabolism and bone function.

**Prostaglandins:**

**The body's natural opiate system:** Endorphins and enkephalins.

**Biochemistry of Odorant Receptors:**

## **ENZYMOLGY:**

Historical Perspective

Enzyme Classification

Recommendation and Systemic Nomenclature

**Enzyme Chemistry:** Subcellular Distribution of Enzymes. Isolation and Purification of Enzymes, Criteria for Enzyme homogeneity, General Properties, Enzyme Activity, Specific Activity and Turnover Number, Marker, Enzymes.

**Enzyme Kinetics:** Enzyme Substrate Interactions, ES Complex, Binding Site, Active Site. Specificity, Steady State, Pre-Steady State and Equilibrium-State Kinetics, Michaelis-Menten Equation and its derivation, Graphical Methods for determination of  $K_m$   $V_{max}$  and their significance.

**Factors affecting Initial rate of Enzyme catalyzed Reaction:** Enzyme, Substrate, pH temperature Collision and transitional state theories, Significance of Activation, Energy, Mechanism of bisubstrate and multisubstrate reaction, Methods for identifying mechanism.

**Enzyme Inhibition and Activation:** Types of inhibition, and activation, Competitive non-competitive and Uncompetitive inhibitors, Determination of  $K_i$ , Suicide inhibitors.

**Mechanism of Enzyme action:** enzyme-substrate complementarity, Stereochemistry of enzyme substrate action, factors associated with catalytic efficiency.

**Enzyme regulation:** Allosteric and Hysteric Enzymes, Proenzymes, Zymogens and activation.

**Structure and Function of Selected Enzymes:** Chemical modification of active-site group, substrate/driven mutagen, etc. Chymotrypsin, Glyceraldehyde-3P- Dehydrogenase, Serine and Cysteine proteases

**Multi Enzyme Complexes**

**Immobilized Enzymes:** Immobilization methods, Kinetics, Industrial applications

**Enzyme engineering and Co-Factor Engineering**

**Ribozymes, Abzymes**

## **INTERMEDIARY METABOLISM**

**Introduction to metabolism:** Basic concepts and design.

**Carbohydrate metabolism:** An overview of aerobic and anaerobic carbohydrate metabolism. Glycolysis and the catabolism of hexoses. Feeder pathways. Regulation. Pentose

phosphate pathway. Utilization of glycogen. The Citric Acid cycle. Anaplerosis Regulation. The glyoxylate cycle. Carbohydrate biosynthesis. Gluconeogenesis. Glycogen synthesis. Glucuronic acid pathway, Photosynthesis. Light and dark reactions. Electron flow. ATP synthesis by photophosphorylation.

**Lipid metabolism:** Introduction to Lipids as energy sources.  $\beta$  oxidation. Oxidation of unsaturated and odd chain fatty acids Ketone bodies.

Biosynthesis of: Fatty acids. Triacyl glycerols. Membrane phospholipids. Cholesterol, steroids and isoprenoids. Membrane Phosphoinositides, Ceramides.

**Protein Metabolism:** Metabolic fate of amino groups. Transamination and deamination. Essential and non-essential amino acids. Nitrogen excretion and the Urea cycle.

Pathways of amino acid degradation. One carbon transfers, role of Tetrahydrofolate and S-adenosyl methionine.

Overview of Nitrogen Metabolism. Biosynthesis of amino acids and compounds derived from amino acids.

**Oxidative phosphorylation:** Electron transport chain and formation of ATP. Regulation Biochemical role of vitamins and minerals as coenzymes and cofactors Integration and hormonal regulation of metabolism.

## MOLECULAR CELLULAR BIOLOGY

**Ultra-structure of Cell:** Study of Cells Organization of Cellular components

**Nucleic Acids as Genetics Repositories:** Genetics Transformation, Hershey–Chase Experiments, Gene Transfer Mechanisms in Bacteria (Transformation, Conjugation and Transduction, Transfection)

**Molecular Basis of Mutations:** Insertional mutagenesis, Transversions, Frame–Shift mutation, Suppressor mutation.

**Mapping of Bacterial Chromosomes:** Site–directed mutagenesis, PCR Technology, DNA–Footprinting.

**Structure and Replication of Nucleic Acids:** Structure of RNAs, Structural polymorphism of DNA, RNA and 3–D structure, Hybridisation, Heteroduplex analysis, Models of replication, Histone and Non–Histone proteins, Nucleosome structure, Eukaryotic genome.

**DNA Replication Mechanism:** DNA Polymerases, DNA ligases, Gyases, Nucleases, Restriction Endonucleases and their use in Gene Cloning, Replication in vitro, Organisation and direction of replication, Okazaki Fragments, Differences between Pro– and Eucaryotic DNA replication.

**DNA Damage and Repair:** Gene amplification, Sequence rearrangement,

## Recombinant DNA technology, Biology of Cloning vectors:

**Gene Cloning:** Plasmids Bacteriophages, Cosmids, Phagemids, BACs, YACs and HACs as Cloning vehicles, Genomic Library and cDNA libraries.

**Organisation and Regulation of transcription:** Mechanisms of transcription in Pro– and Eucaryotes, RNA processing events (capping, poly A Tailing, Splicing, Introns, Exons,



Splicing) Spliceosome, Ribonucleoparticles, Structure of mRNA, tRNA Transcription in vitro RNA Polymerase and factors, Self-splicing RNA (Ribozymes)

**Replication of RNA Viruses:** Replicase and Reverse Transcriptase

**Translation in Prokaryotes and Eukaryotes: Mechanism and Regulation:**

Involvement of Ribosome, structure of Ribosome: Translational factors: Initiation, Elongation and Termination of polypeptide.

**Regulation of Gene Expression:** Gene Expression, Attenuation, anti-attenuation, Anti-sense RNA, Operon Concept, Inducible versus Repressible regulation, Negative vs Positive Control, Translational Regulation.

**Biomembrane & Cell Architecture: Plasma Membrane**

Lipid Bilayer and Membrane assembly, Membrane carbohydrates, phospholipids and asymmetric organization GPI-anchored proteins and their dynamism, Membrane transport of small molecules. Membrane transport of macromolecules, Exocytosis, Endocytosis (Fluid phase, Receptor-mediated) and Transcytosis. ATP

**Membrane Traffic and Sorting events:**

Compartmentalization of higher cells, Nuclear export and import of Proteins, Mitochondrial export and import of proteins, Signal Hypothesis, Secretory-Endocytic Vesicular Path(ER-Golgi-Lysosome) and Secretory vesicles, Co-translational and Post-translational Protein Modification (Oligosaccharides, lipid)

**Nuclear Organisation:** Chromosomal DNA, Nucleosome, Chromosomal replication and processing.

**Control of Gene Expression:** Strategies of Gene Control, Pre-transcriptional control, Basic genetic mechanisms in cell differentiation, Post-transcriptional controls.

**Cell Signaling:** Neurine Paracrine and synaptic strategies, Chemical Signaling: Signal mediated by intracellular receptors and surface-receptor-mediated transduction (PI- glycans, DAG, Ca<sup>++</sup> G-Proteins)

**G-Protein Coupled Receptors:** Functional Classification Activator or Inhibitor of Adenyl Cyclase, Regulation of ion-channels, PI-PLC activation.

**Cell Cycle & Programmed Cell death:** Steps in Cell Cycle, Yeast as Model system, euc. Genes for Social Control of Cells. Mechanisms of cell division (Cyclins); Apoptosis.

**Molecular Genetics of Cancer:** Cancer, Classification, Cancer development, Genetic basis of cancer, DNA-Microarray analytics of Cancer cells. Retroviruses in cancer, Proto-oncogenes, Oncogenes. Role of Carcinogens and DNA Repair in Cancer. Telomerase.

**ATP-Powered Pumps and Intracellular ionic Environment:** Muscle Ca<sup>++</sup> ATPase, Na<sup>+</sup>-K<sup>+</sup> Pump, V Class H<sup>+</sup> ATPases, Bacterial ABC Proteins, Eukaryotic ABC Pumps.

## MICROBIOLOGY AND IMMUNOLOGY

**Biology of Microbes:** Classification of bacteria, Bacterial cell wall biosynthesis and action of antibiotics, Nutrition physiology and growth characteristics of bacteria, Protozoa, special Features of bacterial metabolism.

**Microbial Genetics:** Gene transfers in bacteria, Microbial fermentation: Antibiotics, organic acids, and vitamins, Microbial transformations.

**Microbes in Decomposition and Recycling Processes:** Symbiotic and non-symbiotic, Nitrogen Fixation, Microbiology of water, air, soil and sewage, Food-borne infections. Microbial leaching of minerals, applications of microbes in industry, agriculture and environment.

**Viruses:** General Properties and Classification, Replication, Retroviruses and Reverse, Transcriptase, Interferons, Bacteriophages.

**Immune Response:** Specific and Non-Specific immune responses. Humoral versus Cell-mediated immunity.

**Immunological memory:** Antigens, Haptens, Adjuvants, Lymphokines.

**Immunoglobulins:** Structure, properties and functional significance, Different Classes.

**Antigen-Antibody Interaction:** Agglutination, Opsonization, precipitation, neutralization.

**Immunological Techniques:** Gel Diffusion, Immunodiffusion, RIA, ELISA Ouchterlony, Immunoblotting, Immunoelectronmicroscopy.

**Delayed/Immediate Hypersensitivity Reactions:** HLAs (MHCs), Auto-antibody, alternate versus Classical paths of complement activation, Surface antigens. Transplantation antigens, HLAs, MHCs T Cell Receptor Biology, Natural Killer cells, Perforins, Interleukins.

**Biosynthesis of Immunoglobulins and Mechanisms of Antibody Diversity:**

Clonal selection hypothesis, Epitopes and Monoclonal antibodies, Hybridoma Technology, Idiotypes and Idiotypes.

**Vaccines:** Immunization, Protective efficacy of some vaccines, Synthetic vaccine desire.

## **BIOCHEMISTRY OF ENVIRONMENT, HEALTH AND DISEASE, BIOSTATISTICS AND BIOINFORMATICS**

### **Biochemistry of Health and Disease**

#### **Meaning and scope of health versus disease**

**Integration of metabolism:** General principles of organ interrelationships.

#### **Role of Nutrition in maintenance of health:**

**Elements of Nutrition:** The fuels used by the body. Body composition. Energy Requirements Basal Metabolic requirements, activity, growth. Role of various dietary carbohydrates, proteins and fat in maintenance of health.

Requirements for vitamins, minerals, water and electrolytes in maintenance of body functioning. Recommended Dietary Allowances.

Assessment and methods of identification of nutritional problems. Techniques of dietary survey, anthropometric, biochemical, clinical and radiological techniques, limitation and interpretation.

**Biochemistry of starvation:** Alternate methods of energy generation, organ interrelationships during starvation, acid–base balance, ketosis.

**Lipid metabolism:** Metabolism of chylomicrons, VLDL and IDL, HDL, LDL. Formation of atherosclerotic plaque. Effects of dietary and other factors. Adipose tissue metabolism: White and brown adipose tissue. Lipolysis, re–esterification. Lipoprotein lipase.

**Alcohol Metabolism:** As a source of energy. Fatty liver and cirrhosis.

**Biochemistry of aging:** Theories General features and molecular details of aging. Role of Free radicals in aging, Antioxidants as scavengers.

**Biochemistry of stress.**

## **BIOSTATISTICS AND BIOINFORMATICS**

**Statistical analysis of Biochemical data:** Measures of central tendency, Standard deviation, Variance, Correlation and regression, Basic probability theory Distribution– normal, binomial, students’ t–test, ANOVA.

Introduction to commercial computer softwares and their uses in biochemical education.

**Introduction to Bioinformatics:** Biological Databases, Search and analysis Genomics: Physical Gene Mapping, Sequencing Technology Proteomics: Protein Folding, Structure–Function relationship.

## **(09) BIOINFORMATICS**

**Carbohydrates:** monosaccharides, oligosaccharides polysaccharides, proteoglycans and glycoproteins; Lipids; fatty acids, acylglycerols; phospholipids, sphingolipids, cholesterol and their biological importance;

**Proteins:** amino acids and peptides; protein structure, function and evolutionary relationships; protein—protein interactions; protein folding; **Nucleic acid:** bases, nucleotides, RNA and DNA, different structural forms of DNA; denaturation, renaturation and hybridization of DNA; Protein and Nucleic Acid Electrophoresis techniques.

**Enzymes:** Nomenclature and classification; units of enzyme activity; coenzymes and metal cofactors; temperature and pH effects; Michaelis–Menten kinetics, inhibitors and activators; active site and catalytic mechanisms; Isoenzymes; Metabolic systems multienzyme complexes and multifunctional enzymes; Oxidation of glucose in cells; high energy bond, glycolysis, citric acid cycle and oxidative phosphorylation.

## **BIO–STATISTICS**

Calculus; Limits, Complete Differentials, Partial differentials of function, Integration: Definite and nondefinite integral, Logarithms, Ordinary differential equations (first order), Partial differential equations—example from biology, Vector–Addition, subtraction, dot cross, scalar triple product, divergence, curl of a vector, equation of normal; Matrix algebra: Addition, subtraction, multiplication, transpose inverse, and conjugate of matrix, Boolean

logic; Additional subtraction, multiplication and division using binary, octal and hexadecimal systems, introduction to principles of statistical sampling from a population. Random sampling; Frequency distributions and associated statistical measures; Probability Distribution; Correlation and regression analysis; Multivariate analysis: Hypothesis testing; Markov Models; Cluster Analysis – Nearest neighbour search, Search using stem numbers, Search using text signatures; Phylogenetic Analysis Tools; Maximum Likelihood, Parsimony methods.

**IMMUNOLOGY:** Overview of immune system, innate and acquired immune system: Structure and function of antibody molecule and TCR: Genetics of antibody diversity; MHC I & II, Polymorphism; Characteristics of B Cell and T Cell antigens; MHC Peptide interaction; Affinity maturation; Autoimmunity and molecular mimicry; Ligand– receptor interaction in the light of protein structure in immune system; Use of bioinformatics in immunology and vaccine development.

### **BIOLOGICAL DATABASES, DATA MINING**

Data warehousing, data capture, data analysis, Introduction to Nucleic Acid and Protein Sequence Data Banks: Nucleic acid sequence data banks: Genbank, EMBL nucleotide sequence data bank, AIDS Virus sequence data bank, rRNA data bank, Protein sequence data banks; NBRF–PIR, SWISSPROT, Signal peptide data bank; Database Similarity Searches; BLAST, FASTA, PSI–BLAST algorithms: Pair wise sequence alignment – NEEDLEMAN and Wunsch, Smith Waterman algorithms; Multiple sequence alignments – CLUSTAL PRAS: Patterns motifs and Profiles in sequences: Derivation and searching; Derived Databases of patterns, motifs and profiles: Prosite, Blocks, Prints–S, Pfam etc.; Primer Design.

### **SEQUENCE ANALYSIS**

Analysis of protein and nucleic acid sequences, multiple alignment programs, Development of programs for analysis of nucleic acid sequences. Use of GCG package. Conversion of various file formats. Use of Molecular Package(s), programs of calculate potential energy of regular structures and their visualization. Use of curve, NUPARM, NEW helix etc.

### **MOLECULAR MODELLING**

Concepts of Molecular Modeling. Molecular structure and internal energy, Application of molecular graphics. Energy minimization of small molecules, Empirical representation of molecular energies. Use of Force Fields and MM methods. Local and global energy minima. Techniques in MD and Monte Carlo. Simulation for conformational analysis *Ab initio*, DFT and semi–empirical methods, Design of ligands, Drug–receptor interactions. Classical SAR/QSAR, 2D and 3D data searching. Protein quaternary structure modeling. Interaction networks and systems biology.

### **GENOMICS AND PROTEOMICS**

*Genomics* – Genome sequencing technology. Whole genome analysis, Comparative genomics – Paralogs and orthologs, Phylogenetic profiling. Pathway analysis, Repeat analysis, Human genetic disorders, Candidate gene identification, Linkage analysis, Genotyping analysis, Concepts of Pharmacogenomics Proteomics – Introduction to basic Proteomics technology, Bio–informatics in Proteomics. Gene to Protein Function: a Roundtrip, Analysis of Proteomes. Analysis of 2–D gels. Protein to Disease and Vice Versa, Human Genome and science after Genome era.

**Genome Technology:** high throughout sequencing and assembly.

**Microarray and genome wide expression analysis:** transcriptomes, proteome: Genomics in medicine, disease monitoring, profile for therapeutic molecular targeting. Diagnostics drug discovery and genomics. Pharmacogenomics and its application. SNPs and their applications. Proteomics in medicine and its application. Patenting and data generation from patent literature for commercial benefits. IPR and bioinformatics. Bioinformatics patents.

**MICROARRAY TECHNOLOGY:** Introduction to basic microarray technology, Bioinformatics in microarrays. Getting started – target selection, Customized microarray design, Image processing and quantification. Normalization and filtering. Exploratory statistical analysis. Public Microarray data resources.

## **BIOTECHNOLOGY**

Molecular Biology of Pro and Eukaryotes, Plant and Animal Cloning and Expression Vectors, Hybrid Vectors, Homologous and Heterologous Expression, Industrial Biotechnology, Tools of Genetic Engineering, Recombinant DNA Technology Transgenetics. Molecular Farming, Organ, Tissue and Cell Culture techniques. Nanobiotechnology Nanomedicine PCR technique, GFP. Molecular Genetics.

## **BIOPHYSICAL METHODS**

## **TREES and GRAPHS**

## **COMPUTER AIDED DRUG DESIGNING**

# **(10) BIOTECHNOLOGY**

## **1. MOLECULES AND THEIR INTERACTION RELAVENT TO BIOLOGY**

- A.** Structure of atoms, molecules and chemical bonds.
- B.** Composition, structure and function of biomolecules (carbohydrates, lipids, proteins, nucleic acids and vitamins).
- C.** Stabilizing interactions (Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction etc.)
- D.** Principles of biophysical chemistry (pH, buffer, reaction kinetics, thermodynamics, colligative properties)
- E.** Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.
- F.** Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.
- G.** Conformation of proteins (Ramachandran plot, secondary, tertiary and quaternary structure; domains; motif and folds).
- H.** Conformation of nucleic acids (A–, B–, Z–, DNA), t–RNA, micro–RNA).
- I.** Stability of protein and nucleic acid structures.
- J.** Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

## **2. CELLULAR ORGANIZATION**

**A. Membrane structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

**B. Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

**C. Organization of genes and chromosomes:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

**D. Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

**E. Microbial Physiology:** Growth, yield and characteristics, strategies of cell division, stress response.

### 3. FUNDAMENTAL PROCESSES

**A. DNA replication, repair and recombination:** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

**B. RNA synthesis and processing:** Transcription factors and machinery, formation of initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

**C. Protein synthesis and processing:** Ribosome, formation of initiation complex initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading translational inhibitors, post-translational modification of proteins.

**D. Control of gene expression at transcription and translation level:** Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

### 4. CELL COMMUNICATION AND CELL SIGNALING

**A. Host parasite Interaction:** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells; alteration of host cell behaviour by pathogens, virus-induced cell transformation, pathogen-induced diseases, in animals and plants, cell-cell fusion in both normal and abnormal cells.

**B. Cell signaling:** Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component signaling systems, bacterial chemotaxis and quorum sensing.

**C. Cellular communication:** Regulations of hematopoiesis, general principles of cell communication, cell adhesion and roles of different adhesion molecules, gap junctions, extracellular matrix, integrins, neurotransmission and its regulation.

**D. Cancer:** Genetic rearrangements in progenitor, tumor suppressor genes, cancer and the cell cycle, virus-induced cancer, metastasis, interaction of cancer cells with normal cells, apoptosis, therapeutic interventions of uncontrolled cell growth.

**E. Innate and adaptive immune system:** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity. B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interactions, MHC molecules, antigen processing and presentation, activation and differentiation of B and T cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement

system, Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

## 5. DEVELOPMENT BIOLOGY

**A. Basic concepts of development:** Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development.

**B. Gametogenesis, fertilization and early development:** Production of gametes, cell surface molecules in sperm-egg recognition in animals; embryo sac development and double fertilization in plants; zygote formation, cleavage, blastula formation, embryonic fields, gastrulation and formation of germ layers in animals; embryogenesis, establishment of symmetry in plants; seed formation and germination.

**C. Morphogenesis and organogenesis in animals:** Cell aggregation and differentiation in *Dictyostelium*; axes and pattern formation in *Drosophila*, amphibia and chick; organogenesis – vulva formation in *Caenorhabditis elegans*; eye lens induction, limb development and regeneration in vertebrates; differentiation of neurons, post embryonic development–larval formation, metamorphosis; environmental regulation of normal development; sex determination.

**D. Morphogenesis and organogenesis in plants:** Organization of shoot and root apical meristem; shoot and root development; leaf development and phyllotaxy; transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

**E. Programmed cell death, aging and senescence.**

## 6. SYSTEM PHYSIOLOGY – PLANT

**A. Photosynthesis:** Light harvesting complexes; mechanisms of electron transport; photoprotective mechanisms; CO<sub>2</sub> fixation–C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

**B. Respiration and photorespiration:** Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

**C. Nitrogen metabolism:** Nitrate and ammonium assimilation; amino acid biosynthesis.

**D. Plant hormones:** Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action.

**E. Sensory photobiology:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; photoperiodism and biological clocks.

**F. Solute transport and photoassimilate translocation:** Uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates.

**G. Secondary metabolites:** Biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

**H. Stress Physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses; mechanisms of resistance to biotic stress and tolerance to abiotic stress.

## 7. SYSTEM PHYSIOLOGY – ANIMAL

**A. Blood and circulation:** Blood corpuscles, haemopoiesis and formed elements, plasma function, blood volume, blood volume regulation, blood groups, haemoglobin, immunity, haemostasis.

**B. Cardiovascular system:** Comparative anatomy of heart structure, myogenic heart, specialized tissue, ECG – its principle and significance, cardiac cycle, heart as a pump, blood pressure, neural and chemical regulation of all above.

**C. Respiratory system:** Comparison of respiration in different species, anatomical considerations, transport of gases, exchange of gases, waste elimination, neural and chemical regulation of respiration.

**D. Nervous system:** Neurons, action potential, gross neuroanatomy of the brain and spinal cord, central and peripheral nervous system, neural control of muscle tone and posture.

**E. Sense organs:** Vision, hearing and tactile response.

**F. Excretory system:** Comparative physiology of excretion, kidney, urine formation, urine concentration, waste elimination, micturition, regulation of water balance, blood volume, blood pressure, electrolyte balance, acid base balance.

**G. Thermoregulation:** Comfort zone, body temperature – physical, chemical, neural regulation, acclimatization.

**H. Stress and adaptation.**

**I. Digestive system:** Digestion, absorption, energy balance, BMR.

**J. Endocrinology and reproduction:** Endocrine glands, basic mechanism of hormone action, hormones and diseases; reproductive processes, neuroendocrine regulation.

## 8. INHERITANCE BIOLOGY

**A. Mendelian Principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

**B. Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.

**C. Extension of Mendelian principles:** Codominance, Incomplete dominance, gene interactions, pleiotropy, genomic imprinting penetrance and expressivity phenocopy, linkage and crossing over, sex linkage, sex limited and sex influenced characters.

**D. Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

**E. Extra chromosomal Inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

**F. Microbial genetics:** Methods of genetic transfers – transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

**G. Human genetics:** Pedigree analysis lod score for linkage testing, karyotypes, genetic disorders.

**H. Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

**I. Mutation:** Types, causes and detection, mutant types – lethal, conditional, biochemical, loss of function, gain of function, germinal implications.

**J. Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

**K. Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

## 9. DIVERSITY OF LIFE FORMS

**A. Principles and methods of taxonomy:** Concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of plants, animals and microorganisms.



**B. Levels of structural organization:** Unicellular, colonial and multicellular forms; levels of organization of tissues, organs and systems; comparative anatomy.

**C. Outline classification of plants, animals and microorganisms:**

Important criteria used for classification in each taxon; classification of plants, animals and microorganisms; evolutionary relationships among taxa.

**D. Natural history of Indian subcontinent:** Major habitat of the subcontinent, geographic origins and migration of species; common Indian mammals, birds; seasonality and phenology of the subcontinent.

**E. Organisms of health and agricultural Importance:** Common parasites and pathogens of humans, domestic animals and crops.

## 10. ECOLOGICAL PRINCIPLES

**A. The Environment:** Physical environment; biotic environment; biotic and abiotic interactions.

**B. Habitat and niche:** Concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.

**C. Population ecology:** Characteristics of a population growth curves; population regulation; life history strategies ( $r$  and  $K$  selection); concept of metapopulation – demes and dispersal, interdemic extinctions, age structured populations.

**D. Species Interactions:** Type of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.

**E. Community ecology:** Nature of communities; community structure and attributes; levels of species diversity and its measurement; edges and ecotones.

**F. Ecological succession:** Types; mechanisms; changes involved in succession; concept of climax.

**G. Ecosystem:** Structure and function; energy flow and mineral cycling (CNP); primary production and decomposition; structure and function of some Indian ecosystems (forest, grassland) and aquatic (fresh water, marine eustarine).

**H. Biogeography:** Major terrestrial biomes; theory of island biogeography; biogeographical zones of India.

**I. Applied ecology:** Environmental pollution; global environmental change; biodiversity–status, monitoring and documentation; major drives of biodiversity change; biodiversity management approaches.

**J. Conservation biology:** Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

## 11. EVOLUTION AND BEHAVIOUR

**A. Emergence and evolutionary thoughts:** Lamarck; Darwin–concepts of variation, adaptation, struggle, fitness and natural selection; Mendelism; spontaneity of mutations; the evolutionary synthesis.

**B. Origin of cells and unicellular evolution:** Origin of basic biological molecules; abiotic synthesis of organic monomers and polymers; concept of Oparin and Haldane; experiment of Miller (1953); the first cell; evolution of prokaryotes; origin of eukaryotic cells; evolution of unicellular eukaryotes; anaerobic metabolism, photosynthesis and aerobic metabolism.

**C. Paleontology and evolutionary history:** The evolutionary time scale; eras, periods and epoch; major events in the evolutionary time scale; origins of unicellular and multicellular organisms; major groups of plants and animals; stages in primate evolution including Homo.

**D. Molecular Evolution:** Concepts of neural evolution, molecular divergence and molecular clocks; molecular tools in phylogeny, classification and identification; protein and nucleotide sequence analysis; origin of new genes and proteins; gene duplication and divergence.

**E. The Mechanism:** Population genetics – populations, gene pool, gene frequency; Hardy–Weinberg law; concepts and rate of change in gene frequency through natural selections, migration and random genetic drift; adaptive radiation and modifications; isolating mechanisms; speciation; allopatricity and sympatricity; convergent evolution; sexual selection; co–evolution.

**F. Brain, Behavior and Evolution:** Approaches and methods in study of behavior, proximate and ultimate causation, altruism and evolution–group selection, kin selection, reciprocal altruism; neural basis of learning, memory, cognition, sleep and arousal; biological clocks; development of behavior; social communication; social dominance; use of space and territoriality; mating systems, parental investment and reproductive success; parental care; aggressive behavior habitat selection and optimality in foraging; migration, orientation and navigation; domestication and behavioral changes.

## 12. APPLIED BIOLOGY:

**A.** Microbial fermentation and production of small and macro molecules.

**B.** Application of immunological principles (vaccines, diagnostics), tissue and cell culture methods for plants and animals.

**C.** Transgenic animals and plants, molecular approaches to diagnosis and strain identification.

**D.** Genomics and its application to health and agriculture, including gene therapy.

**E.** Bioresource and uses of biodiversity.

**F.** Breeding in plants and animals, including marker – assisted selection.

**G.** Bioremediation and phytoremediation.

**H.** Biosensors.

## 13. METHODS IN BIOLOGY

**A. Molecular biology and recombinant DNA methods:** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels; molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems; expression of recombinant proteins using bacterial, animal and plant vectors; isolation of specific nucleic acid sequences; generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAC and YAC

vectors; in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms; protein sequencing methods, detection of post–translation modification of proteins; DNA sequencing methods, strategies for genome sequencing; methods of analysis of gene expression at RNA and protein level, large scale expression analysis, such as micro array based techniques; isolation, separation and analysis of carbohydrate and lipid molecules; RFLP, RAPD and AFLP techniques.

**B. Histochemical and Immunotechniques:** Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, *in situ* localization by techniques such as FISH and GISH.

**C. Biophysical methods:** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X–ray diffraction and NMR; analysis using light scattering, different types of mass spectrometry and surface plasma resonance methods.

**D. Statistical Methods:** Measures of central tendency and dispersal; probability distribution (Binomial, Poisson and normal); sampling distribution; difference between parametric and non–parametric statistics; confidence interval; errors; levels of significance; regression and

correlation; t-test; analysis of variance; X<sup>2</sup> test; basic introduction to Multivariate statistics, etc.

**E. Radiolabeling techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement; incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material safety guidelines.

**F. Microscopic techniques:** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM, freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

**G. Electrophysiological methods:** Single neuron recording, patch-clamp recording, ECG, Brain activity recording, lesion and stimulation of brain, pharmacological testing, PET, MRI, fMRI, CAT.

**H. Methods in field biology:** Methods of estimating population density of animals and plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior, habitat characterization-ground and remote sensing methods.

**I. Computational methods:** Nucleic acid and protein sequence databases; data methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

## (11) BOTANY

### 1. MOLECULES AND THEIR INTERACTION RELATANT TO BIOLOGY

A. Composition, structure and function of biomolecules (carbohydrates, proteins, nucleic acids and vitamins)

B. Bioenergetics, glycolysis, oxidative phosphorylation, coupled reaction, group transfer, biological energy transducers.

C. Principles of catalysis, enzymes and enzyme kinetics, enzyme regulation, mechanism of enzyme catalysis, isozymes.

D. Conformation of nucleic acids (A-B-Z-DNA), t-RNA, micro-RNA).

E. Stability of protein and nucleic acid structures.

F. Metabolism of carbohydrates, lipids, amino acids, nucleotides and vitamins.

### 2. CELLULAR ORGANIZATION

A. **Membrane structure and function:** Structure of model membrane, lipid bilayer and membrane protein diffusion, osmosis, ion channels, active transport, ion pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes.

B. **Structural organization and function of intracellular organelles:** Cell wall, nucleus, mitochondria, Golgi bodies, lysosomes, endoplasmic reticulum, peroxisomes, plastids, vacuoles, chloroplast, structure & function of cytoskeleton and its role in motility.

C. **Organization of genes and chromosomes:** Operon, interrupted genes, gene families, structure of chromatin and chromosomes, unique and repetitive DNA, heterochromatin, euchromatin, transposons.

D. **Cell division and cell cycle:** Mitosis and meiosis, their regulation, steps in cell cycle, and control of cell cycle.

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### 3. FUNDAMENTAL PROCESSES

A. **DNA replication, repair and recombination :** Unit of replication, enzymes involved, replication origin and replication fork, fidelity of replication, extrachromosomal replicons, DNA damage and repair mechanisms.

**B. RNA synthesis and processing :** Transcription factors and machinery, formation of initiation complex. Transcription activators and repressors, RNA polymerases, capping, elongation and termination, RNA processing, RNA editing, splicing, polyadenylation, structure and function of different types of RNA, RNA transport.

**C. Protein synthesis and processing:** Ribosome, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA identity, aminoacyl tRNA synthetase, translational proof-reading, translational inhibitors, post-translational modification of proteins.

**D. Control of gene expression at transcription and translation level :** Regulation of phages, viruses, prokaryotic and eukaryotic gene expression, role of chromatin in regulating gene expression and gene silencing.

#### 4. CELL COMMUNICATION AND CELL SIGNALING

**A. Host parasite interaction:** Recognition and entry processes of different pathogens like bacteria, viruses into animal and plant host cells, alteration of host cell behavior by pathogens, virus-induced cell transformation, pathogen-induced diseases in animals and plants, cell-cell fusion in both normal and abnormal cells.

**B. Innate and adaptive immune system:** Cells and molecules involved in innate and adaptive immunity, antigens, antigenicity and immunogenicity, B and T cell epitopes, structure and function of antibody molecules, generation of antibody diversity, monoclonal antibodies, antibody engineering, antigen-antibody interaction, MHC molecules, antigen processing and presentation, activation and differentiation of B and T Cells, B and T cell receptors, humoral and cell-mediated immune responses, primary and secondary immune modulation, the complement system. Toll-like receptors, cell-mediated effector functions, inflammation, hypersensitivity and autoimmunity, immune response during bacterial (tuberculosis), parasitic (Malaria) and viral (HIV) infections, congenital and acquired immunodeficiencies, vaccines.

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**A. Basic concepts of development:** Potency, commitment, specification, induction, competence, determination and differentiation, morphogenetic gradients, cell fate and cell lineages, stem cells genomic equivalence and the cytoplasmic determinants, imprinting, mutants and transgenics in analysis of development.

**B. Gametogenesis , fertilization and early development :** Production of gametes, embryo sac development and double fertilization in plants; zygote formation, embryogenesis, establishment of symmetry in plants, seed formation and germination.

**C. Morphogenesis and organogenesis in plants :** Organization of shoot and root apical meristem, shoot and root development, leaf development and phyllotaxy, transition to flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum*.

**D. Programmed cell death, aging and senescence.**

#### 6. SYSTEM PHYSIOLOGY PLANT

**A. Photosynthesis:** Light harvesting complexes, mechanisms of electron transport, photoprotective mechanisms, CO<sub>2</sub> fixation-C<sub>3</sub>, C<sub>4</sub> and CAM pathways.

**B. Respiration and photorespiration:** Citric acid cycle, plant mitochondrial electron transport and ATP synthesis, alternate oxidase photorespiratory pathway.

**C. Nitrogen Metabolism:** Nitrate and ammonium assimilation, amino acid biosynthesis.

**D. Plant hormones:** Biosynthesis, storage, breakdown and transport, physiological effects and mechanisms of action.

E. **Sensory photobiology:** Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins, stomatal movement, photoperiodism and biological clocks.

F. **Solute transport and photoassimilate translocation:** Uptake, transport and translocation of water, ions solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem, transpiration, mechanisms of loading and unloading of photoassimilates.

G. **Secondary metabolites:** biosynthesis of terpenes, phenols and nitrogenous compounds and their roles.

H. **Stress physiology:** Responses of plants to biotic (pathogen and insects) and abiotic (water temperature and salt) stresses, mechanisms of resistance to biotic stress and tolerance to abiotic stress.

## 7. INHERITANCE BIOLOGY

A. **Mendelian principles:** Dominance, segregation, independent assortment, deviation from Mendelian inheritance.

B. **Concept of gene:** Allele, multiple alleles, pseudoallele, complementation tests.

C. **Extensions of Mendelian principles:** Codominance, incomplete dominance, gene interactions, pleiotropy genomic imprinting penetrance and expressivity, phenocopy, linkage and crossing over sex linkage sex limited and sex influenced characters.

D. **Gene mapping methods:** Linkage maps, tetrad analysis, mapping with molecular markers, mapping by using somatic cell hybrids, development of mapping population in plants.

E. **Extra chromosomal inheritance:** Inheritance of mitochondrial and chloroplast genes, maternal inheritance.

F. **Microbial genetics:** Methods of genetic transfers-transformation, conjugation, transduction and sex-duction, mapping genes by interrupted mating, fine structure analysis of genes.

G. **Quantitative genetics:** Polygenic inheritance, heritability and its measurements, QTL mapping.

H. **Mutation:** Types, causes and detection, mutant types-lethal, conditional, biochemical, loss of function, gain of function, germinal versus somatic mutants, insertional mutagenesis.

I. **Structural and numerical alterations of chromosomes:** Deletion, duplication, inversion, translocation, ploidy and their genetic implications.

J. **Recombination:** Homologous and non-homologous recombination, including transposition, site-specific recombination.

## 8. DIVERSITY OF LIFE FORMS

A. **Principles and methods:** of taxonomy, concepts of species and hierarchical taxa, biological nomenclature, classical and quantitative methods of taxonomy of plants and microorganisms.

B. **Levels of structural organization:** Unicellular colonial and multicellular forms, levels of organization of tissues, organs and systems, comparative anatomy.

C. **Outline classification of plants and microorganisms:** Important criteria used for classification in each taxon, classification of plants and microorganisms, evolutionary relationships among taxa.

D. **Natural history of Indian subcontinent:** Major habitat types of the subcontinent, geographic origins and migrations of species.

## 9. ECOLOGICAL PRINCIPLES

A. **The environment:** Physical environment, biotic environment, biotic and abiotic interactions.

- B. **Habitat and niche** : Concept of habitat and niche, niche width and overlap, fundamental and realized niche, resource partitioning, character displacement.
- C. **Population ecology**: Characteristics of population, population growth curves, population regulation, life history strategies (r and K selection), concept of metapopulation-demes and dispersal, interdemic extinctions, age structured populations.
- D. **Species interactions** : Types of interactions, interspecific competition, herbivory, carnivory, pollination, symbiosis.
- E. **Community ecology** : Nature of communities, community structure and attributes, levels of species diversity and its measurement, edges and ecotones.
- F. **Ecological succession** : Types, mechanisms, changes involved in succession, concept of climax.
- G. **Ecosystem**: Structure and function, energy flow and mineral cycling (CNP) primary production and decomposition, structure and function of some Indian ecosystems, terrestrial (forest, grassland) and aquatic (fresh water, marine, estuarine).
- H. **Biogeography** : Major terrestrial biomes, theory of island biogeography, biogeographical zones of India.
- I. **Applied ecology**: Environmental pollution, global environmental change, biodiversity-status, monitoring and documentation, major drivers of biodiversity change, biodiversity management approaches.
- J. **Conservation biology** : Principles of conservation, major approaches to management, Indian case studies on conservation/management strategy (Project Tiger, Biosphere reserves).

## 10. EVOLUTION AND BEHAVIOUR

- A. **Emergence of evolutionary thoughts**: Lamarck, Darwin-concepts of variation, adaptation, struggle, fitness and natural selection, Mendelism, spontaneity of mutations, the evolutionary synthesis.
- B. **Origin of cells and unicellular evolution**: Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, concept of Oparin and Haldane, experiment of Miller (1953), the first cell evolution of prokaryotes, origin of eukaryotic cells evolution of unicellular eukaryotes, anaerobic metabolism, photosynthesis and aerobic metabolism.
- C. **Paleontology and evolutionary history**: The evolutionary time scale, eras, periods and epoch, major events in the evolutionary time scale, origins of unicellular and multicellular organisms, major groups of plants and animals, stages in primate evolution including Homo.
- D. **Molecular Evolution**: concepts of neutral evolution, molecular divergence and molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence.
- E. **The Mechanisms**: Population genetics-populations genepool, gene frequency, Hardy-Weinberg law, concepts and rate of change in gene frequency through natural selection, migration and random genetic drift, adaptive radiation and modifications, isolating mechanisms, speciation, allopatricity & sympatricity, convergent evolution, sexual selection, co-evolution.

## 11. APPLIED BIOLOGY

- A. Microbial fermentation and production of small and macro molecules.
- B. Application of immunological principles (vaccines, diagnostics), tissue and cell culture methods for plants and animals.
- C. Transgenic plants, molecular approaches to diagnosis & strain identification.
- D. Genomics & its application to health and agriculture, including gene therapy.
- E. Bioresource and uses of biodiversity.
- F. Breeding in plants.

- G. Bioremediation and phytoremediation.  
H. Biosensors.

## 12. METHODS IN BIOLOGY

**A. Molecular biology and recombinant DNA methods:** Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods, analysis of RNA, DNA and proteins by one and two dimensional gel electrophoresis, isoelectric focusing gels, molecular cloning of DNA or RNA fragments in bacterial and eukaryotic systems, expression of

recombinant proteins using bacterial, animal and plant vectors, isolation of specific nucleic acid sequences, generation of genomic and cDNA libraries in plasmid, phage, cosmid, BAG and YAC vectors, in vitro mutagenesis and deletion techniques, gene knock out in bacterial and eukaryotic organisms, protein sequencing methods, detection of post-translation modification of

proteins, DNA sequencing methods, strategies for genome sequencing, methods for analysis of gene expression at RNA and analysis of carbohydrate and lipid molecules, RFLP, RAPD and AFLP techniques.

**B. Histochemical and immunotechniques :** Antibody generation, detection of molecules using ELISA, RIA, western blot, immunoprecipitation, flow cytometry and immunofluorescence microscopy, detection of molecules in living cells, localization by techniques such as FISH and GISH.

**C. Biophysical methods :** Analysis of biomolecules using UV/visible, fluorescence, circular dichroism, NMR and ESR spectroscopy, structure determination using X-ray diffraction and NMR analysis using light scattering different types of mass spectrometry and surface plasma resonance methods.

**D. Statistical Methods:** Measures of central tendency and dispersal, probability distributions (Binomial, Poisson and normal), sampling distribution, difference between parametric and non-parametric statistics, confidence interval, errors, levels of significance, regression and test, basic introduction to 2% correlation, t-test, analysis of variance, Multivariate statistics, etc.

**E. Radiolabeling techniques:** Properties of different types of radioisotopes normally used in biology, their detection and measurement, incorporation of radioisotopes in biological tissues and cells, molecular imaging of radioactive material, safety guidelines.

**F. Microscopic techniques:** Visualization of cells and subcellular components by light microscopy, resolving powers of different microscopes, microscopy of living cells, scanning and transmission microscopes, different fixation and staining techniques for EM freeze-etch and freeze-fracture methods for EM, image processing methods in microscopy.

**G. Methods in field biology:** Methods of estimating population density of plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of behavior habitat characterization-ground and remote sensing methods.

**H. Computational Methods:** Nucleic acid and protein sequence databases, data mining methods for sequence analysis, web-based tools for sequence searches, motif analysis and presentation.

## (12) CHEMISTRY

**Molecular Symmetry & Spectroscopy :** Symmetry elements and operations, Symmetry point groups of molecules. Terms symbols and their determination for gaseous atom/ions. Spin-orbit coupling in free ion terms.

**Spectroscopy** : Theoretical treatment of rotational, vibrational-rotation, electronic and Raman spectroscopy, Theory of nuclear magnetic resonance, Mossbauer, photoelectron spectroscopy, scanning tunneling microscopy. Applications of electronic, vibrational, UV-VIS, IR, NMR and Raman spectroscopy for structural elucidation of compounds and in analysis.

**Electrochemistry and Electroanalytical methods** : Electrochemical cell equation, EMF of cells with transference and without transference. Electrode kinetics, electrical double layer, electrode/electrolyte interface, Mechanism of electrode reactions. Overpotential batteries, primary and secondary fuel cells, corrosion and corrosion prevention, Ionselective electrodes, controlled potential electrolysis, voltammetry – polarography, Anodic stripping voltammetry, cyclic voltammetry.

**Electrochemistry and Polarization** : Mechanism of electrode reactions. The current potential relation. The Tafel equation. Butler-Volmer equation, Concept of hydration number, activities in electrolytic solutions; mean ionic activity coefficient; Debye-Huckel treatment of dilute electrolyte solutions.

**Nuclear Chemistry and Radiochemical Analysis**: Stability of nucleus, Nuclear reactions, measurements of nuclear radiations, nuclear energy and nuclear reactors. Neutron activation analysis, dilution analysis, tracer techniques.

**Surface Phenomena** : Uni and bimolecular surface reactions. Langmuir-Hinshelwood and Langmuir-Rideal mechanisms. Inhibition of surface reactions Absolute reaction rate theory of surface reaction.

**Chromatographic techniques** : Principles, classification and applications of column chromatography, size exclusion chromatography, ion exchange chromatography, gas chromatography and high performance liquid chromatography.

**Other Physical Techniques** : Principle and applications of TGA, DTA and DSC. Atomic Absorption spectroscopy, Atomic Fluorescence spectroscopy, X-ray Fluorescence Spectroscopy, photoelectron spectroscopy, ESCA, Auger electron spectroscopy and Scanning Tunneling Microscopy (STM). Kinetic methods of analysis - Enzyme catalyzed reactions and their applications in chemical analysis, immunoassay.

**Data Analysis**: Data reduction, accuracy and precision, determinate and indeterminate errors, propagation of errors, confidence interval, rejection of results, least squares analysis, hypothesis testing using statistical analysis.

**Intermolecular Forces** : Nature of intermolecular forces, Various contribution of intermolecular forces. London theory of dispersion forces. Potential parameters of L-J potentials and evaluation of second virial coefficients.

**Ideal and non-ideal solutions** : Thermodynamic functions of mixing and excess functions, Partial molar properties of liquid mixtures. Determination of partial molar volume and partial molar enthalpy, Gibbs-Duhem – Margules equation. Thermodynamics of hydrolysis of adenosine triphosphate (ATP). Standard Gibbs free energies of a number of phosphate esters. Binding of oxygen by Myoglobin and Hemoglobin.

**Thermodynamics** : Second law of thermodynamics, entropy, Gibbs-Helmholtz equation. Third law of thermodynamics and determination of entropy. Free energy and entropy of mixing, partial molar quantities, Gibbs-Duhem equation. Equilibrium constant, temperature-dependence of equilibrium constant, phase diagram of one and two component systems, phase rule and its thermodynamics derivation.

**Statistical Thermodynamics** : Thermodynamic probability and entropy; Maxwell-Boltzmann, Bose-Einstein and Fermi-Dirac statistics. Partition function: rotational translational, vibrational, and electronic partition functions for diatomic molecules; calculations of thermodynamic functions and equilibrium constants. Theories of specific heat for solids.



**Non-equilibrium Thermodynamics** : Postulates and methodologies, linear laws, Gibbs equation, Onsager reciprocal theory. Entropy production and entropy flow.

**Reaction Kinetics** : Mechanisms of photochemical chain and oscillatory reactions. Collision theory of reaction rates; steric factor, treatment of unimolecular reactions. Theory of absolute reaction rates, comparison of results with Eyring and Arrhenius equations. Ionic reactions: salt effect. Homogeneous catalysis and Michaelis-Menten kinetics; heterogeneous catalysis. Luminescence and Energy transfer processes. Study of kinetics by stopped-flow technique, relaxation method, flash photolysis and magnetic resonance method.

**Mechanism of Organic Reactions**: Labelling and Kinetic isotope, Hammett equation, ( $\sigma$ - $\rho$ ) relationship, non-classical carbonium ions, neighbouring group participation.

**Inorganic Reaction and Mechanism** : Inert and labile complexes. Ligand displacement reactions in octahedral and tetrahedral complexes. Trans effect. Mechanism of electron transfer, isomerisation and recombination reaction.

**Quantum Chemistry** : Postulates of quantum mechanics and Schrodinger equation : free particle, particle in a 3-dimensional box, degeneracy, harmonic oscillator, rigid rotator and the hydrogen atom. Angular momentum, including spin; coupling of angular momenta including spin-orbit coupling. The variation method and perturbation theory : Application to the helium atom; antisymmetry and Exclusion Principle, Slater determinantal wave functions. Terms symbols and spectroscopic states. Born-Oppenheimer approximation : LCAO-MO and VB treatments of the hydrogen molecule Hydrogen molecule ion, electron density, forces and their role in chemical binding. Huckel  $\pi$ -electron theory and its applications to ethylene, butadiene and benzene. Idea of self-consistent fields.

**Macromolecules** : Determination of molecular weights. Kinetics of polymerization. Stereochemistry and mechanism of polymerization.

**Solids** : Bonding and conduction, Electronic structures of solids, Schottky and Frenkel defects, Electrical properties; Insulators and semiconductors; superconductors; Free electron theory, Fermi-gas theory and band theory of solids, Solid-state reactions.

**Pericyclic Reactions** : Selection rules and stereochemistry of electrocyclic reactions, cycloaddition reactions and sigmatropic shifts, Cope and Claisen rearrangements.

**Common Organic Reactions and Mechanisms** : Reactive intermediates, Formation and stability of carbonium ions, carbanions, carbenes, nitrenes, radicals and arynes. Nucleophilic, electrophilic, radical substitutions, addition and elimination reactions. Familiar name reactions: Aldol, Perkin, Stobbe, Dieckmann condensations; Hofmann, Schmidt, Lossen, Curtius, Beckmann and Fries rearrangement; Reimer – Tiemann, Reformatsky and Grignard reactions. Diels – Alder reactions; Claisen rearrangement; Fries rearrangement; Wittig reaction; and Robinson annulation. Routine functional group transformations and interconversions of simple functionalities. Hydroboration, Oppenauer oxidation; Clemmensen, Wolff-Kishner, Meerwein-Ponndorf-Verley and Birch reductions. Favorskii reaction; Stork enamine reaction; Michael addition, Mannich Reaction; Sharpless asymmetric epoxidation; Ene reaction, Barton reaction, Hofmann-Löffler-Freytag reaction, Shapiro reaction, Baeyer-Villiger reaction, Chichibabin reaction.

**Reagents in Organic Synthesis** : Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium diisopropylamide (LDA) dicyclohexylcarbodiimide. 1,3-Dithiane (reactivity umpolung), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Baker yeast, ylides and enamines.

**Photochemistry** : Cis-trans isomeriation, Paterno-Buchi reaction, Norris Type I and II reactions, di- $\pi$  methane rearrangement, photochemistry of arenes. Photo rearrangements of  $\alpha$ ,  $\beta$  unsaturated enones and dienones.

**Aromaticity** : Criteria of aromaticity, Aromaticity of ions and annulenes. Construction of pi molecular orbital energy diagram of aromatic and antiaromatic compounds.

**Stereochemistry and conformational Analysis** : Recognition of symmetry elements and chiral structures; R-S nomenclature, diastereoisomerism in acyclic and cyclic systems; E-Z isomerisms, conformational analysis of cyclic (chair and boat cyclohexanes) and acyclic systems. Interconversion of Fischer, Newman and Sawhorse projections. Newre method of asymmetric synthesis (including enzymatic and catalytic nexus), enantio and diastereo selective synthesis. Effects of conformation on reactivity in acyclic compounds and cyclohexanes.

**Coordination Chemistry** : Crystal field, ligand field and molecular orbital theories, crystal field splitting of d-orbitals, CFSE, Interpretation of electronic spectra of coordination compounds using Orgel diagrams. Calculation of Racahparameter ( $B'$ ) and nephelauxetic ratio  $\beta$  for octahedral  $d^2/d^8$  and tetrahedral  $d^2/d^7$  3d metal complexes. Magnetic properties of 3d metal complexes with A, E and T crystal field ground terms, calculation of effective magnetic moment. Orbital contribution to the magnetic moment, spin-orbit coupling, high spin-low spin equilibria. Mononuclear and polynuclear metal carbonyls. Structure and bonding in metal carbonyls and nitrosyls.

**Organometallic Chemistry** : Classification of organometallic compounds based on hapticity and polarity of M-C bond, nomenclature and general characteristics. General methods of preparation and important reactions of transition metal  $\Lambda$ - complexes of unsaturated hydrocarbons such as alkenes, alkynes, allyl, cyclopentadiene and arene. Organometallics in organic synthesis and in homogeneous catalytic reactions (hydrogenation, hydroformylation, isomerisation). Activation of small molecules by coordination.

**Chemistry of Lanthanides and Actinides**: Oxidation states and coordination numbers, spectral and magnetic properties; Ion exchange separation, use of lanthanide compounds as shift reagents.

**Bioinorganic and Bioorganic Chemistry** : Metal ions in biological system, Function, Structure and bonding of hemoglobin and myoglobin, molecular mechanism of ion transport across membranes; ionophores. Photosynthesis, PSL, PSH; nitrogen fixation, oxygen uptake proteins, cytochromes. Elementary structure and function of biopolymers such as proteins and nucleic acids.

**Chemistry of Non-transitional Elements**: General discussion on the properties of the nontransition elements; special features of individual elements; synthesis, properties and structure of their halides and oxides, polymorphism of carbon, phosphorus and sulphur. Synthesis, properties and structure of boranes, carboranes, borazines, silicates carbides, silicones, phosphazenes, sulphur – nitrogen compounds: peroxo compounds of boron, carbon and sulphur; oxy acids of nitrogen, phosphorus, sulphur and halogens, interhalogens pseudohalides and noble gas compounds.

**Chemistry of Transition Elements**: Coordination chemistry of transition metal ions; Stability constants of complexes and their determination; stabilization of unusual oxidation states. Stereochemistry of coordination compounds. Ligandfield theory, splitting of d-orbitals in low-symmetry environments, Jahn-Teller effect; interpretation of electronic spectra including charge transfer spectra; spectro chemical series, nephelauxetic series Magnetism: Dia-para-ferro and antiferromagnetism, quenching of orbital angular moment, spinorbit coupling, inorganic reaction mechanisms; substitution reactions, trans effect and electron transfer reactions, photochemical reaction of chromium and ruthenium complexes. Fluxional

molecules iso and heteropolyacids; metal clusters. Spin crossover in coordination compounds.

### **(13) COMMERCE AND BUSINESS ADMINISTRATION**

#### **Unit-I**

Business Environment

Meaning and Elements of Business Environment

Economic environment, Economic Policies, Economic Planning

Legal environment of Business in India, Competition Policy, Consumer protection, Environment protection

Policy Environment: Liberalization Privatization and globalization, Second generation reforms, Industrial policy and implementation. Industrial growth and structural changes.

#### **Unit-II**

Financial & Management Accounting

Basic Accounting concepts, Capital and Revenue, Financial statements

Partnership Accounts: Admission, Retirement, Death, Dissolution and Cash Distribution

Advanced Company Accounts : Issue, forfeiture, Purchase of Business, Liquidation, Valuation of shares, Amalgamation, Absorption and Reconstruction, Holding Company Accounts

Cost and Management Accounting: Ratio Analysis, Funds Flow Analysis, Cash Flow Analysis, Marginal costing and Break-even analysis, Standard costing, Budgetary control, Costing for decision-making

Responsibility accounting

#### **Unit-III**

Business Economics

Nature and uses of Business Economics, Concept of Profit and Wealth maximization, Demand Analysis and Elasticity of Demand, Indifference Curve Analysis, Law

Utility Analysis and Laws of Returns and Law of variable proportions

Cost, Revenue, Price determination in different market situations; Perfect competition, Monopolistic competition, Monopoly, Price discrimination and Oligopoly, Pricing strategies.

#### **Unit – III**

Business Economics

Nature and uses of Business Economics, Concept of Profit and Wealth maximization, Demand Analysis and Elasticity of Demand, Indifference Curve Analysis Law

Utility Analysis and Laws of Returns and Law of variable proportions

Cost, Revenue, Price determination in different market situation : Perfect competition, Monopolistic competition, Monopoly, Price discrimination and Oligopoly, Pricing strategies

#### **Unit – IV**

Business Statistics & Data Processing

Data types, Data collection and analysis, sampling, need, errors and methods of sampling, Normal distribution, Hypothesis testing, Analysis and Interpretation of Data

Correlation and Regression, small sample tests – t-test, F-test and chi-square test

Data processing – Elements, Data entry, Data processing and Computer applications

Computer Application to Functional Areas – Accounting, Inventory control, Marketing

**Unit – V**

Business Management

Principles of Management

Planning – Objectives, Strategies, Planning process, Decision-making

Organising, Organisational structure, Formal and Informal Organisations, Organisational culture

Staffing

Leading: Motivation, Leadership, Committees, Communication

Controlling

Corporate Governance and Business Ethics

**Unit – VI**

Marketing Management

The evolution of marketing, Concepts of marketing, Marketing mix, Marketing environment

Consumer behaviour, Market segmentation

Product decisions

Pricing decisions

Distribution decisions

Promotion decisions

Marketing planning, Organising and Control

**Unit – VII**

Financial Management

Capital Structure, Financial and Operating leverage

Cost of capital, Capital budgeting

Working capital management

Dividend Policy

**Unit – VIII**

Human Resources Management

Concepts, Role and Functions of Human Resource management

Human Resource Planning, Recruitment and selection

Training and Development, Succession Planning

Compensation : Wage and Salary Administration, Incentive and Fringe benefits, Morale and Productivity

Performance Appraisal

Industrial Relations in India, Health, Safety, Welfare and Social security, Workers'

Participation in Management

**Unit – IX**

Banking and Financial Institution

Importance of Banking to Business, Types of Banks and Their Functions, Reserve Bank of India, NABARD and Rural Banking

Banking Sector Reforms in India, NPA, Capital adequacy norms

E-banking

Development Banking : IDBI, IFCI, SFCs, UTI, SIDBI

**PAPER-III (B)**

[ELECTIVE /OPTIONAL]

**Elective – I: Accounting and Finance**

Accounting standards in India, Inflation Accounting, Human Resource Accounting, Responsibility Accounting, Social Accounting  
Money and Capital market, Working of stock exchanges in India, NSE, OTCEI, NASDAQ, Derivatives and Options  
Regulatory Authorities : SEBI, Rating Agencies; New Instruments : GDRs, ADRs Venture Capital Funds, Mergers and Acquisitions, Mutual Funds, Lease Financing, Factoring, Measurement of risk and returns securities and portfolios  
Computer Application in Accounting and Finance

**Elective – II : Marketing**

Marketing Tasks, Concepts and Tools, Marketing Environment  
Consumer Behaviour and Market Segmentation  
Product decisions  
Pricing decisions  
Distribution decisions  
Promotion decisions  
Marketing Researches  
On-line marketing  
Direct Marketing. Social, ethical and legal aspects of marketing in India

**Elective – III : Human Resource Management**

Concept; Role and Functions of Human Resource Management  
Human Resource Planning, Job analysis, Job description and specifications, Use of Job analysis information, Recruitment and Selection  
Training and development, Succession Planning  
Compensation : Wage and Salary administration, Incentives and Fringe benefits, Morale and Productivity  
Appraisal Performance  
Industrial Relations in India, Health, Safety, Welfare and Social Security, Workers participation in Management

**(14) COMPUTER APPLICATION (IPS)**

**1. Discrete Structures**

Set, Relations, Functions, Pigeonhole Principle, Inclusion-Exclusion Principle, Equivalence & Partial Orderings, Elementary Counting Techniques, Probability, Measure(s) for computation - Finite information and Mutual information.  
Computability: Models of computation – Finite Automata, Pushdown Automata, Nondeterminism and NFA, DPDA and PDAs and Languages accepted by these structures, Grammars, Non-computability and examples of non-computable problems.  
Graph: Definition, Walks, Paths, Trails, Connected Graphs, Regular & Bipartite Graphs, Cycles & circuits, Tree and rooted tree, Spanning trees, Eccentricity of a vertex radius and diameter of a graph.

**2. Basic Digital Electronics & Computer Organization**

Propositional (Boolean) Logic, Predicate Logic, Well Formed Formulae, Satisfiability & Tautology.

Logic Families: TTL, ECL & C-MOS gates, Boolean Algebra, Combinatorial & Sequential Circuits, Logic Expressions – SOP & POS form, minimization of Boolean functions, Flip-Flops, Design of combinational & Sequential circuits.

Representation of integers: Octal, Hex, Decimal and binary, 2's complement & 1's complement arithmetic, Floating point representation.

Hardwired & Micro-programmed Processor Design, Instruction Formats, Addressing modes, Memory types and organization, Interfacing peripheral devices, Interrupts; Microprocessor architecture, Instruction Set & Programming, Microprocessor applications.

### **3. Programming in C & C++**

Programming in C: Elements of C – Tokens, Identifiers, Data types in C, Control structures in C, Basic constructs - Sequence, Selection and iteration, Structured data types in C – arrays, Struct, Union, String and Pointers.

Object Oriented Programming concepts: Class, Object, Instantiation, Inheritance, Polymorphism and Overloading.

C++ Programming: Elements of C++ - Tokens, Identifiers, Variables and Constants, Data types, Operators, Control statements, Functions, Parameter passing, Class & Objects, Constructors & Destructors, Templates, Exception handling.

### **4. Relational Database Design and SQL**

Database Concepts, ER diagrams, Data Models, Design of Relational Database, Normalization– 1NF, 2NF, 3NF, BCNF and 4NF, Limitations of 4NF and BCNF, SQL & QBE, Query processing & Optimization, Security, Concurrency & Recovery.

SQL : Data Definition Language, Data Manipulation Language, Data Control Language commands, Database objects like – Views, Indexes, Sequences, Synonyms, Data Dictionary.

### **5. Data and File Structures**

Data, Information, Definition of Data structure, Lists, Arrays, Linked Lists, Stacks, Queues, Trees, Graphs, Priority Queues and Heaps.

File Structures: Fields, Records and Files, Sequential, Direct and Indexed Sequential files, Relative files, Hashing, Inverted lists and multi-lists, B trees and B+ trees.

### **6. Computer Networks**

Network fundamentals: Types of networks, Advantages/Disadvantages, Wired & wireless networks, Inter networks, ISO-OSI model, TCP/IP model, Active & Passive elements of a network, Internetworking components.

Data Communication: Channel Capacity, Telephones – local loop, trunks, multiplexing, switching, narrowband ISDN, broadband ISDN, ATM, High Speed LANs, Cellular Radio, Communication Satellites – geo-synchronous & low-orbit.

Internetworking: Bridge, Router, Gateways, Fragmentation, Firewalls.

Routing: Virtual circuits & datagrams, Routing algorithms, Congestion control.

Networking Security: Cryptography – Public Key, Secret Key, Domain Name System, Electronic Mail & WWW, Name Servers.

### **7. System Software and Compilers**

Assembly language fundamentals, Assemblers, Types of Assemblers, Macros & macroprocessors.

Loaders, Linkers, Relocation, Program relocatability, Linkage editing.

Compilation & Interpretation, Bootstrap compilers, Phases of compilation process, Lexical analysis.

Context free grammars, Parsing & Parse trees, Representation of parse trees as rightmost and leftmost derivations, Bottom-up parsers- shift-reduce, Operator precedence and LR. Lex & Yacc package.

Top-down parsers – left recursion and its removal, recursive descent parser, predictive parser, Intermediate codes – Quadruples, triples, code generation, code optimization.

### **8. Operating Systems**

Definition, Function, CPU Scheduling; Memory Management; I/O Management; System Deadlock & its avoidance; Support for concurrent processes.

Process & Threads, Multi-programming, Multi-tasking and Multi-processing systems, CPU scheduling techniques, Device Management Techniques, Memory Management Techniques; Concurrent processing, Mutual exclusion, Critical regions, Semaphores, Deadlocks, Deadlock avoidance.

### **9. Software Engineering**

System Development Life cycle, Design methodology, Software metrics, Software reliability, Software re-engineering; Software Validation & Quality Assurance Techniques; Software Maintenance & Management.

### **10: Computer Graphics & Imaging Systems**

Display Systems, Input Devices, 2D Geometry, Graphic Operations.

### **11. Current trends & Technologies**

Parallel computing: Parallel Virtual machines, message passing & interconnections, Advanced architectures.

Mobile Computing: Cells, Frameworks, Switching methods & wireless technology, mobile information access devices, mobile data internetworking standards, cellular data communication protocols, mobile databases and mobile computing applications

E-technologies: E-commerce, Electronic payment systems, Electronic Data Interchange, Internet based EDI

Digital Libraries & Data Warehousing; Concepts, Type of Digital documents, Issues behind document infrastructure, Corporate data warehouses: analysis, design, construction & administration.

E-Business, E-Governance and ERP packages.

Data Mining: Extracting models and patterns from large databases, Data mining techniques, classification, regression, clustering, summarization, dependency modeling, link analysis, sequencing analysis, mining scientific and business data.

## **(15) DEFENCE & STRATEGIC STUDIES**

1. Defence of National Security with Reference to the Contemporary Thinking.
2. Defence, Foreign, Security and Domestic Policies; Concept, Formulation, Objectives and Linkages.
3. Military Alliances and Pacts, Peace Treaties, Defence Cooperation, Strategic Partnership and Security Dialogue.
4. Environmental Security.
5. Armaments: Arms Race, Arms Aid, Arms Trade and Small Arms proliferation.
6. Problem of System of Governance and Human Rights.
7. Proliferation of Weapons of Mass Destruction (WMD) and NPT, CTBT, MTCR, NMD, and FMCT.

8. Military – Industrial Complex
9. Military, Nuclear and Missile Capabilities of China, Pakistan and India.
10. End of Cold War and Mergence of New World Order, New Trends after Sept., 9/11, 2001.
11. Development of Central Asian Republics.
12. Confidential Building Measures: Concept, Kinds and Utility,
13. Civil Defence
14. Civil-Military Relations.
15. India's Relation with USA, Russia, China, Pakistan, Israel, European Union, Central Asia.
16. Conceptual Analysis of Conflict and Peace.
17. Nature and Forms of Conflict.
18. Conflict Management and Conflict Resolution.
19. Insurgency and Terrorism in South Asia.
20. An Evaluation of the Existence, Importance and Future of Guerilla Warfare in the Nuclear Age.
21. Terrorism and Human Right Issues.
22. Defence Policy of India: 1947-1971.
23. Defence Policy in India: 1971 onwards.
24. Higher Defence Organisation in India.
  - (a). Powers of the President in relation to the Armed Forces.
  - Parliament and Armed Forces.
  - Defence Committee of the Cabinet.
  - Ministry of Defence.
  - National Security Council.
25. Strategic Thought of India.
26. Internal Threats of India's Security: Socio, Economic, Political, Science & Technological, Military and Allied Aspects.
27. Security Problems in the North Eastern Region of India.
28. Counter Terrorist Strategy of India.
29. Future Trends and Prospects of Security in the Region.
30. Indian Ocean as a Zone of Peace.
31. Development of New marine Technologies.
32. Maritime Strategy of India.

## (16) DEVELOPMENTAL STUDIES

**Theories of Globalization :** Hyper Globalizers, Skeptics and Transformationalists; End of History, End of Ideology, Internationalism, Theories of Conflict, Consensus and Change, Multi-culturalism, State Theory, Development Economics Theory, Democracy Theories of Development: Modernization Theory, Theories of Underdevelopment (World System Theory, Dependency Theory, Development of Underdevelopment); Articulation of Mode of Production, Sustainable Development Approaches to Globalization: Liberal, Classical, Neo-liberal, Neo-classical, Marxist, Neo- Marxist, Neo-Realist, Fundamentalism vs. Secularism, Feminist Approach, Social Constructivist, Cosmopolitanism, Post-modernist Approaches to Development: System Approach, Sectoral Approach, Integrated Approach, Feminist Approach, Reformists vs. Transformationlist, Capability Approach, Centralized vs. Decentralized Planning, Welfareism, Environmental and Ecological Approach, Sen and Dreze, Regional Identities and Cooperation Perspectives: Positivism, Marxism, Idealism,



Liberalism, Functionalism Structuralism, Post-Structuralism, Modernism, Post-modernism, Neo-Liberal, Neo- Marxism, Interactionism

**Research Design :** Exploratory, Descriptive, Explanatory Formulation of Research Problem: Hypothesis, Sources of Data, Observation, Questionnaire, Interview Schedule and Interview Guide, PRA Techniques, Applied Social Research Content Analysis, Case Study, Panel Study, Sampling Methods and Analysis of Data, Scaling Techniques, Graphic Presentation, Thesis Writing, Notes and Bibliography Statistical Techniques: Mean, Median, Mode, SD, Co-relation, Coefficient, Application of Computer in Social Science Research: MS Office, Use of Internet for Social Science Research Economic Growth and Development.

- a. Factor affecting Economic Growth: Capital, Labour and Technology
- b. Neo-classical Growth Models: Solow and Meade, Mrs. Joan Robinson's Growth Model
- c. Explanation of Cross Country Differentials in Economic Growth

### **Sectoral Aspects of Development**

- a. Role of Agriculture in Economic Development
- b. Efficiency and Productivity in Agriculture
- c. New Technology and Sustainable Agriculture
- d. Globalization and Agriculture Growth
- e. Rationale and Pattern of Industrialization in developing countries

### **Democracy and Development**

- a. Colonialism, Neo-colonialism and Post-colonial State
- b. Decision Making, Planning and Policies for Development in Westminster and Presidential Forms
- c. Democracy, Dissent and Development

### **Political Modernization and Development**

- a. Colonial and Post-colonial Development and Modernization

### **Politics and Economics of Development in India**

- a. Mixed v/s Open Economy
- b. Aim and Objectives of Five Year Plan
- c. Democratic Decentralization / Panchayati Raj and Development
- d. Good Governance

### **Basic Concepts of Region**

- a. Meaning, Definition and Concept
- b. Changing Concepts of the Region from an Inter-disciplinary viewpoint
- c. Types of Regions : Formal and Functional, Uniform and Nodal, Single Purpose and Composite Region, Special Purpose Regions
- d. Concept of Space, Area and Locational Attributes

### **Theories of Regional Development**

- a. Spatial Organization and Integration
- b. Theories of Polarized Development
- c. Theories of Regional Underdevelopment
- d. Theories of Sustainable Development

### **Introducing Planning**

- a. Planning Process: Sectoral, Temporal and Spatial Dimensions
- b. Short-term and Long-term Perspectives of Planning
- c. Regional Development and Multi-regional Planning in a National Context
- d. Indicators of Development and their Data Sources
- e. Measuring Levels of Regional Development and Disparities

### **Multi-level and Decentralized Planning**

- a. Concept of Multi-level planning
- b. Decentralized Planning: Sectoral v/s Decentralized; Top-down v/s Bottom-up Planning

### **Regional Development, Planning and Practices in India**

- a. Five Year Plans
- b. Macro-Meso-Micro Planning in India
- c. Target area and Target Group Approach
- d. Regional Social Movements and their Linkages with Regional Policy and Regional Development Strategies

### **Introduction to Human Development**

- a. Choice, Functioning and Capabilities
- b. Approaches: Capability, Commodity based System and Utility Approach, Quality of Life, Basic Needs Approach, Rawlsian Approach
- c. Linkages between Human Rights and Human Development: Right to Development
- d. Millennium Development Goals (MDGs): Understanding MDGs, Linkages between Human Development and MDGs

### **Measuring and Reporting on Human Development**

- a. Emergence of HDI: HDI as compared to per capita GDP, Methods of Computing HDI, Critique of HDI
- b. Other Indices: HPI, GRDI, GEI, Using Indices for Policy Purpose, Experiences of HDI and Inter-state Comparison in India

### **Application of Human Development**

- a. People's Participation and Action: Forms of Participation (Economic, Sociocultural, Political), Exclusion: Forms and Types (Poor, Women, Minorities and Indigenous)
- b. Obstacles to Participation (Legal Systems, Bureaucratic Constraints, Social Norms)
- c. PRA and PLA
- d. Social Movements; Civil Society, NGOs and CBOs
- e. Role of INGOs / Donor Agencies

### **Governance and Human Development**

- a. Defining Governance
- b. Understanding Governance: Economic, Political and Civil
- c. Emerging Issues in Governance
- d. Actors in Governance: State, Tiers of Governance
- e. Elements in Governance: Institutions, Delivery Mechanisms, Laws, Rules and Procedure.
- f. Linkages between Governance and Human Development: Political Freedom, Participation, Decentralization, Empowerment, Equity and Efficiency, Accountability, Right to Information

### **Globalization and Human Development**

- a. Implication for Growth
- b. Employment, Inequality and Poverty

- c. Gender Issues
- d. Livelihoods and Rights
- e. Health, Education, Environment and Human Security

### **Basic Concepts**

- a. Inequality–Natural Differences and Social Inequality; Structuring of Inequality, Social Differentiation, Hierarchy, Social Stratification
- b. Poverty - Definitions of Poverty: Epistemological and Theoretical Issues concerning the conceptualization of deprivation, exclusion, marginalization and poverty;
- c. Development - Growth, Evolution, Progress, Modernization, Sustainable Development

### **Form of Social Inequality**

- a. Caste, Class, Gender, Ethnicity and Race Methods of Poverty, Deprivation Measurement: Identification of Poor, Gender Poverty, Social and Gender Audit.

### **Social Inequality and Poverty in India**

- a. Absolute and Relative Poverty
- b. Poverty Eradication/Reduction Programmes
- c. Social Reforms Movements against Deprivation, Exclusion and Marginalization International Agencies (Bi/Multi-lateral, Aid and Humanitarian) and Poverty Reduction Policies and Programmes in India Comparative Development of Latin America, Asia and Africa Brief Socio-Cultural History and Development Profile of Latin America, Asia and Africa Colonization and Underdevelopment in Latin America, Asia and Africa.

### **Comparative Analysis of Social Development**

- a. Industrialization and Development
- b. Agriculture and Structural Inequality
- c. Economic Growth, Gender, Education and Health
- d. North-South Divide and South-South Cooperation
- e. Share in Global Trade and GDP
- f. Democracy and Development Case Studies of India, China, Brazil, Venezuela, South Africa, Mali

## **(17) EARTH AND PLANETARY SCIENCE**

### **GENERAL EARTH SCIENCES:**

#### **1. The Earth and the Solar System:**

Milky Way and the solar system. Modern theories on the origin of the Earth and other planetary bodies. Earth's orbital parameters, Kepler's laws of planetary motion, Geological Time Scale; Space and time scales of processes in the solid Earth, atmosphere and oceans. Age of the Earth. Radioactive isotopes and their applications in earth sciences. Basic principles of stratigraphy. Theories about the origin of life and the nature of fossil record. Earth's gravity and magnetic fields and its thermal structure: Geoid, spheroid; Isostasy.

**2 A. Earth Materials:** Gross composition and physical properties of important minerals and rocks; properties and processes responsible for mineral concentrations; nature and distribution of rocks and minerals in different units of the earth and different parts of India

**2 B. Surface features and Processes**

Physiography of the Earth; weathering, erosion, transportation and deposition of Earth's material; formation of soil, sediments and sedimentary rocks; energy balance of the Earth's surface processes; physiographic features and river basins in India

**3. Interior of the Earth, Deformation and Tectonics**

Basic concepts of seismology and internal structure of the Earth. Physico-chemical and seismic properties of Earth's interior. Concepts of stress and strain. Behaviour of rocks under stress; Folds, joints and faults. Earthquakes – their causes and measurement. Interplate and intraplate seismicity. Paleomagnetism, sea floor spreading and plate tectonics.

**4. Environmental Earth Sciences**

Properties of water; hydrological cycle; water resources and management. Energy resources, uses, degradation, alternatives and management; Ecology and biodiversity. Impact of use of energy and land on the environment. Exploitation and conservation of mineral and other natural resources. Natural hazards. Elements of Remote Sensing.

**GEOLOGY:**

**1) MINERALOGY AND PETROLOGY:**

Concept of point group, space group, reciprocal lattice, diffraction and imaging. Concepts of crystal field theory and mineralogical spectroscopy. TEM and SEM applications. Lattice defects (point, line and planar). Electrical, magnetic and optical properties of minerals. Bonding and crystal structures of common oxides, sulphides, and silicates. Transformation of minerals – polymorphism, polytypism, and polysomatism. Solid solution and exsolution.

Steady-state geotherms. Genesis, properties, emplacement and crystallization of magmas. Phase equilibrium studies of simple systems, effect of volatiles on melt equilibria. Magma-mixing, -mingling and -immiscibility.

Metamorphic structures and textures; isograds and facies. Mineral reactions with condensed phases, solid solutions, mixed volatile equilibria and thermobarometry. Metamorphism of pelites, mafic-ultra mafic rocks and siliceous dolomites. Material transport during metamorphism. P-T-t path in regional metamorphic terrains, plate tectonics and metamorphism.

Petrogenetic aspects of important rock suites of India, such as the Deccan Traps, layered intrusive complexes, anorthosites, carbonatites, charnockites, khondalites and gneisses.

**2) STRUCTURAL GEOLOGY AND GEOTECTONICS:**

Theory of stress and strain. Behaviour of rocks under stress. Mohr circle. Various states of stress and their representation by Mohr circles. Different types of failure and sliding criteria. Geometry and mechanics of fracturing and conditions for reactivation of pre-existing discontinuities. Paleostress analyses. Common types of finite strain ellipsoids. L-, L-S-, and S-tectonic fabrics. Techniques of strain analysis. Particle paths and flow patterns. Progressive strain history and methods for its determination. Deformation mechanisms. Role of fluids in deformation processes. Geometry and analyses of brittle-ductile and ductile shear zones. Sheath folds. Geometry and mechanics of development of folds, boudins, foliations and lineations. Interference patterns and structural analyses in areas of superposed folding. Fault-related folding. Gravity induced structures. Major tectonic features and associated structures in extensional-, compressional-, and strike-slip-terraces. Geological and geophysical characteristics of plate boundaries. Geodynamic evolution of Himalaya.

### **3) PALEONTOLOGY AND ITS APPLICATIONS:**

Theories on origin of life. Organic evolution – Punctuated Equilibrium and Phyletic Gradualism models. Mass extinctions and their causes. Application of fossils in age determination and correlation. Paleoecology, Life habitats and various ecosystems, Paleobiogeography. Modes of preservation of fossils and taphonomic considerations. Types of microfossils. Environmental significance of fossils and trace fossils. Use of microfossils in interpretation of sea floor tectonism. Application of micropaleontology in hydrocarbon exploration. Oxygen and Carbon isotope studies of microfossils and their use in paleoceanographic and paleoclimatic interpretation. Important invertebrate fossils, vertebrate fossils, plant fossils and microfossils in Indian stratigraphy.

### **4) SEDIMENTOLOGY AND STRATIGRAPHY:**

Clastic sediments- gravel, sand and mud; biogenic, chemical and volcanogenic sediments. Classification of conglomerates, sandstones and mudstones, and carbonate rocks. Flow regimes and processes of sediment transport. Sedimentary textures and structures. Sedimentary facies and environments, reconstruction of paleoenvironments. Formation and evolution of sedimentary basins. Diagenesis of siliciclastic and carbonate rocks.

Recent developments in stratigraphic classification. Code of stratigraphic nomenclature – Stratotypes, Global Boundary Stratotype Sections and Points (GSSP). Lithostratigraphic, chronostratigraphic and biostratigraphic subdivisions. Methods of stratigraphic correlation including Shaw's Graphic correlation. Concept of sequence stratigraphy. Rates of sediment accumulation, unconformities. Facies concept in Stratigraphy – Walther's law. Methods for paleogeographic reconstruction. Earth's Climatic History. Phanerozoic stratigraphy of India with reference to the type areas– their correlation with equivalent formations in other regions. Boundary problems in Indian Phanerozoic stratigraphy.

### **5) MARINE GEOLOGY AND PALEOCEANOGRAPHY:**

Morphologic and tectonic domains of the ocean floor. Structure, composition and mechanism of the formation of oceanic crust. Seawater-basalt interactions, hydrothermal vents- chemical

and biological significance of hydrothermal vents systems. Ocean margins and their significance. Ocean Circulation, Coriolis effect and Ekman spiral, convergence, divergence and upwelling, El Nino. Thermohaline circulation and oceanic conveyor belt. Formation of Bottom waters; major water masses of the world's oceans. Oceanic sediments: Factors controlling the deposition and distribution of oceanic sediments; geochronology of oceanic sediments, diagenetic changes in oxic and anoxic environments. Tectonic evolution of the ocean basins. Mineral resources. Paleoceanography – Approaches to paleoceanographic reconstructions; various proxy indicators for paleoceanographic interpretation. Joint Global Ocean Flux Study (JGOFS) and its applications in Paleoceanography. Ocean Drilling Programme and its major accomplishments in paleoceanography. Opening and closing of ocean gateways and their effect on circulation and climate during the Cenozoic. Sea level processes and Sea level changes.

## **6) GEOCHEMISTRY:**

Structure and atomic properties of elements, the Periodic Table; ionic substitution in minerals; Phase rule and its applications in petrology, thermodynamics of reactions involving pure phases, ideal and non-ideal solutions, and fluids; equilibrium and distribution coefficients. Nucleation and diffusion processes in igneous, metamorphic and sedimentary environments, redox reactions and Eh-pH diagrams and their applications. Mineral/mineral assemblages as 'sensors' of ambient environments. Geochemical studies of aerosols, surface-, marine-, and ground waters. Radioactive decay schemes and their application to geochronology and petrogenesis. Stable isotopes and their application to earth system processes.

## **7) ECONOMIC GEOLOGY:**

Magmatic, hydrothermal and surface processes of ore formation. Metallogeny and its relation to crustal evolution; Active ore-forming systems, methods of mineral deposit studies including ore microscopy, fluid inclusions and isotopic systematics; ores and metamorphism-cause and effect relationships. Geological setting, characteristics, and genesis of ferrous, base and noble metals. Origin, migration and entrapment of petroleum; properties of source and reservoir rocks; structural, stratigraphic and combination traps. Methods of petroleum exploration. Petroliferous basins of India. Origin of peat, lignite, bitumen and anthracite. Classification, rank and grading of coal; coal petrography, coal resources of India. Gas hydrates and coal bed methane. Nuclear and non-conventional energy resources.

## **8) PRECAMBRIAN GEOLOGY AND CRUSTAL EVOLUTION:**

Evolution of lithosphere, hydrosphere, atmosphere, biosphere, and cryosphere; lithological, geochemical and stratigraphic characteristics of granite – greenstone and granulite belts. Stratigraphy and geochronology of the cratonic nuclei, mobile belts and Proterozoic sedimentary basins of India. Life in Precambrian. Precambrian – Cambrian boundary with special reference to India.

## **9) QUATERNARY GEOLOGY:**

Definition of Quaternary. Quaternary Stratigraphy – Oxygen Isotope stratigraphy, biostratigraphy and magnetostratigraphy. Quaternary climates – glacial-interglacial cycles, eustatic changes, proxy indicators of paleoenvironmental/ paleoclimatic changes, - land, ocean and cryosphere (ice core studies). Responses of geomorphic systems to climate, sea level and tectonics on variable time scales in the Quaternary,. Quaternary dating methods, – radiocarbon, Uranium series, Luminescence, Amino-acid, relative dating methods. Quaternary stratigraphy of India– continental records (fluvial, glacial, aeolian, palaeosols and duricrust); marine records; continental-marine correlation of Quaternary record.

Evolution of man and Stone Age cultures. Plant and animal life in relation to glacial and interglacial cycles during Quaternary.

Tectonic geomorphology, neotectonics, active tectonics and their applications to natural hazard assessment.

## 10) (I)APPLIED GEOLOGY:

- (i) **Remote Sensing and GIS:** Elements of photogrammetry, elements of photo-interpretation, electromagnetic spectrum, emission range, film and imagery, sensors, geological interpretations of air photos and imageries. Global positioning systems. GIS- data structure, attribute data, thematic layers and query analysis.
- (ii) **Engineering Geology:** Engineering properties of rocks and physical characteristics of building stones, concretes and other aggregates. Geological investigations for construction of dams, bridges, highways and tunnels. Remedial measures. Mass movements with special emphasis on landslides and causes of hillslope instability. Seismic design of buildings.
- (iii) **Mineral Exploration:** Geological, geophysical, geochemical and geobotanical methods of surface and sub-surface exploration on different scales. Sampling, assaying and evaluation of mineral deposits.
- (iv) **Hydrogeology:** Groundwater, Darcy's law, hydrological characteristics of aquifers, hydrological cycle. Precipitation, evapotranspiration and infiltration processes. Hydrological classification of water-bearing formations. Fresh and salt-water relationships in coastal and inland areas. Groundwater exploration and water pollution. Groundwater regimes in India.

## GEOPHYSICS:

- 1) **Signal Processing:** Continuous and discrete signals; Fourier series; linear time invariant systems with deterministic and random inputs; band limited signal and sampling theorem; discrete and Fast Fourier transform; Z-transform; convolution; Filters: discrete and continuous, recursive, non-recursive, optimal and inverse filters; deconvolution.
- 2) **Field theory:** Newtonian potential; Laplace and Poisson's equations; Green's Theorem; Gauss' law; Continuation integral; equivalent stratum; Maxwell's equations

and electromagnetic theory; Displacement potential, Helmholtz's theorem and seismic wave propagation.

**3) Numerical analysis and inversion:** Numerical differentiation and integration, finite element, and finite difference techniques; Simpson's rules; Gauss' quadrature formula; initial value problems; pattern recognition in Geophysics. Well posed and ill-posed problems; method of least squares; direct search and gradient methods; generalized inversion techniques; singular value decomposition; global optimization.

**4) Gravity and Magnetic fields of the earth:** Normal gravity field; Clairaut's theorem; Shape of the earth; deflection of the vertical, geoid, free-air, Bouguer and isostatic anomalies, isostatic models for local and regional compensation. Geomagnetic field, secular and transient variations and their theories; palaeomagnetism, construction of polar wandering curves.

**5) Plate Tectonics and Geodynamics:** Vine-Mathews hypothesis, marine magnetic anomalies, sea floor spreading; mid-oceanic ridges and geodynamics; plate tectonics hypothesis; plate boundaries and seismicity. Heat flow mechanisms, core-mantle convection and mantle plumes.

**6) Seismology & Tomography:** Seismometry: short period, long period, broad band and strong motion; elements of earthquake seismology; seismic sources: faulting source, double couple hypothesis, elastodynamics, Haskell's function, seismic moment tensor, focal mechanism and fault plane solutions; seismic gaps; seismotectonics and structure of the earth; Himalayan and stable continental region earthquakes, reservoir induced seismicity; seismic hazards; earthquake prediction.

**7) Gravity and Magnetic Methods:** Gravimeters and magnetometers; data acquisition from land, air and ship; corrections and reduction of anomalies; ambiguity; regional and residual separation; continuation and derivative calculations; interpretation of anomalies of simple geometric bodies, single pole, sphere, horizontal cylinder, sheet, dyke and fault. Forward modelling and inversion of arbitrary shaped bodies and 2-D, 3-D interfaces. Interpretations in frequency domain.

**8) Electrical and Electromagnetic Methods:** Electrical profiling and sounding, typical sounding curves, pseudo-sections; resistivity transform and direct interpretation; induced polarization methods. Electromagnetic field techniques; elliptic polarization, in-phase and out of phase components, horizontal and vertical loop methods; interpretation; VLF (very low frequency); AFMAG (Audio frequency magnetic) methods; and central frequency sounding; transient electromagnetic methods; magneto-telluric method; geomagnetic depth sounding.

**9) Seismic Methods:** Generalized Snell's Law; Ray theory; reflection, refraction, diffraction; Zoeppritz's equation; seismic energy sources; detectors; seismic noises and noise profile analysis; seismic data recording and telemetry devices; reduction to a datum and weathering corrections; Interpretation of a refraction seismic data by graphical and



analytical techniques; CDP/CMP; seismic reflection data processing, velocity analysis, F-K filtering, stacking, deconvolution, migration before and after stack; bright spot analysis; wavelet processing; attenuation studies, shear waves, AVO; VSP; introduction to 3D seismics; seismic stratigraphy.

**10) Well logging and other methods:** Open hole, cased hole and production logging; Electrical logs; lateral, latero, induction, S.P; porosity logs; sonic, density, neutron; natural gamma; determination of formation factor, porosity, permeability, density, water saturation, lithology; logging while drilling. Radioactive and geothermal methods.

## (18) ECONOMICS

Theory Demand-Axiomatic Approach, Demand Functions, Consumer Behaviour under conditions of Uncertainty. Theory of Production, Collusive and Collusive Oligopolies , Different models of objectives of the firm – Baumol, Morris and Williamson , Factor Pricing, General Equilibrium and Welfare Economics

Keynesian and Post-Keynesian approaches to theory of output and employment; concept of investment multiplier; consumption hypotheses, Theory of investment and accelerator, Theories of Demand for Money – Keynesian and post-Keynesian, Different approaches to money supply; money supply; components and determinants; money multiplier, Output-Price Determination (aggregate supply and aggregate demand curve analysis), Fleming-Mundell Open Economy Model.

Development and Growth Role of Institutions, Theories of Growth and Development – Models of Growth of Joan Robinson and Kaldor; Technical Progress-Hicks, Harrod and Learning by doing, Production Function Approach to the Determinants of Growth: Endogenous Growth: Role of Education, Research and Knowledge – Explanation of Cross Country Differentials in Economic Development and Growth.

Theories of Development – Classical, Marx, Schumpeter and Structural Analysis of Development - Imperfect Market Paradigm, Lewis, Model of Development, Ranis-Fei Model, Dependency Theory of Development, Factor in Economy Development – Natural Resources, Population, Capital, Human Resource Development and Infrastructure.

Trade and Development – Trade as engine of Growth two gap Analysis, Prebisch, Singer and Myrdal Views; Gains from Trade and LDCs.

Theories of Taxation, Types, Incidence and Effects. Theories of Public Expenditure Effects on Saving, Investment and Growth, Burden of Public Debt.

Union Finance – Trends in Revenue and Expenditure of the Government of India

State Finance – Trends in Revenue and Expenditure of the State Governments

Public Debt India's Public Debt Since 1951 – Growth Composition, Ownership, Pattern and Debt Management.

Union State Financial Relations – Horizontal and Vertical Imbalance; the Financial Commissions. Fiscal Policy and Fiscal reforms in India – Fiscal, Reform Deficit, Recovery & FRBM.

Monetary Approach and Adjustment in the Balance of Payments, Regional Blocs – Multilateralism and World Trading System, The Political Economy of Imposition of Non-Tariff Barriers, International Trade under conditions of imperfect competition in Goods Market Theory of International Reserves.

Optimum Currency Areas – Theory and Impact in the Developed and Developing Countries. WTO and its Impact on the different Sectors of the Economy. Components of Money Supply, Role, Constituents and Functions of Money and Capital Markets. RBI recent Monetary and Credit Policies, Commercial Banks and Co-operatives Banks. Specialised Financial and Investment Institutions, Non Bank Financial Institutions and Regional Rural Banks.

Industrial Structure and Economic Growth, Pattern of Industrialisation - Public and Private, Large and Small Industries, Theories of Industrial location – Indian Experience, Industrial Productivity – Measurement, Partial and total trends, Industrial Finance in India, Industrial Labour – Problems, Policies and Reforms in India, Economic Reforms and Industrial Growth

Population and Economic Development – Interrelation between population, Development and Environment, sustainable Development, Malthusian theory of Population, Optimum theory of Population (theory of demographic transition, population as ‘Limit’ to Growth’ and as ‘Ultimate Source’, Concept of Demography – Vital rates, Life tables, composition and uses, Measurement of fertility – Total fertility rate, gross and net reproduction rate – Age pyramids, population projection –stable, stationary and quasi-stationary population; characteristics of Indian population through recent census.

Poverty in India – Absolute and Relative; analysis of Poverty in India, Environment as necessity – amenity and public goods; causes of environmental and ecosystem degeneration – policies for controlling pollution –economic and persuasive; their relative effectiveness in LDCs; Relation between population, poverty and environmental degradation – micro-planning for environment and eco-preservation – water sheds; joint forest management and self-help groups.

Role of State in Environmental Preservation – Review of Environmental legislation in India. Role of Agriculture in Indian Economy – Share of Agriculture, Interrelationship between Agriculture and Industry.

Institution Aspects – Land Reforms, Green Revolution, Technological Aspects – Agricultural inputs and shifts in production function, Capital formation in the Rural Sector – Saving, Assets and Credits, Strategies for Rural Development, Regional Disparities in Indian Agriculture, Cooperative movement in India – Organisation, Structure and Development of different types of Cooperatives in India.

Application of Differential and Integral Calculus in Theories of Consumer Behaviour, Production and Pricing under different Market Conditions, Input-Output Analysis and Linear programming, Application of Correlation and Regression , Testing of Hypothesis in Regression Analysis.

### **(19) EDUCATION**

Western School of Philosophy:

Idealism, Realism, Naturalism, Pragmatism, Existentialism with special reference to the concepts of knowledge, reality and values; their educational implications for aims, contents and methods of teaching.

Indian Schools of Philosophy:

Vedanta, Buddhism, Jainism, Islamic traditions with special reference to the concepts of knowledge, reality and values; and their educational implications.

Contributions of Educational Thinkers: Vivekananda, Tagore, Gandhi and Aurobindo to Education.

Meaning and nature of Sociology of Education, Education and social change, Constraints on social change (Caste, ethnicity, class, language, religion, population and regionalism). Education as related to social equity and equality of educational opportunities. Education of socially and economically disadvantaged section of society with special reference to scheduled castes and scheduled tribes, Women and rural population. Education as a fundamental right.

Process of growth and Development with reference to –

- Physical, Social, Emotional and Intellectual development.
- Development of Concept formation, Logical reasoning, Problem solving and Creative thinking, Language Development.
- Individual differences – determinants- role of heredity and environment. Implication of individual differences for organizing educational programmes.

Intelligence- Its Theories and Measurement.

Learning and Motivation.

Theories of learning: Thorndike's connectionism, Pavlov's Classical and Skinner's operant Conditioning; Learning by insight. Hull's reinforcement theory and Tolman's theory of learning.

Gagne's hierarchy of learning.

Factors influencing learning.

Learning and Motivation.

Transfer of learning and its theories.

Personality – type and theories- measurement of personality

Mental health and hygiene.

Process of adjustment, conflicts and defence mechanism.

Concept and principles of guidance and counselling, types of guidance and counselling. Tools and Techniques of Guidance - records, scales and tests, interview. Organizing Guidance services at different levels of education, occupational information, kinds of services, like information testing, counselling and follow up.

Meaning and Nature of Educational Research, Types, Theory development, Nature of Variables, Formulation of Research Problem.

Hypothesis : Concept, difference with assumptions, source, various types of hypothesis.

Sample: Concept of population and sample, Various method of sampling.

Tools: Questionnaire, Observation and interview as tools of data collection, tests and scales

Descriptive Research, Ex-Post facto Research, Survey Method, Historical Research

Experimental Research: Designs of experimental research, Characteristics internal and external validity in experimental research

Qualitative research: Phenomenological research, Ethnomethodical and Naturalistic inquiry.

Analysis of Data

Descriptive and inferential statistics. The null hypothesis, test of significance.

Types of error, one-tailed and two – tailed tests

The t – test

The F- test ( One way ANOVA)

Non Parametric tests (Chi- Square test)

Biserial, Point – biserial, tetrachoric and phi-coefficient of correlation

Partial and Multiple correlations

Universalization of elementary education in India

Vocationalization of education in USA and India.

Educational Administration in USA, UK (Britain and Ireland) and India

Distance education and continuing education in Australia, UK and India

Construction and Development of Curriculum-different models

Administrative, Grassroot, Demonstration, System Analysis.

Measurement and Evaluation- Formative evaluation, Summative evaluation.

Characteristics of a good measuring tool, Reliability, Validity and Norm, Construction and standardization of Achievement test.

Educational Administration and Management- Concept and Development

Taylorism, Administration as a process, Administration as a bureaucracy, Human relation approach to administration, System era.

Modern trends in Educational Administration such as (a) Decision making (b) Organizational Compliance (c) Organizational Development (d) PERT (e) System Approach and Total Quality

Management.

Educational Technology, Meaning and Nature

Systems Approach; Communication: Concept theory and barriers. ICT in education: meaning,

scope, uses. Open and Distance learning system: Needs, scope and models, Student support services.

## **(20) ENGLISH**

**The Course for English will include the following topics:**

1. Chaucer to Shakespeare
2. Jacobean and Restoration Periods
3. Augustan Age: 18th Century literature
4. Romantic Period
5. Victorian Period
6. Modern Period
7. Contemporary Period
8. American and Other Non-British Literatures
9. Literary Theory and Criticism
10. Rhetoric and Prosody.

## (21) ENVIRONMENTAL SCIENCE

Definition, Principles and Scope of Environmental Science.

Earth, Man and Environment. Ecosystems, Pathways in Ecosystems.

Physico-chemical and Biological factors in the Environment.

Geographical Classification and Zones.

Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, Pressure, Temperature, Precipitation, Humidity, Radiation and Wind. Atmospheric Stability, Inversions and Mixing Heights Windroses.

Natural resources, conservation and sustainable development.

**Fundamentals of Environmental Chemistry:** Stoichiometry, Gibbs', energy, Chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

**Chemical Composition of Air:** Classification of elements, chemical speciation Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermo-chemical and photochemical reactions in the atmosphere. Oxygen and Ozone chemistry, Chemistry of air pollutants, Photochemical smog.

**Water Chemistry:** Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.

**Soil Chemistry:** Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.

**Toxic Chemicals in the Environment – Air, Water:** Pesticides in water. Bio- chemical aspects of Arsenic. Cadmium, Lead, Mercury, Carbon Monoxide, O<sub>3</sub> and PAN Pesticides, Insecticides, MIC carcinogens in the air.

**Principles of Analytical Methods:** Titrimetry, Gravimetry, Colourimetry, Spectrophotometry, Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis X-ray fluorescence, X-ray diffraction, Flame photometry.

Definition, Principle and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation.

**Ecosystems:** Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food, web, Ecological pyramids, types and diversity.

Ecological Succession, Population, Community ecology and Parasitism, Preypredator relationships.

**Common flora and fauna in India**

**Aquatic:** Phytoplankton, Zooplankton and Macrophytes

**Terrestrial:** Forests

**Endangered and Threatened Species**

**Biodiversity and its conservation:** Definition, 'Hotspots' of Biodiversity. Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool.

**Microflora of Atmosphere:** Air sampling techniques. Identification of aeroallergens. Air-borne diseases and allergies.

**Environmental Biotechnology:** Fermentation Technology, Vermiculture technology. Biofertilizer technology.

**Environmental Geosciences-** Fundamental concepts.

**The earth system and Biosphere:** Conservation of matter in various geospheres—lithosphere, hydrosphere, atmosphere and biosphere. Energy budget of the earth. Earth's thermal environment and seasons. Ecosystems flow of energy and matter. Coexistence in communities—food webs. Earth's major ecosystem—terrestrial and aquatic. General relationship between landscape, biomes and climate. Climates of India, Indian Monsoon, El Nino, Droughts. Tropical cyclones and Western Disturbance.

**Earth's Processes and Geological Hazards:** Earth's processes; concept of residence, time and rates of natural cycles, Catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche. Prediction and perception of the hazards and adjustments to hazardous activities.

**Mineral Resources and Environment:** Resource and Reserves, Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting and minerals.

**Water Resources and Environment:** Global Water Balance. Ice sheets and fluctuations of sea levels. Origin and composition of seawater. Hydrological cycle. Factors influencing the surface water. Types of water. Resources of oceans. Ocean pollution by toxic wastes. Human use of surface and groundwaters. Groundwater pollution.

**Landuse Planning:** The landuse plan. Soil surveys in relation to landuse planning. Methods of site selection and evaluation.

**Environmental Geochemistry:** Concept of major, trace and REE. Classification of trace elements, Mobility of trace elements, Geochemical cycles. Biogeochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land.

Principle of Remote Sensing and its application of Environmental Sciences. Application of GIS in Environmental Management.

**Sun as source of energy; solar radiation and its spectral characteristics:** Fossil fuels—classification, composition, physico-chemical characteristics and energy content of coal, tidal, petroleum and natural gas. Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds; nuclear energy—fission and fusion; magneto hydrodynamic power, bio-energy—energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world.

Environmental implication of energy use: CO<sub>2</sub> emissions, global warming: air and thermal pollution: radioactive waste and radioactivity from nuclear reactors: impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

**Air:** Natural and anthropogenic sources of pollution. Primary and Secondary pollutants. Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO<sub>2</sub>, NO<sub>x</sub>, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain. Air Quality Standards.

**Water:** Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standard, sewage and waste water treatment and recycling. Water quality standard.

**Soil:** Physico-chemical as bacteriological sampling as analysis of soil quality. Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

**Noise:** Source of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measurement. Impact of noise on human health.

**Marine:** Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system-coastal management.

Radioactive and Thermal Pollution.

Introduction to environmental impact analysis.

Environmental impact Statement and Environmental Management Plan.

EIA guidelines 1994, Notification of Government of India.

Impact Assessment Methodologies.

Generalized approach to impact analysis.

Procedure for reviewing Environmental impact analysis and statement.

Guidelines for Environmental audit.

Introduction to Environmental planning.

Base line information and predictions (land, water, atmosphere, energy etc.)

Restoration and rehabilitation technologies.

Landuse policy for India.

Urban planning for India.

Rural planning and landuse pattern.

Concept and strategies of sustainable development.

Cost-Benefit analysis.

Environmental priorities in India and sustainable development.

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes) Recycling of waste material. Waste minimization technologies.

Hazardous Wastes Management and Handling Rules, 1989, Resource Management, Disaster Management and Risk analysis.

Environmental protection-issues and problems, International and National efforts for Environmental Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A).

Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988, The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986.

Scheme of labeling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Basic elements and tools of statistical analysis; probability sampling, measurement and distribution of attributes; Distribution—Normal,  $t$  and  $\chi^2$ , Poisson and Binomial; Arithmetic, Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance.

Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting. Models of population growth and interactions—Lotka–Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

Environmental Education and Awareness.

Environmental Ethics and Global imperatives.

Global Environmental problems—ozone depletion, global warming and climatic change.

Current Environmental issue in India.

Context: Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.

Waste lands and their reclamation.

Desertification and its control.

Vehicular pollution and urban air quality.

Depletion of Nature resources.

Biodiversity conservation and Agenda-21.

Waste disposal, recycling and power generation, Fly ash utilization.

Water Crises—Conservation of water.

Environmental Hazards.

Eutrophication and restoration of Indian lakes.

Rain water harvesting.

Wet lands conservation.

Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

## **(22) FINE ARTS**

### **Indian:**

**Pre Historic Age:** Paleolithic, Mesolithic, Neolithic, Important Pre-historic Centres of India.

**Pre Buddha and Buddha Period** – Classical wall Painting: Ajanta, Bagh, Ellora, Sittanvasal, Ajanta.



**The Origin of Miniature Painting and their Main Schools:** Jain, Pala, Apabharansh, Mewar, Kishangarh, Bundi-Kota, Mughal & Pahari School, the Company School of Paintings and their Painters.

**The Renaissance School of Paintings and their Painters:** A. N. Tagore, Nand Lal Bose, K. N. Majumdar, Khastgir, A. K. Haldar etc. New Trends in Modern Indian Painting and their Painters: R. N. Tagore, G. N. Tagore, Jamini Roy, Amrita Shergil, Raja Ravi Verma, Ram Kinkar etc.

**Art Movement of India:** Such as Progressive Art Group, Shilpi Chakra, Samikshavad etc.

**Creative Analyses** of Art and Artist such as Roerich, Souza, Raza, M. F. Hussain, Tayab Mehta, K. S. Kulkarni, Ram Kumar, Manjeet Bava, Swaminathan, G. R. Santosh, Himmat Shah, Jeram Patel, Ramchandran, Bhupen Khakkar, R. S. Bist, M. L. Nagar, A. S. Pawar, Satish Chandra, B. N. Arya, Ram Chandra Shukla etc.

**Aesthetics** - Basic concept of Eastern & Western Aesthetics. Scope of Aesthetics, its relation to Science and Philosophy, Concept of Art and Beauty with special reference to thinkers such as Plato, Aristotle, Baumgarten, Kant, Hegel, Roger Fry, Clive Bell, Tolstoy, Oriental Aesthetics and its scope, basic principles of Indian Philosophy and Religious thought. Theories of Rasa and Rasanispati; Six Limbs of Indian Art, Interrelationship of various Aesthetic concept and their relevance to work of Art.

**Current Trends** – Art and Communication, Art and Tradition, Art and Expression, Art and Religion, Art and Symbolism; Art and Design, Art and Society, Comparative study of Painting, Music and Poetry.

Impact of Industrialisation, Science and Technology on Art.

**Western:**

The Primitive Cave Painting, Egyptian, Greek and Roman Painting

Early Christian and Byzantine Painting, Romanesque and Gothic Painting, Renaissance Painting

**Creative Analyses** of Art and Artist such as Michael Angelo, Raphael, Leonardo-Da- Vinci, Titian and others.

**Creative Analyses** of Art and Artist such as (17th Century Painters) Rembrandt, Rubens, Vermeer, Velazquez and others.

**Creative Analyses** of Art and Artist of England and France; Mannerism, Baroque & Rococo Painting

**Referential** studies of main European Sculptures.

**Comparative Study** of various Stylistic Expressions and his capacity towards an innovative insight into the meaning of style in art history and culture; important movements in paintings and sculpture and sculpture from mid 19th Century to the present day.

Realism, Impressionism, Neo-impressionism and their Painters; Cubin, Expressionism, Surrealism and their Work and Painters, **Contemporary Art Movement** such as Action Painting-Synchronism; Orphism, Raynism, Constructivism, Abstract Expressionism etc.

### **(23) FOOD TECHNOLOGY**

#### **Principles of Food Processing**

Introduction of Food Technology - definition, scope and opportunities. Causes of food spoilage, sources of microbial contamination of foods, food borne illnesses, water activity and its relation to spoilage of food. Spoilage of processed products and their detection. Method of food preservation- heat processing, pasteurization, canning, bottling, drying/dehydration, chilling, freezing, fermentation, irradiation and chemical additives, refrigerated and modified/controlled atmosphere storage, aseptic preservation, hurdle technology, hydrostatic pressure technology, microwave processing etc. Use of nonthermal technologies (micro/ultra filtration, ultra high voltage electric fields, irradiation, thermosonication), alternate-thermal technologies (ohmic heating, dielectric heating, infrared and induction heating). Various unit operations - size reduction, mixing and forming, separation, extrusion, encapsulation. Mass and energy balance in food processing.

#### **Food Chemistry**

Chemistry of water. Classification, structure and properties of carbohydrates, protein & fat. Role of carbohydrates in food industry- sugar, starch, cellulose, glucans, hemicelluloses, gums, pectic substances. Purification and denaturation of proteins. Protein interaction and degradation. Major protein systems and factors affecting them. The nature of proteins derived from milk, egg, meat, oil seed and cereal. Refining of crude oils, hydrogenation and winterization. Vegetable and animal fat, margarine, lard, butter. Frying and shortening. Flavor changes in fats and oils, lipid oxidation, factors affecting lipid oxidation, auto-oxidation, and biological significance of auto-oxidation of lipids. Nature, classification and properties of food enzyme, enzyme activity in different food systems, commercial availability, Immobilization of enzymes, flavor production by enzymes. Role of vitamins and minerals in food industry, effect of various processing treatments and fortification of foods.

#### **Instrumental and Laboratory Techniques**

Concept of molar, molal, normal and buffers solutions, measurement of pH. General principles & types of Chromatographic techniques (partition and adsorption chromatography, paper, thin layer, gas liquid, ion exchange, affinity chromatography, Gel filtration and high pressure liquid chromatography), Electrophoresis techniques (Paper and gel electrophoresis). Spectroscopy- Beers and Lambert's Law. General principles of colorimeters and spectrophotometers, atomic spectroscopy, emission spectroscopy, IR spectroscopy, fluorimetry, flame photometry and atomic absorption spectrophotometry. Use of radioisotopes.

#### **Post Harvest Technology & processing of Fruits and Vegetables**

Post harvest handling, and storage of fresh fruits and vegetables. Maturity standards, pretreatments and pre-packaging, refrigerated storage and transportation. Preparation of fruits and vegetables for processing. Minimally processed products. Containers- Tin, glass and other packaging materials used in fruits and vegetables preservations. Canning and bottling: quality of raw materials, preparation of materials, preparation of syrups and brines, canning and bottling, effect of canning and bottling on nutritive value, spoilage of canned foods, detection and control. Thermal processing - process time evaluation for canned products,

process optimization, aseptic canning, methods for canning of different fruits and vegetables. Dehydration and associated quality changes during drying and storage of hydrated products. Solar drying. Intermediate moisture foods. Preparation and utilization of fruits and vegetables, juice in non-fermented aerated beverages. Chemistry and manufacture of pectin role in gel formation and products like jellies and marmalades. Technology of preserve; pickles, chutneys and sauces. Nature and control of spoilage in these products. By-product utilization of fruits and vegetables processing industry. FPO and related formalities to obtain it. Frozen fruits and vegetables—methods, packaging, storage and thawing. Tomato products—juice, puree, paste, soup, sauce and ketchup. Other convenience foods from fruits and vegetables.

### **Food Microbiology**

Classification and identification of yeasts, molds and groups of bacteria important in food industry. Intrinsic and extrinsic factors influencing growth of microorganisms in foods. Bacterial, yeast and mold cultures (single and mixed cultures), propagation, maintenance and evaluation of cultures; factors affecting the activity of cultures, bacteriophages, residual antibiotics and chemicals. Fermented cereal foods, vinegar, and alcoholic beverages. Spoilage of fresh and processed fruit and vegetables, spoilage of meat, fish, eggs and poultry products. Microbial toxins. Microbial infections and intoxications. Food borne diseases, Investigation and their control.

### **Food Packaging**

Principles in development of protective packaging, terminology, operations, functions. Primary, secondary and tertiary packaging. Different types of paper, paperboard, plastics, cellulose films, metalized films, co-extrusion, lamination, thermo formed semi rigid containers, tin plates, steel, aluminum containers, and glass containers. Material handling, filling, air removal, sealing, retorting, Modified atmosphere packaging, vacuum and gas packaging. Package sterilization techniques, cushioning, unitizing, palletizing, stacking and containerization. Evaluation and testing of Packaging materials. Smart packaging, active packaging, anti-microbial packaging etc.

### **Processing of Cereals, Pulses and Oilseeds**

Structure of different grains like wheat, rice, maize. Milling of Wheat (flour/semolina) and its use in traditional/nontraditional foods like breads, biscuits, cakes, doughnuts, buns, pasta goods, extruded, breakfast and snack foods. Property of dough and its rheology. Milling and parboiling of rice, by-products of rice milling and their utilization. Processed products from rice, pearling, malting, and brewing. Wet and dry milling of corn, manufacture of corn flakes, corn syrup, corn starch, corn steep liquor and germ oil. Structure and composition of pulses and their importance in Indian diet. Milling and processing of pulse - germination, cooking, roasting, drying and fermentation. Protein concentrates and Isolates. Oilseed processing - Production, packaging and storage of vanaspati, peanut butter. Anti-nutritional factors in legumes.

### **Milk and Milk Processing**

Milk processing - Collection, chilling, transportation, cream separation, standardization, pasteurization, sterilization, homogenization, packaging, storage and distribution of fluid milk, ultrahigh temperature processed milk. Preparation of various types of milks - Toned, Double Toned, Sterilized, homogenized, fortified, reconstituted and flavored milk. Principles and practices of manufacturing, packaging and storage of cheese, butter, frozen milk products (Ice-cream, Kulfi), evaporated and dried milk products (Condensed Milk ,SMP, WMP),

fermented milk products (Dahi, cultured butter milk, acidophilus milk etc.) and indigenous milk products ghee, Khoa, Chhena and Milk based foods). Sanitary aspects of dairy plant building, equipment and their maintenance. Dairy by products utilization. Defects and their control found in cheese, butter, frozen milk product, evaporated and dried milk products.

### **Quality control**

Objectives, importance and functions of quality control. Quality systems and tools used for quality assurance including control charts, acceptance and auditing inspections, critical control points, reliability, recall and liability, The principles and practices of food, plant sanitation. Food and hygiene regulations. Codex Alimentarius, GMP/GHP, HACCP, US-FDA, ISO-9000, ISO-22000 ISO-14000, PFA, FPO, BIS, AGMARK, Food adulteration. Sensory evaluation, selection methods. Quality control of food at all stages & for packaging materials. Quality certification.

### **Research Methodology and Statistics**

Meaning of research, significance of research and types of research studies. Research Process, sampling design, scaling techniques, experimental designs, processing of data. Nature of measurements, types of measurement scale, Frequency distribution, graphical presentation of data. Computation of mean, median and mode, their uses. Computation of mean deviations, Quartile deviation and standard deviation, their uses. Regression, Meaning, Spearman and Pearson's techniques of correlation, linear regression, Chi Square, Tests of significance of difference between means t-test, ANOVA.

## **(24) GEOGRAPHY**

**Geomorphology:** Fundamental concepts; Factors controlling landform development; Endogenetic and Exogenetic forces; Denudation process; weathering and erosion, Geosynclines, mountain building, continental drift and plate tectonics; Concept of Geomorphic Cycle; Landforms associated with fluvial, glacial. Arid coastal and karst cycles, Slope forms and processes; Environmental and Applied Geomorphology.

**Climatology:** Composition and structure of the atmosphere, Insulation; Heat budget of the earth; Distribution of temperature, atmospheric pressure and general circulation of winds; Monsoons and jet streams; Stability and instability of the atmosphere; Air– masses; Fronts temperate and tropical cyclones; Types distribution of precipitation; Classification of world climates, Kppen's and Thornthwaite's schemes; Hydrological Cycle; Global warming.

**Oceanography:** Origin of ocean basins; Bottom relief of Indian. Atlantic and Pacific Ocean; Ocean deposits; Coral reefs; Temperature and salinity of the Oceans; Density of sea water; Tides and ocean currents; Sea–level changes.

**Bio–Geography:** Physical factors influencing world distribution of plants and animals; Forms and functions of ecosystem : Forest, grassland, marine and mountain ecosystems; Bio–diversity and its depletion through natural and man induced causes; Conservation and management of ecosystems; Environmental hazards and problems of pollution; Ozone depletion.

**History of Geographic Thought:** General character of Geographic knowledge during the ancient and medieval period; Foundations of Modern Geography: Contribution of German, French, British and American schools; Conceptual and methodological developments during

the 20th century; Changing paradigms; Man and Environment, determinism and possibilism, a real differentiation and spatial organization; Quantitative revolution; Impact of positivism, humanism, radiacalism and behaviouralism in Geography.

**Population Geography:** Nature Scope, subject matter and recent trends; Patterns of world distribution, growth and density of population; Policy issues; Patterns and processes of migration; Demographic transition; Population–resource regions.

**Settlement Geography:** Site, situation, types, size, spacing and internal morphology of rural and urban settlements; Ecological processes of urban growth; Urban fringe; City– region; Settlement systems; Primate city; Rank–Size rule; Settlement hierarchy; Christaller’s Centarl Place theory; August Losch’s theory of market centres.

**Economic Geography:** Location of economic activities and spatial organization of economics.

**Classification of economics:** Sectors of Economy: primary, secondary, tertiary and quaternary; Natural resources: Renewable and non–renewable; Conservation of resources.

**Agricultural Geography:** Concept and techniques of delimitation of cultural regions; Measurement of agricultural productivity and efficiency; Crop combinations and diversification; Von Thumen’s Model; Agricultural systems of the world.

**Industrial Geography:** Classification of industries: Weber’s and Losch’s approaches; Resource based and footloose industries.

**Geography of Transport and Trade:** Models of transportation and transport cost; Accessibility and connectivity: Inter–regional and Intra–regional: Comparative cost advantages.

**Political Geography:** Definition and scope of Political Geography; Geopolitics; Global strategic views’ (Heartland and Rimland theories); concept of nation, state and Nation– State; Boundaries and frontiers; Politics of world resources; Geography and Federalism.

**Social Geography:** Nature and scope of social geography; Social structure and social processes; Elements of Social Geography ethnicity, tribe, dialect, language, caste and religion; Concept of Social well–being.

**Cultural Geography:** Nature and scope of Cultural Geography; Environment and culture; Concept of culture–areas and cultural regions; Theories of tribal groups; Dwelling places as cultural expressions.

**Regional Planning:** Regional concept in Geography; its application to planning; Concept of planning region; Regional hierarchy; Types of regions and methods of regional delineation; Conceptual and theoretical framework of regional planning; Regional planning in India: Concept of development; Indicators of development; Regional Imbalances.

**Geography of India:** Physiographic divisions; Climate: Its regional variations; vegetation types and vegetation regions; Major soil types; Coastal and Marine resources; Water resources; Irrigation; agriculture; Agro climatic regions; Mineral and power resources; Major

industries and industrial regions; Population distribution and growth; Settlement patterns; Regional disparities in social and economic development.

**Cartography:** Map as a tool in Geographical studies; Types of maps; Techniques of the study of spatial patterns of distribution; Single purpose and composite maps; Choropleth Isopleths and Chorochromatic maps and pie diagrams; Mapping of location specific data; Accessibility and flow maps. Remote sensing and computer application in mapping; Digital mapping; Geographic Information System (GIS): Thematic maps

**Statistical Methods:** Data sources and types of data: Statistical diagrams; study of frequency distribution and cumulative frequency; Measures of central tendency, Selection of class intervals for mapping; Measures of dispersion and concentration; Standard deviation; Lorenz curve; Methods of measuring association among different attributes Simple and multiple correlation;

Regression. Measurement of spatial patterns of distribution; Nearest-neighbour-analysis; Scaling techniques, rank score, weighted score; Sampling technique for geographical analysis.

## (25) HINDI

हिन्दी (पाठ्यक्रम)

1. हिन्दी भाषा और साहित्य और इतिहास

(क) हिन्दी भाषा का इतिहास

1. अपभ्रंश अवहट्ट पुरानी हिन्दी का स्वरूप और भाषिक विशेषताएँ।
2. आधुनिक आर्यभाषाओं में हिन्दी का स्थान
3. हिन्दी की उपभाषाएँ— राजस्थानी, पहाड़ीएँ पश्चिमी हिन्दी, पूर्वी हिन्दी, आदि का संक्षिप्त परिचय।
4. हिन्दी प्रमुख बोलियाँ— अवधी, ब्रज, खड़ीबोली, भाषिक, परिचय एवं काव्यभाषा के रूप में।
5. हिन्दी के विविध रूप— संपर्क भाषा, राजभाषा, राष्ट्र भाषा
6. देवनागरी लिपि, इतिहास एवं विशेषताएँ
7. कम्प्यूटर और हिन्दी

विकास

(ख) साहित्य का इतिहास :

1. प्रमुख साहित्येतिहासकारों की इतिहास दृष्टि
2. काल के विभाजन का आधार
3. आदिकालीन हिन्दी साहित्य की सांस्कृतिक प्रवृत्तियाँ, लौकिक एवं धार्मिक काव्य
4. भक्ति काल— भक्ति आन्दोलन का समाजशास्त्रीय आधार
5. निर्गुण एवं सगुण भक्ति: काव्य साम्य—वैषम्य
6. निर्गुण काव्य— सन्त काव्य, सूफी प्रेमाख्यानक काव्य— विशेषताएँ एवं सांस्कृतिक प्रदेय, सगुण भक्ति काव्य, राम भक्ति काव्य, कृष्ण भक्ति काव्य, भक्ति काव्य और सामाजिक समन्वय भक्ति काव्य और लोकभाषा
7. आधुनिक काल— आधुनिकता का तात्पर्य, भारतेन्दु युग, द्विवेदी युग, छायावाद, छायावादोत्तर, प्रगतिवाद, प्रयोगवाद, नई कविता आदि की साहित्यिक प्रवृत्तियाँ एवं उपलब्धियाँ।
8. रीतिकाव्य— रितिबद्ध, रितिसिद्ध एवं रीति युक्त काव्य, रीतिकालीन सर्जनात्मक परिवेश, रीतिकाव्य की उपलब्धियाँ एवं सीमाएँ। रीतिकालीन विविध काव्य प्रवृत्तियाँ।
9. गद्य की विधाओं का विकास— निबंध, कहानी, उपन्यास, नाटक, आलोचना, संस्मरण, आत्मकथा आदि।

2. निम्नलिखित रचनाकारों की काव्यगत विशेषताएँ एवं साहित्यिक प्रदेय  
सरहपा, अमीर खुसरो, विद्यापति, कबीर, रैदास, नानक, जायसी, तुलसी, सूरदास, केशवदास, घनानन्द, बिहारी, भारतेन्दु, मैथलीशरणगुप्त, प्रसाद, निराला, महीदेवी, पंत, दिनकर, नागार्जुन, अज्ञेय, मुक्तिबोध, सर्वेश्वर दयाल, रघुवीर सहाय, नरेश मेहता, अशोक बवजपेयी, धूमिल, शमशेर बहादुर, अरुण कमल, राजेश जोशी आदि।
3. निम्नलिखित रचनाओं की व्याख्या तथा आलोचना:  
  1. कबीर गंथावली, श्यामसुन्दर दास आरम्भ से 30 पद, साखी-सतगुरु कौ अंग, सुमिरन भजन कौ अंग, परचा कौ अंग, विरह कौ अंग
  2. जायसी कृत पद्मावत- सिंहल दीप, मानसरोवर एवं नागमती विरह वर्णन
  3. सूरदास- भ्रमरगीत, आरमी से 50 पद
  4. तुलसीदास- रामचरीतमानस, उत्तरकाण्ड
  5. बिहार- बिहारी सतसई के आरम्भिक 150 दोहे(पाठ बिहारी रत्नाकर)
  6. निराला- राम की शक्ति पूजा, सरोज समृति, अधिवास कुकुरमुत्ता, वह तोड़ती पत्थर
  7. प्रसाद- कामायनी: चिन्ता, श्रद्धा, इडा
  8. नरेश मेहता- संशय की रात
  9. मुक्तिबोध- ब्रह्मराक्षस
  10. धूमिल- पटकथा
  11. प्रेमचंद- गोदान
  12. फणीश्वरनाथ रेणु- मैलस आँचल
  13. भारतेन्दु- भारत दशा
  14. प्रसाद- स्कन्द गुप्त, ध्रुवस्वामिनी
  15. मोहन राकेश- आषढ का एक दिन

#### साहित्यशास्त्र एवं आलोचना भारतीय काव्यशास्त्र के विभिन्न सम्प्रदाय

रस, ध्वनि, वक्रोक्ति, अलंकार, औचित्य हिन्दी के प्रमुख आचार्य एवं उनका प्रदेय- अरस्तू का विरेचन सिद्धान्त, अनुकरण ट्रैजिडी।

#### स्वच्छन्दतावादी आलोचना के प्रतिमान-

क्रोचे की सौन्दर्य दृष्टि तथा काव्य दृष्टि, नई समीक्षा, समकालीन आलोचना उनके सिद्धान्त- रोलावार्थ, देरिदा, संरचना, पाठ और विच्छेद, विमर्श केन्द्रित आलोचना- स्त्री विमर्श, दलित विमर्श, संस्कृति विमर्श, हिन्दी आलेचना की आलेचना दृष्टि- बालकृष्ण भट्ट, महावीरप्रसाद द्विवेदी, रामचन्द्र शुक्ल, हजारी प्रसाद द्विवेदी, नन्द दुलारे बाजपेयी, नगेन्द्र, रामविलास शर्मा, नामवर सिंह, रामस्वरूप चतुर्वेदी

## (26) HISTORY (MEDIEVAL & MODERN)

### Medieval & Modern Indian History: Concepts, Ideas And Terms

Khilafat	Pargana	Federalism
Sulah-i-kul	Communalism	Sarraf
Maharashtra-dharma	Bengal Vaishnavism	Utilitarianism
Turkan-i-Chahlgani	Orientalism	Polygars
Watan	Alt magha	Filtration Theory
Baluta	De-industrialization	Jagir
Iqta	Sbahna-i-Mandi	Forward Policy
Jizyah	Subsidiary Alliance	Dastur
Madad-i-maash	Mercantilism	Doctrine of Lapse

Amaram	Evangelicalism	Mansab (Rank)
Raya–Rekho	Economic Nationalism	Satyagraha
Jangama	Bhudan	Deshmukh
Chauth	Indian Renaissance	Swadeshi
Dyarchy	Panchsheel	Nadu
Hundi (Bills of Exchange)	Economic Drain	Revivalism
Colonialism	Mixed Economy	Indian Left
Paramountcy	Hindu Code	Bill

### **India from 1206 to 1526**

Expansion and Consolidation – The Ghoris. The Turks, The Khiljis, The Tughlaqs, The Sayyids and the Lodis.

Vijayanagar and Bahamani Kingdoms.

State and Religion–Concept of sovereignty, Religious movements and Sufism.

Economic Aspect–Urban Centers, Industries, Trade and Commerce, Land Revenue and Prices.

Mongol problem and its impact.

Administrative structure.

Art, Architecture and Literature.

Source – Archaeological, Persian, and non–Persian Literature, Foreign travelers' account.

### **India from 1526 onward**

Sources of Mughal period

Mughal Expansion and Consolidation – Babur's establishment of Mughal rule in India; Humayun and Surs; Akbar, Jahangir, Shahjahan and Aurangzeb.

Mughal relations with the nobility and the Rajputs.

Jahangir – the period of stability and expansion 1611–1621; the period of crises 1622–1627 – The Nurjahan Junta.

Decline of Mughal Empire: Political, administrative and economic causes.

The Maratha Movement the foundation of Swarajya by Shivaji – its expansion and administration, Maratha Confederacy and causes of decline.

Administration: Sher Shah's administrative reforms, Mughal administration, land revenue and other source of income, Mansabdari and Jagirdari.

### **Socio-economic and cultural life under the Mughals**

Village Society and Economy

Art, Architecture and Literature

Trade and Commerce.

Religious Policy from Akbar to Aurangzeb

Urban Centers and Industries

Currency

Position of Women

### **Foundation of the British Rule**

Rise of European Power – Expansion and Consolidation of the British Rule.

British relations with major Indian powers – Bengal, Oudh, Hyderabad, Mysore, Marathas and Sikhs.

Administration, under the East India Company and Crown, Paramountcy, Civil Service, Judiciary, Police and Army.



Local Self–Government, Constitutional Development from 1909 to 1935.

### **Economic and Social Policies**

Agrarian policy of the British, Land Revenue, Agriculture and Land Rights, Famine Policy, Rural Indebtedness.

Policy towards trade, and Industries, Condition of Labour, Trade Union Movements, Factory Legislation, Banking, Transport, Drain Theory.

Indian Society in transition, Christian missions, Socio–religious reform movements, status of women.

New Educational Policy, English Language, Modern Sciences, Journalism, Indian languages and Literature.

### **National Movement and Post–Independent India**

Rise of nationalism. Revolt of 1857. Tribal and Peasant Movements. Ideologies and Programmes of Indian National Congress. Swadeshi Movement. Indian Revolutionary Movement in India and abroad.

Gandhian Mass Movements. Ideologies and Programmes of the Justice Party; Left wing politics, Movement of the depressed classes, Genesis of Pakistan, India towards Independence and Partition. India after Independence, Rehabilitation after partition, Integration of Indian States, the Kashmir Question.

Making of the Indian Constitution, Structure of Bureaucracy and the police, Economic policies and the planning process, Linguistic reorganization of the States. Foreign policy initiatives

### **World History: Concepts, Ideas and Terms**

Pre-History	Manorial System	Slavery
Humanism	Darwinism	Nation States
Burial Practices	Black Death	Aristocracy
Enlightened Despotism	Great Depression (1929)	Renaissance
Mother-Goddess	Feudalism	Confucianism
Divine Right	Feminism	Reformation
Law codes	Non-alignment	Slavery
Supremacy of Church	Parliamentary Democracy	Nation States
Athenian Democracy	Nazism	Aristocracy
Holy Roman Empire	Commonwealth	Renaissance
Imperial Rome	Imperialism	Confucianism
Social Contract and General will	Socialism	Reformation
Apartheid	Balance of power	Manorial System
Right of Man	Cold	War
Apartheid	Post-modernism	

### **Research in History**

Scope and Importance of History

Objectivity and Bias in History

Causation in History

History and its auxiliary science

Significance of Regional History

Recent trends of Indian History

Research Methodology

Area of Proposed Research

Sources – Primary / Secondary in the Proposed area of Research.

Recent Historical writings in the proposed area of Research.

## **(27) HOME SCIENCE**

### **Unit-I Food Science**

Food groups

Food preparation

Food preservation

Food Science and Food Analysis

Food Processing

### **Unit-II Nutrition Science**

Fundamentals of Nutrition

Nutritional Biochemistry

Food Microbiology

Public Nutrition

Therapeutic Nutrition

### **Unit III Clothing**

Principles of Clothing- Socio- psychological aspects of clothing, selection of fabric and family clothing

Clothing construction- Basic principles of drafting, flat pattern and drape methods

Textile design- Principles and concept

Fashion Design- fashion cycle, business and merchandizing

Care and maintenance of textiles

Laundry agents- method and equipments

### **Unit IV Textiles**

General properties of all textile fibers

Processing and manufacturing of all natural and man made fibers

Definition and classification of all natural and man made fibers

Fabric construction, definition and types of woven nonwoven knitted and other construction techniques

Testing of fibers, yarns and fabric: importance of quality control and research institutes,

### **Unit-V Human development**

Child development- Principles and stages

Life span development- theories of human development and behavior, child rearing, socialization practices and dynamics

Early childhood care and education- emerging trends

Development problems and disabilities during childhood and adolescence, guidance and counselling

Advance child study method and assessment

Womens studies, family Welfare program- recent approaches

**Unit- VI Research methods**

Trends in research in Home Science

Research Design

Types of Research

Sampling Techniques

Selection and preparation of Tools for data collection

Types of variables and their selection

Data collection and classification/ coding

Analysis of data through parametric and non parametric statistics

Report writing- presentation of data, interpretation and discussion

Research problem- Design and methodology

Teaching methods and aids

Food Science- cereals, pulses, milk and milk product, fruit and vegetables

Therapeutic Nutrition

Food preservation and processing

Macro and micro nutrients

Fortification, fermentation, supplementation and germination of food.

Child and Human development

Human development- rights and perspective

Principles and theory of human development

Early child hood care and development- strategies, monitoring and supervision

Children with special needs

Intervention programmes

Socialization in various family contexts across the globe

Clothing and textiles

Textile chemistry

Dyeing and printing

Textile and apparel Industry- fundamentals of business, specification quality control agencies and marketing

Traditional textiles

Textile testing

Entrepreneurial competency

**(28) LAW**

**PAPER – II**

**1. Constitutional Law of India**

Preamble

Essential Features of Indian Constitution

Distribution of Legislative Powers between Union and States

Fundamental Rights, Fundamental Duties and Directive Principles of State Policy

Judiciary

Parliament and State Legislatures

Amending Process of the Constitution

Emergency Provisions

Executive

Writ Jurisdiction

**2. Jurisprudence**

- Schools of Law
- Legal Personality
- Theories of Punishment
- Rights and Duties
- Concept of Possession and Ownership
- Sources of Law
- Judicial Contribution in Bringing Social Changes
- Law and Morality

**3. Law of Contract**

- Essentials of a contract
- Offer, acceptance and consideration
- Capacity to Contract – Minor's agreement
- Elements vitiating contract – mistake, fraud, misrepresentation, public policy, coercion, undue influence
- Void Agreements
- Mode of Discharge of a Contract – Specific performance, Frustration of contract, Novation of contract, Breach of contract including anticipatory breach
- Contingent contract, Quasi Contract
- Remedies for breach of contract – Damages
- Contract of Indemnity & Guarantee
- Contract of bailment, Pledge and agency

**4. Law of Crimes**

- Nature and Definition of Crime
- General Exceptions
- Common Intention and Common Object
- Criminal Attempt, Conspiracy and Abetment
- Offences against Human Body
- Offences against Property
- Defamation

**5. Partnership & Sales of Goods**

- Partnership Act – Nature and essentials of partnership, mutual rights and liabilities of partners, advantage of registration of firms
- Sales of Goods Act
- Limited Liability Partnership

**6. Public International Law**

- Nature of International Law and its relationship with Municipal Law
- Sources of International Law
- Recognition of States and Governments
- United Nations
- Settlement of International Disputes
- Human Rights

**7. Environmental Law**

Environmental Pollution – Meaning of Environment and Environmental Pollution;  
Kinds of Pollution  
Legislative Measures for Prevention and Control of Environmental Pollution in India – Air and Water Pollution and General Protection of Environment  
International Development for protection of Environmental Pollution  
Remedies for Environmental Protection – Civil, Criminal and Constitutional  
Environmental impact assessment and control of Hazardous wastes

## 8. Law of Tort

Meaning, Nature & Elements of Tort, Difference between, Tort & contract, Tort & Crime, Tort & Quasi Contract  
Ubi Jus Ubi Remedium, Injuria Sine Damno, Damnum Sine Injuria  
General Defences to an action of Tort  
Remoteness of Damage  
Vicarious Liability  
Absolute and Strict Liability  
Contributory Negligence  
General Principles of Tortious Liability  
Specific Torts – Negligence, Nuisance and Defamation  
Absolute Liability – Emerging trends in India  
Redressal of Consumer Grievances

## 9. Family Law (Hindu Law & Muslim Law)

Sources of Family Law in India  
Marriage and Dissolution of Marriage  
Maintenance  
Adoption and Guardianship  
Matrimonial Remedies  
Uniform Civil Code

## (29) MATERIALS SCIENCE

Postulates of quantum mechanics, Particle in a Box, Harmonic Oscillator, Hydrogen atom, Operators, Angular momentum.

Helmholtz and Gibbs free energies, Maxwell's relations and applications, Micro-canonical, Canonical and Grand Canonical ensembles, Maxwell, Boltzmann, Bose- Einstein and Fermi- Dirac statistics, First and second order phase transformations. Symmetry operations and symmetry elements, Reciprocal lattice, Atomic scattering factor, Point group symmetry, Space group, Miller indices of planes and directions, Generation and properties of X-ray.

Types of bonding, Lattice energy, Vibration of crystal with mono-atomic and diatomic lattices, Phonon momentum, Energy level in one dimension, Electrical conductivity and Ohms law, Motion of electron in magnetic field, Hall effect. Nearly free electron model, Bloch function, Kronig Penny model, Formation of energy bands and gaps, Brillouin zones and boundaries, Number of orbital in a band, Insulators, Conductors, Semiconductors and Semimetals.

Dielectric constant and polarizability, Clausius-Mossatti equation, Ferro-electricity, Types and models of ferro-electric transition, Piezo-electric and Pyro-electric materials.

Mechanical tests, Stress and strain, Tensile, Shear, Hardness, Reflection, refraction, Absorption and transmission of electromagnetic radiation in solids, Luminescence, Photoconductivity.

Dia, Para, Ferro, Anti-ferro and Ferri-magnetism, Langevin and Weiss theories, Quantum theory of diamagnetism, Para-magnetism, Hund's rule, Magnetic anisotropy, Magnetic order, Hysteresis, Hard and soft magnetic materials, Superconductivity, Meissner effect, Type I and Type II superconductors, Cooper pairs and BCS theory

**Option**

Electronic, Rotational and Vibrational spectra, Raman Spectra, Selection Rules, Basic Principles of Nuclear magnetic resonance.

Main group elements and their compounds: General characteristics, allotropes, structure and properties.

Transition elements and coordination compounds: Structure, isomerism, spectral and magnetic properties, valence bond, MO and Crystal field theories.

Inner Transition elements: General, spectral and magnetic properties.

Intermediates and Organic Reaction Mechanisms: Carbocations, carbanions, free radicals, carbenes, benzyne and nitrenes; Addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species.

Stereochemistry: D-L and R-S Nomenclature, Stereoisomers, Stereochemistry of C, N, S and Phosphorous compounds.

Organic Synthesis and reactions: Alkanes, alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines, Important name reactions, Rearrangements.

Laws of photochemistry, photochemical reactions, Photo physical phenomenon, photooxidation, photo-reduction and photosynthesis.

Spectroscopic Techniques and its applications: UV- visible, IR, NMR, Raman, ESR, Mossbauer, electro-analytical techniques.

Electrochemistry: Electrolysis Debye-Huckel theory, Nernst equation, determination of E.M.F. of cell, electrochemical cells, concentration cells, acid and base concept.

Nernst equation, redox systems, electrochemical cells, Debye-Huckel theory, electrolytic conductance, ionic equilibria, conductometric and potentiometric titrations.

**(30) MATHEMATICS**

**Algebra:** Basic theory of Groups, Permutation groups (Symmetric and Dihedral groups); Group actions, Class equation, Sylow Theorems and their applications; Euclidean domains, Principal ideal domains and Unique factorization domains; Fields, Finite fields.

**Linear Algebra:** Finite dimensional vector spaces; Linear transformations and their matrix representations, Systems of linear equations, Eigenvalues and Eigenvectors, Characteristic and Minimal polynomials, Diagonalization, Inner product spaces, Gram- Schmidt orthonormalization process, Modules over rings, Exact sequences, Hom functor, Projective and Injective Modules.

**Real Analysis:** Limit, Continuity and Differentiability of functions of one and several real variables; Convergence of sequences and series of constants; Uniform convergence of sequence and series of functions, power series, Fourier Series; Riemann's theory of integration, Multiple integrals, line surface and volume integrals, Theorems of Green, Stokes and Gauss; Lebesgue measure, Measurable functions; Lebesgue integral, Fatou's lemma, Dominated convergence theorem.

**Complex Analysis:** Analytic functions, conformal mappings, bilinear transformations; complex integration: Cauchy's integral theorem and formula; Liouville's theorem, Maximum modulus principle; Taylor and Laurent's series; Residue theorem and applications for evaluating real integrals.

**Topology:** Basic concepts of topological spaces including metric spaces, product and quotient topology, Connectedness, Compactness, countability and separation axioms; Homotopy of maps, Fundamentals groups.

**Differential Equations:** Ordinary and Partial differential equations of first and second order, Solution techniques, Existence theory for Ordinary differential equations; Laplace transforms, Power series methods: Legendre and Bessel functions; Calculus of variations and Linear integral equations.

**Functional Analysis:** Banach spaces, Hahn-Banach extension theorem, Open mapping and Closed graph theorems, Principle of Uniform Boundedness, Weak topology; Hilbert spaces, orthonormal bases, Riesz Representation Theorem, Self-adjoint and Normal operators.

**Mechanics:** Lagrange's and Hamiltonian equations of Motion, Euler's dynamical Equations, Contact transformations, Poisson's brackets; Equation of Fluid Motion and Equation of Continuity.

**Operation Research:** Linear Programming Problem, Convex sets, Simplex Method, Transportation Problems, Assignment Problems, Game Theory.

**Differential Geometry:** Elementary theory of curves and surfaces in Euclidean 3-space; differentiable Manifolds, Tensors.

### (31) MUSIC AND PERFORMING ARTS

#### Technical – Terminology

Nada, Shruti, Swara, Grama–Moorchana, Jati, Raga, Tala Tan, Gamak, Gandharva–Gaan, Marga–Deshi, Giti, Gaan, Varna, Alankar, Melody, Harmony, Musical Scales, Musical intervals, Consonance–Dissonance Harmonics, Western and South Indian terminology and their explanation, Staff Notation, Drone, Alpatva–Bahutva Abirbhav–Tirobhav, Uthan, Peshkar, Kayda, Rela, Rang; Laggi, Ladi, Farshbandi, Tala, Laya, Matra, Avartan, Vibhag, Sashabda, Kriya, Nishadba, Kriya, Theka, Saral Gat, Adi Gat, Chakradar Gat, Farmaishi Gat and other variety of Gats and Kayadas, Upanga, Bhashanga, Gita, Kriti, Kirtana, Jatiswara, Pada, Swarjati, Ragmalika, Tillana, Nyasa, Amsa, Prasa, Yati, Anuprasa, Alapana, Neraval, Sangati and other terms, Gitinatya, Nritya–natya, Baitalik Varsha–Mangal, Vasantotsav, Gita–Bitana, Swara–Bitan Akarmatrik notation.

#### Applied Theory

Detailed and critical study of Rags, Changing form of Ragas classification of Ragas, i.e. Grama Raga vargikaran, Mela Raga Vargikaran, Raga-Ragini Vargikaran. Thata Raga Vargikaran, and Raganga Vargikaran, time–theory of Ragas, Application of melody and harmony in Indian Music, Chords and its various kinds. Placement of shuddha and Vikrit Swaras on Shruties in ancient, medieval and modern period.

Detailed knowledge of prevalent talas of Hindustani music, knowledge of tala Dashpranas and Marga and Deshi talas of ancient period, comparative study of Hindustani and Karnatak tala system with special reference to ten pranas of tala, detailed study of different layakarīs viz, Dugun, Tigon, Chaugun, Ada, Kuada, Viyada and method to apply them in compositions.

Tagore's treatment of Hindustani ragas and raginis, elements of Hindustani classical music Karnatak music, Western music from other provinces, folk music and Kirtan of Bengal and their influence of Tagore's treatment of raga.

#### Compositional forms and their Evolution

Prabandha, Drupad, Khyal, Dhamar, Thumri, Tappa, Tarana, Chaturang, Trivat, Vrindagana, Vrinda Vadan, Javeli, Kriti, Tillana, Alap, Varnam (Pad Varnam and Tana Varnam), Padam Ragam, Tanam, Pallavi, Gita, Varna, Swarajati, Kalpita, Sangita, Ragamalika, Swara Kalpana (Manodharma Sangeet),

### **Main forms of Rabindra Sangeet**

#### **History of Music of Bengal.**

#### **Gharanedar Gayakri**

Origin and development of Gharanas in Hindustani music and their contribution in preserving and promoting traditional Hindustani classical music. Merits and demerits of Gharana system. Origin and Development of Gharanas in Instrumental music and Percussion and their contribution in promoting traditional Indian Classical music, merits and demerits of Gharana system. Study of traditions and specialties of different gharanas in vocal, instrumental and percussion group. Desirability and possibility of gharanas in contemporary music. Guru shishya parampara and different styles of singing and playing in Hindustani and Karnatak Music.

An overall survey of Rabindra Nath Tagore's musical creativity, tonal and rhythmic varieties of Tagore's musical compositions including his own experimental variations. Periods and phases of Tagore's musical compositions.

The Cultural atmosphere of Tagore's family (Pathuriaghata and Jorasanko, Calcutta). Thematic variations of Tagore's Music: (Puja, Swadesh, Prem, Prakriti, Vichitra, Anusthanik)

#### **Contribution of Scholars to Indian Music and their textual tradition**

Narad, Bharat, Dattil, Matanga, Sharangadeva, Nanyadeva and others. Lochan, Ramamatya, Pundarik Vitthal, Somnath, Damodar Mishra, Ahobal, Hridaya Narain Deva, Vynkatmakhi, Srinivas, Pt. Bhatkhande, Pt. V.D.P. Paluskar, Pt. Omkarnath Thakur, K.C.D. Brahaspati, and others.

Study of ancient, medieval and modern treatises in Percussion instruments like Bharat Natyashastra, Sangeet Samaysar, Radha Govind Sangit Sar, Madrul Mosiqui, Sangeet Shastra, Bhartiya Sangeet Mei Taal aur Roop. Abhinav Tala Manjari, and other treatises. Contribution of various Scholars to percussion instruments like Kudau Singh Bhagwan Das, Raja Chatrapati Singh, Anokhe Lal Ahmadjan Thirakwa, Shamta Prasad, Kishan Maharaj and others in ancient, medieval and modern period.

Tagore's Musical dramas (gitinatyas) and dance-dramas. (nrityanatyas); e.g., Valmiki Pratibha, Kalmrigaya, Mayur Khela, Chitranganda, Chanadlika, Shyama and other dramas full of various songs, i.e., dramas like Prayaschitta, Visarjan, Saradotsava, Raja, Phalguni, Taser Desh, Vasanta etc. Tagore's musical creativity in Gitabitan, Part I, II, III Swarabitan (notation books) Part I-63, Sangeet-China (Vishwa-Bharti).

Contribution of prominent Karnatak Scholars, composers and performers of medieval and modern period such as Ramamatya, Vyankatmakhi, Tyagraja, Muttu-Swami Dikshitara, Shyama Sastri, Gopal Krishna Bharat, Prof. Sambamoorti, Papanasam Shiv an, Vasantha Kumari, Subbulakshmi, Ramari, T.N. Krishnan and others.

### **Historical Perspective of Music**



A study of the historical development of Hindustani music (Vocal, Instrumental, Percussion), Karnatak Music and Rabindra Sangeet in ancient, medieval and modern period.  
Contribution of Western Scholars to Indian Music.

### **Aesthetics**

Its origin, expression and appreciation: Principle of aesthetics and its relation to Indian Music, Rasa theory and its application to Indian Music.

Relationship of Musical aesthetics and Rasa to Hindustani Music (Vocal, Instrumental and Percussion), Karnatak Music and Rabindra Sangeet. Four aspects of Rasa Theory, Relation of Raga and Seasons, Bandish (composition) Kaku Bhed, Kala and its vargikaran.

Interrelationship of Fine arts with special reference to Rag–Ragini Paintings, Dhyān of Ragas and other, Bibliography of Rabindra Nath Tagore

### **Music Teaching and Research technologies**

Guru Shishya Parampara, Sangeet–Sampradaya Pradarsini and institutional system of music teaching with reference to Hindustani, Karnatak music and Rabindra Sangeet, Aims and objectives of Higher Education, Aspects of music Education.

Utility of teaching aids like electronic equipments in music education with reference to Hindustani, Karnatak music and Rabindra Sangeet.

- (01) The methodologies of music research, preparing synopsis, data collection, field work, writing project reports, finding bibliography, reference material etc. With reference to Hindustani, Karnatak music and Rabindra Sangeet.

Study of interrelation between textual and oral tradition.

Contemporary Trends of Indian Music, Music Therapy, Distance Education of Music, Temple Music (Haveli Sangeet), Musicology and its vocational scope.

### **Folk Music**

Influence of folk music on Indian Classical Music, stylization of folk melodies into ragas, Popular folk tunes and folk dances of Hindustani, Karnatak and: Rabindra Sangeet, such as Baul, Bhatiyali, Lavani, Garba, Kajri, Chaity, Maand, Bhangra, Gidda, Jhoomar, Swang, Pandawani, Amar–Praner Manush, Acchhe Prane, Amar Sonar Bangla, Kirtan, Rai–Sera Jhumar, Karakattam, Kavadi Attam. Villuppattu, Maiyandi Melam and other prominent folk forms.

Analysis of the elements of Hindustani folk music, Karnatak folk music or Indian folk music and Rabindra folk Sangeet or folk music of Bengal and the elements regarding their interrelationship.

General study of the folk music of various regions of India like Uttar Pradesh, Rajasthan, Haryana, Punjab, Maharashtra, Bengal and South India.

### **Instruments / Dance**

Origin, evolution, structure of various instruments and their well-known exponents of Hindustani (Vocal Instruments and Percussion), Karnatak Music and Rabindra Sangeet. Importance of Tanpura and its Harmonics.

Classification of Instruments of Hindustani, Karnatak Music in ancient, medieval and modern period. Popular instrument used in Rabindra Sangeet.

Elementary knowledge of Indian dances like kathak, Bharatnatyam, Kuchipudi, Oddissi, Kathakali etc.

### **(32) NUTRITIONAL SCIENCE**

Chemistry of Macronutrients, Introduction to metabolism: Catabolism and anabolism, Role of enzymes in metabolism, Carbohydrate metabolism: Energy from dietary carbohydrate through Glycolysis, Tricarboxylic Acid cycle, Utilization of glycogen, Gluconeogenesis, Significance of Pentose phosphate pathway and glucuronic acid pathway, Photosynthesis, Utilization and storage of dietary carbohydrates. Lipid metabolism: Introduction to Lipids as energy sources,  $\beta$  oxidation, Biosynthesis of fatty acids. Utilization and storage of body fat. Protein Metabolism: transamination and deamination, essential and non-essential amino acids, nitrogen excretion and the urea cycle. Biosynthesis of some important nitrogen compounds, amino acid oxidation, Body protein synthesis and breakdown. Electron transport chain and oxidative phosphorylation, Formation of ATP. Integration of biochemical pathways, Overview of Food to Energy conversion, Hormones as regulators of biochemical pathways

#### **Normal Human Nutrition**

Body composition, Energy Requirements, Basal Metabolic requirements, activity, growth. Measurement Recommended allowances, Critical evaluation of Recommended Dietary Allowances Food Groups, Balanced diet. Nutritional Assessment and Methods of identification of Nutritional Problems Types, Functions, Dietary sources, Requirements and Storage of Carbohydrates, proteins, fats, vitamins, minerals, fibre and water in human body, Regulation of food intake, nitrogen balance, protein quality, amino acid requirements and amino acid imbalance Nutrient adaptation to low intake of energy and protein Inter-relationship between vitamins, minerals and hormones.

#### **Human Physiology**

**Physiological Principles:** Cell structure and function, body fluid compartments, transport mechanisms, homeostasis and feedback control systems. General organization of the **Nervous system:** Sensory and motor nerves, major levels of nervous system function, Central and autonomic nervous systems, transmission of nerve impulse, synapse, neurotransmitters. Digestion and absorption in the gastrointestinal tract: digestion and absorption of carbohydrates, fats and proteins, Gastrointestinal hormones. Blood: Composition of blood, functions of blood constituents, hemostasis, blood transfusion and tissue transplant.

**Circulatory system:** Pumping of heart, Cardiac cycle, ECG, Blood pressure. The immune response: Humoral, cell-mediated. Factors affecting vaccinations Regulation of acid-base balance: Role of buffers in blood, respiratory control, renal controls.

**Transport and exchange of respiratory gases:** oxygen and carbon dioxide

**Urine formation:** Principles. Effect on body fluids.

**Elements of Reproductive physiology:** Sex hormones. Breast milk production and its role in contraception.

**Principles of endocrinology :** Chemical control of metabolism. Adrenaline. Thyroid hormones. Control of water and electrolyte metabolism. Calcium metabolism. Prostaglandins. Endorphins and enkephalins. Renin-angiotensin system.

### **Dietetics and Therapeutic Nutrition**

Nutritional requirements during : Pregnancy, lactation, Infancy, Childhood, Adolescence, Geriatric group, laborers and athletes.

Nutrition for weight management: Underweight, Overweight and obesity.

Therapeutic nutrition- Its importance and scope: Therapeutic adaptation of normal diets, Dietary Modifications- soft diets, liquid diets, enteral and total parenteral nutrition, other therapeutic diets.

Etiology, metabolic aberrations, clinical manifestations, complications, dietary management and counseling for: Febrile conditions such as viral fevers, typhoid and tuberculosis. Gastrointestinal diseases such as diarrhoea, constipation, flatulence, peptic ulcer. Malabsorption syndromes: Colic disease, tropical sprue. Lactose intolerance. Diabetes: NIDDM, IDDM, Cardiovascular diseases: atherosclerosis, hyperlipoproteinemia, congestive heart failure, myocardial infarction, hypertension. Renal diseases: nephrotic syndrome, acute glomerulonephritis, acute renal failure,

chronic renal failure. Biliary diseases: of the liver: hepatitis, cirrhosis. hepatic coma, of gallbladder: gall stones/cholelithiasis, of the pancreas: pancreatitis.

### **Community Health and Nutrition**

Concept of community. Community development. Social and cultural perspectives in relation to food preferences and health.

Nutritional epidemiology: Birth rates, mortality rates, morbidity, natality, parity, sex ratio, life expectancy etc., Demographic data. Case control and Cohort studies. Developmental milestones. Gomez and Waterlow classifications of growth. Standard norms for evaluation of growth. Growth charts. Vulnerable or at-risk groups. Nutritional problems of the Indian community: Etiology, Government intervention /combat strategies for: Low birth weight infants, protein-energy malnutrition, kwashiorkor and marasmus. Vitamin A deficiency, Nutritional anemia, Iodine deficiency disorders, Endemic fluorosis, Lathyrism.

Community Nutrition Services: Role of National Nutrition Monitoring Bureau, National Sample Survey in assessment of geographical distribution of dietary patterns in India. National and International Services. Immunization and Supplementary feeding programs.

Nutrition Education: Objectives. Channels, Methods and Evaluation of Communication.

Food Production in relation to needs of the country. Food security. Food economics. Food surveillance: Food hygiene. Food adulteration and Food Toxins. Epidemic dropsy, botulism, ergotism. Legislation & Quality control regarding food.

Global perspectives in malnutrition: Global environmental problems: Global warming and its impact on agriculture.

### **Food Science**

Food Science: Concept and Scope.

Food preparation: Basic terminology of cooking methods, chemical, physicochemical and microbiological effects of heat on food constituents.

Sensory evaluation of food. Food laws and regulations.

Effects of cooking, processing, and storage on nutrients in: Cereals, Pulses, Fruits, Vegetables, Role of Food Additives in food preparation: Anti-oxidants. Coloring agents. Curing agents. Emulsifiers. Flavoring agents. Leavening agents. Nutrient supplements. Sweeteners. pH controllers. Preservatives. Other additives.

Food toxins: Naturally occurring Toxins- trypsin inhibitors, hemagglutinins, lathrogens, aflatoxins, saponins, cyanogens, gossypol, glucosinolates, etc.

Methods of improving Nutritional quality of foods: germination, fermentation, supplementation, fortification.

Food preservation: Causes of food spoilage, principles of food preservation, methods of food preservation.

Food packaging: basic concepts.

Food adulteration: Definition, common adulterants in different foods, contamination, methods of detection.

Milk and milk products, Meat, fish and poultry, Sugars and Beverages.

### **Biochemistry of Health and Diseases**

Assessment of health and diseases: Biochemical tests in assessment of health and nutritional status. Analytical factors affecting results of biochemical tests.

Significance of commonly measured analytes: Blood cells, plasma proteins, ions, enzymes, proteins, lipids and lipoproteins, major metabolites such as urea, hormones, acid-base balance, gases in blood in assessment. Merits and demerits of various methods.

Assessment of sub-clinical and clinical nutrient deficiencies: Biochemical indices of thiamine, riboflavin, niacin, vitamin A, iron, calcium, and other nutrient status. Blood and urine analysis.

Assessment of diseases such as diabetes, major genetic diseases such as phenylketonuria.

Non-invasive methods for assessment: Radiological, Bone mineral density, ECG, EEG, NMR.

Biochemistry of starvation: Alternate methods of energy generation, organ interrelationships during starvation, acid-base balance, ketosis.

Regulation of Food Intake:

Adipose tissue metabolism: White and brown adipose tissue. Lipolysis, reesterification. Lipoprotein lipase.

Lipoprotein metabolism: Metabolism of chylomicrons, VLDL and IDL, HDL, LDL. Formation of atherosclerotic plaque. Effects of dietary and other factors.

Alcohol Metabolism: As a source of energy. Fatty liver and cirrhosis.

Genetic controls in the body: Storage of genetic information. Its implications for disease. Oncogenes and cancer. Carcinogens and mutagens in food. Role of polymerase chain reaction in diagnosis.

Free Radicals and anti-oxidants: Formation and harmful effects of free radicals.

Defence against free oxygen species. Role of anti-oxidant enzymes, vitamins and other free radical scavengers.

Biochemistry of stress.

### **Applied Nutrition**

Nutrition for Health and Fitness:

Nutrition in eating disorders. Anorexia Nervosa, Bulimia.

Nutrition for exercise and sports performance. Energy production. Nutritional requirements for optimum performance. Ergogenic aids. Carbohydrate loading.

Nutrition for bone health.

Role of nutrition in skin and hair care: Cosmetic effects of diet. Cellulite. Allergies.

Anti-aging foods. Foods as cosmetic agents.

Maternal and Child Nutrition:

Growth and development of fetus: Effects of maternal nutrition on birth weight.

Appropriate-for-gestational-age. Low birth weight (LBW), small-for-date (SFD), premature babies.

Nutritional management of high-risk and low-risk pregnancies.

Malnutrition and mental development. Critical periods of brain development.

Nutrition and immunity: Basics of immunity. Nutrition in infections. Immunity in varying nutritional states.

Drug-nutrient interrelationships: Effects of drugs on nutrient absorption and utilization, effects of foods and nutrients on drug utilization. Effects of nutritional state on drug metabolism.

Scientific evaluation of food-related beliefs: Fads. Application of research methodology to test claims of efficacy of foods used in alternative systems of medicines: ayurvedic, herbal and home remedies.

### **Microbiology of Food and Disease**

Introduction to microbes: Bacteria, Fungi, Algae, Viruses.

Sources of Food contamination: Air. Water. Soil. Sewage. Post-processing.

Food spoilage: Food borne illnesses. Causes and prevention.

Food toxins: Toxins in the food chain

Environmental contaminants: Pesticides, insecticides, untreated sewage in food.

Causes and prevention. Contamination of water. Analysis and treatment. Public water supply:

Sources, regulations, contaminants.

Consumer Protection: Consumer concerns about food and water. Food safety and sanitation

Microbes and the production of foods and beverages: Role of microbes in production of milk products, pickled foods, fermented foods, bakery products, alcoholic beverages.

Microbes in diseases: Causes and prevention of: Infectious intestinal diseases, Bacterial diseases of the digestive tract, viral infections.

Biotechnology applications: Diagnosis of diseases, medical therapy, vaccines.

### **Biochemical Correlates of Nutrition Therapy**

Advances in Nutrition Therapy of selected disease states: Biochemical basis of dietary modifications. Biochemical evaluation of efficacy of dietary changes.

Complications. Short term and long term controls in the diseases such as Diabetes Mellitus, Cardiovascular diseases, Renal diseases, Obesity.

Nutritional management of: Food allergies. Selected diseases of genetic origin such as phenylketonuria, Gout.

Critical care for conditions of metabolic stress: Sepsis, Trauma, Burns and Surgery.

Nutrition and Cancer: Effects of cancer on nutritional requirements. Effects of food on incidence of certain cancers. Carcinogenic foods. Foods that prevent cancer.

Food and Endorphins: Alteration of mental states by food.

### **Institutional Food Management**

Food Service systems: Introductory concepts. Development.

Types of food services: Hospital, hostel, cafeteria, community kitchens.

Planning for food services in hospitals:

Physical plant, its location, floor plans, space allowance, kitchen units, storage unit, baking, dishwashing and servicing unit.

Equipment requirement: For food preparation, storage, distribution and serving.

Manpower requirement: Personnel management, selection, training and supervision

Food service management: Menu planning, Receipt of food and its storage, principles and techniques in quantity food production. Food service.

Time and energy management:

Financial Management: Principles of accounting, pricing and cost control.

Laws affecting food service operations: Food laws. Personnel laws.

Consumer education: Consumer Protection Laws, Consumer concerns.

### **Laboratory Techniques in Human Nutrition**

Principles and introductory concepts of general analytical techniques: Colorimetry and spectrophotometry, Chromatography, Fluorimetry, Electrophoresis, Radioisotope methodology, Saturation analysis- radioimmunoassay, ELISA, Microbiological assays, Metabolic balance studies.

Collection, handling, transport and storage of biological samples in a field situation: Blood, plasma, serum, urine, feces. Relative merits and demerits.

Methods for food analysis: Estimations of carbohydrates, protein, fat, vitamins and minerals.

Methods of assessment of nutritional status: Hematological tests. Nitrogen balance and other metabolic studies. Vitamin load tests. Clinical assessment. Biochemical assessment. Animal experimentation.

### **Methods in research and advanced Statistics**

Scientific Approach to Research: Meaning, significance, types of research studies.

Research Process: Formulating the problem, objectives, hypothesis, research design, sample design, collection of data, analysis of data, interpretation, preparation of report.

Sampling design: Census vs. sample survey. Steps. Types.

Scaling techniques: Continuum, Reliability, Validity, Scale construction techniques.

Methods of data collection: Observation, interview, questionnaire, case study, focus group discussion.

Processing of data: Development of code book. Socioeconomic indicators: Kuppaswamy, Prasad, Kumar and other scales. Consumer price index.

Scientific way of report writing:

Measurements: Measures of central tendency, variability, correlation, chi-square, t-test

Applications of advanced statistics: Analysis of variance (ANOVA). Multivariate statistics: MANOVA, regression. Non-parametric statistics.

Application of research and statistics in Nutritional Surveillance: Code-30 - 5 -

### **(33) PERSIAN**

#### **PAPER—II and PAPER—III (Part A & B)**

The syllabus is divided into the following **six** different parts. The first four headings consists of two units each, i.e., e.g. : units and the remaining two headings form one unit each, i.e., the ninth and the tenth unit :

- The Ancient Iranian Literature
- The Classical Persian Literature
- The Indo-Persian Literature
- The Modern Persian Literature
- Literary History and Criticism
- General information regarding the Persian speaking world

*N.B.* : All questions of Paper—III should be framed in Persian only.

#### **Ancient Iranian Literature**

General information regarding

اوستا  
پارسی باستان  
پهلوی اشکانی

پهلوی ساسانی  
زبان و ادبیات بین دوره ساسانی و دوره سامانی

Classical Persian Literature periods

سامانی  
غزنوی  
سلجوقی

Eminent poets and poetesses

رابعه قزداري  
رودکی  
فردوسی  
عنصری  
فرخی  
عسجدی  
منوچهری  
مسعود سعد سلمان  
خاقانی  
انوری  
باباطاهر  
نظامی

Important Prose works

ترجمہ تاریخ طبری  
چهارمقالہ  
سیاستنامہ  
قابوسنامہ  
کلیلہ ودمنہ  
کیمیای سعادت و سفرنامہ ناصر خسرو

Period

مغول (تیموری و تاتاری)  
صفوی  
قاجار

Eminent poets and poetesses

سنائی  
عطار  
ابوسعید ایلی الخیر  
ناصر خسرو  
مولوی  
سعدی  
حافظ



جامی  
خواجوی کرمانی  
محتشم کاشی  
قاآنی  
انواع مختلف سخن سرای

Important Prose works

انوار سهیلی  
اخلاق جلالی  
اخلاق ناصری  
اخلاق محسنی  
گلستان سعدی

Indo-Persian Literature

Periods

دوره آغاز زبانوادبیات فارسی درهند  
دوره مغول درهند

Eminent poets and poetesses

امیر خسرو  
فیضی  
غزالی مشهدی  
قدسی

نظیری نیشاپوری  
عرفی شیرازی  
ابوطالب کلیم

Important Prose works

تذکرۃ الاولیاء  
راما ین  
تاریخ کرشناجی  
رت پدم  
نل دمن  
اکبرنامہ  
عیار دانش

دورہ تیموری و بعد درہند

Eminent poets and poetesses

غنی کشمیری  
صائب تبریزی  
زیب النساء  
بیدل  
غالب  
اقبال

Famous Prose works

مجمع البحرين  
سفينة الاولياء  
چهار عنصر  
آتشکده  
خزانة عامره  
سه نثر ظهوری  
چهار چمن  
دستنبو

Modern Persian Literature

General information regarding

آغاز نثر جدید  
روزنامه نویسی در ایران  
فرق بین شعر کلاسیک و شعر جدید  
ادبیات دوره مشروطیت

Eminent authors

دهخدا  
زین العابدین مراغه ای

جمالزاده  
صادق هدايت  
سعید نفیسی  
صنعتی زاده کرمانی  
محمد حجازی  
بزرگ علوی  
صادق چوبک  
غلامحسین ساعدی  
محمد علی اسلامی

Famous poets and poetesses

قره العین  
دهخدا  
بهار  
پروین اعتصامی  
عارف قزوینی  
ایرج میرزا  
عشقی  
سیمین بهبهانی  
نیما یوشیج

General information regarding

انواع مختلف نثر جدید  
شعر موج نو  
سخنسرایی در دوره انقلاب اسلامی

Famous authors

ایرج افشار  
علی دشتی  
محمد علی افغانی  
زرین کوب  
جلال آل احمد  
سیمین دانشور  
نادر ابراهیمی

Eminent poets and poetesses

فروغ فرخزاد  
نادر نادرپور  
شهریار  
سهراب سپهری  
مهدی اخوان ثالث  
احمد شاملو  
سایه  
پرویز نائل خانلری

Literary History and Criticism

شعر العجم  
تاریخ ادبیات در ایران  
تاریخ زبان پارسی  
سواد و بیاض  
سبک شناسی  
کاروان هند

The Literary History of Persia  
History of Iranian Literature  
Persian Literature at the Mughal Court  
Post-Revolutionary Persian Verse

General information regarding Persian Speaking World, i.e., history, culture, literature, and society of

ایران  
افغانستان  
هندوستان  
تاجیکستان  
ازبکستان

**(34) PHILOSOPHY**

**1. Classical Indian philosophy:**

Vedic and Upanisadic world-views: Rta-the cosmic order, the divine and the human realms; the centrality of the institution of yajna(sacrifice), the concept of ma-duty/obligation; theories of creation

Atman- Self(and non-self), jagrat, svapna, susupti and turiya, Brahman, seryas and preyas  
Karma, samsara, moksa,

Carvaka: Pratyaksa as the only pramana, critique of the anumana and sabda. Rejection of the non-material entities and dharma and moksa.

Jainism : Concept of reality- sat, dravya, guna, paryaya, jiva, ajiva, anekantavada, syadvada and nayavada; theory of knowledg; bondage and liberation.

Buddhism: Four noble truths, astangamarga, nirvana, madhyam partipad, pratityasamutpada, ksanabhangavada, anatmavada

School of Buddhism : Vaibhasika, Sautrantika, Yagacara and madhyamika

Nyaya: Prama and aprama, pramanya and apramanya; pramana : pratyaksa, Nirvikalpaka, savikalpaka, laukika and alaukika; anumana: anavayavyatreka, lingaparamarsa, vyapti classification: vyaptigrahopayas. Hetvabhasa, upamana, sabda: Sakit, laksana, akanksa, yogyata, sannidhi and tatparya, concept of God, arguments for the existence of God, adrsta, nihsryeasa.

Vaisesika: Concept of padartha, dravya, guna, karma, samanya, samavaya, visesa, abhava causation: Asatkayavada, Samavayi, asamavayt, asamavayi nimittakarana, paramanvada, adrsta, nihsryeas.

Samkhya : Satkaryavda, prakrti and its evolutes, arguments for the existence of prakrit, nature of purusa, arguments for the existence and plurality of purusa, relationship between purusa and prakrit, kaivalya, atheism.

Yoga: patanjali's concept of citta and citta-vrtti, eight-fold path of yoga, the role of God in yoga.

Purva- Mimamsa

Sruti and its importance, atheism of purvamimamsa, classification of srutivakyas, vidhi, nisedha and arthavada, dharma, bhavana, sabdanityavada, jatisaktivada.

Kumarila and prabhakara Schools of mimamsa and their major points of difference, tripusti-samvit, jivatata, abhava and anupalabdhi, anvitabhidhanavada, abihitanvayavada.

Vedanta

Advaita- Rejection of difference : Adhyasa, maya, three grades of satta, jiva, jivanmukti, vivartavada.

Visistadvaita: Saguna Brahman, refutation of maya, aprthaksiddhi, parinamavada, jiva, bhakti and prapatti.

Dvaita- Rejection of nirguna brahman and maya, bheda and sakst, bhakti.

**2. Modern Indian Thinkers:**

Vivekananda- Practical vedanta, universal religion.  
Aurbindo- Evolution, mind and supermind integral yoga.  
Iqbal- Self, god, man and superman,  
Tagore: religion of man, ideas on education.  
K.C. Bhattacharyya- Concept of Philosophy, Subject as Freedom, the doctrine of maya  
Radhakrishnan- Intellect and intuition, the idealist view of life.  
J krishnamurti- Freedom from the known, analysis of self.  
Gandhi- Non- violence, satyagraha, swaraj, critique of modern civilization.  
Ambedkar- Varna and the caste system, Neo- Buddhism.

**3. Classical Western Philosophy**

Early greek philosophers, Plato and Aristotle.  
Ionians, Pythagoras, parmenides, heraclitus and Democritus  
The Sophists and Socrates  
Plato- theory of knowledge, knowledge (episteme) and opinion (daxa), theory of ideas, the method of dialectic, soul and God.  
Aristotle- Classification of the sciences, the theoretical, the practical and the productive (theoria, praxis, techne), logic as an organon, critique of Plato's, Theory of ideas, theory of causation, form and matter, potentially and actuality, soul and God.

Medieval Philosophy

St.Augustine- Problem of evil

St.Anselm-Ontological Argument

St Thomas Aquinas-Faith and reason,essence and existence ,the existence of God.

**4. Modern Western Philosophy**

Rationalism

Descartes: Conception of method and the need for method in philosophy, clarity and distinctness as the criterion of truth ,doubt and methodological scepticism,the cogito-intuition or inference? innate ideas ,the 'real' distinction between mind and matter, role of God, proofs for the existence of God. Mind-body interactionalism.

Spinoza: Substance, Attribute and Mode, the concept of 'God or nature'. The mind-body problem, pantheism, three order of knowing.

Libniz: Monadology, truths of reason and truths of fact, innateness of all ideas, proofs for the existence of God, principles of non-contradiction, sufficient reason and identity of indiscernibles, the doctrine of pre-established harmony, problem of freedom and philosophy.

Empiricistn

Locke: Ideas and their classification, refutation of innate ideas, theory of knowledge, three grades of knowledge, theory of substance, distinction between primary and secondary qualities.



Berkeley: Rejection of distinction between primary and secondary qualities, immaterialism, critique of abstract ideas, *esse est percipi*, the problem of solipsism, God and self,

Hume: Impressions and ideas, Knowledge concerning relation of ideas and knowledge concerning matters of fact, Induction and causality, the external world and the self, personal identity, rejection of metaphysics, scepticism, reason and the passions,

Critical philosophy and After

Kant: the critical philosophy, classification of judgements, possibility of synthetic a priori judgement, the copernican revolution forms of sensibility, categories of understanding, the metaphysical and the transcendental deduction of the categories, phenomenon and noumenon, the ideas of Reason- soul, God and world as a whole, freedom and immortality, rejection of speculative metaphysics

Hegel: The conception of Geist (Spirit), the dialectical method, concept of being, non-being and becoming, absolute idealism.

Nietzsche: Critique of western culture, will to power,

Moore: Refutation of idealism, defence of commonsense, philosophy and analysis.

Russell: Refutation of idealism, logic as the essence of philosophy, logical atomism.

Wittgenstein: Language and reality, facts and objects, names and propositions, the picture theory, philosophy and language, meaning and use, forms of life.

Husserl: The Husserlian method, Intentionality

Heidegger: Being and nothingness, man as being-in-the-world, critique of technology civilization.

Logical Positivism: the verifiability theory of meaning, the verification principle, rejection of metaphysics, unity of science.

C.S. Pierce and William James: Pragmatic theories of meaning and truth.

G. Ryle: Systematically misleading expressions, category mistake, concept of mind, critique of Cartesian dualism.

Vyavanharika and Paramarthika Satta  
Nitya and Anitya Dravya  
Karnata  
Akasa, Dik and Kala  
Samanya and Sambandha  
Cit, Acit and Atman

Appearance and reality

Being and becoming  
Casualty, Space and Time  
Matter, Mind and Self  
Substance and Universals  
The Problem of personal identity

Prama  
Kind of Pramanas  
Khativada  
Pramanyavada  
Anvitabhidhanavada and Abhihitavayavada  
Sabdagraha

Difinitation of Knowledge  
Ways of Knowing  
Theories of error  
Theories of truth  
Belief and scepticism  
Problems if induction

Concept of Pratyaksa in Nyaya  
Concept of Pratyaksa in Buddhism  
Concept of Pratyaksa in Samkara Vedanta  
Nature and kind of Anumana  
Definition and Nature of Vyapti  
Hetvabhasas

Rna and Rta  
Purusarthas, Svadharma  
Varnadharma and Asramadharma  
Niskamakarma and Lokasamgraha  
Pancastla and Triratnas  
Brahmavtharas

Good right, justice  
Duty and obligation  
Cardinal virtues  
Eudaemonism  
Freedom and responsibility  
Crime and punishment

Ethical cognitivism and non-cognitivism  
Ethical realism and intuitionism  
Kant's moral theory  
Kinds of utilitarianism  
Human rights and social disparities  
Feminism

Truth and validity  
Nature of Propositions

Categorical syllogism  
Laws of thought  
Classification of propositions  
Square of opposition

Truth-function and propositional logic  
Quantification and rules of quantification  
Decision procedures  
Proving validity  
Argument and Argument-form  
Axiomatic system, consistency, completeness

### **(35) PHYSICAL EDUCATION**

Introduction to Physical Education and definition, aim and objectives of Physical Education and other terms- health education and recreation.

Philosophies of Education as applied to Physical Education- Idealism, Naturalism, Realism, Pragmatism, Existentialism, and Humanism.

Biological basis of physical activity- benefits of exercise, growth and exercise, exercise and well-being sex and age characteristic of adolescent body types.

Psychological basis of Physical Education-Play and Play theories, general principles of growth and development, Principles of motor- skill acquisition, transfer of training effects.

Sociological basis of Physical Education- socialization process, social nature of men and physical activity, sports as cultural heritage of mankind, customs traditions and sports, competition and cooperation.

Physical Education in ancient Greece, Rome and Contemporary Germany, Sweden, Denmark and Russia.

Olympic movement- Historical development of ancient and modern Olympic Games.

Physical Education in India.

Physiology of Muscular activity, neurotransmission and movement mechanism, Physiology of respiration.

Physiology of blood circulation.

Factors influencing performance in sports.

Bioenergetics and recovery process.

Athletic injuries-their management and rehabilitation.

Therapeutic modalities.

Ergogenic aids and doping.

Joints and their movements-planes and axes.

Kinetics, Kinematics-linear and angular, levers.

Laws of motion, principles of equilibrium and force, spin and elasticity.

Posture, Postural deformities and their correction.

Mechanical analysis of various sports activities.

Mechanical analysis of fundamental movements- (running, jumping, throwing, pulling and pushing).

Massage manipulation and therapeutic exercises.

Learning process – theories and laws of learning.  
Motivation, theories and dynamics of motivation in sports.  
Psychological factors affecting sports performance- viz., stress, anxiety, tension and aggression.  
Personality, its dimensions, theories, personality and performance.  
Group dynamics, team cohesion and leadership in sports.  
Sociometrics, economics and politics in sports.  
Media and sports.

Development of teacher education in Physical Education.  
Professional courses in sports and Physical Education in India.  
Professional Ethics.  
Qualities and Qualifications of Physical Educational Personnel.  
Principles of curriculum planning.  
Course content for academic and professional courses.  
Age characteristic of pupils and selection of activities.  
Construction of class and school Physical education Time Table.

Health-Guiding principles of health and health education.  
Nutrition and dietary manipulations.  
Health-related fitness, obesity and its management.  
Environmental and occupational hazards and first aid.  
Communicable diseases-their preventive and therapeutic aspect.  
School health programme and personal hygiene.  
Theories and principle of recreation.  
Recreation programme for various categories of people.

Characteristic and principle of sports training.  
Training load and periodization.  
Training methods and specific training programme for development of various motor qualities.  
Technical and Tactical preparation of sports.  
Short-term and long-term training plans.  
Sports talent identification-process and procedures.  
Preparing for competition-(build up competition, main competition frequency, psychological preparation).  
Rules of Games and Sports and their interpretations.

Nature, scope and type of research.  
Formulation and selection of research problem.  
Sampling- process and techniques.  
Methods of research.  
Data collection- tools and techniques.  
Statistical techniques of data analysis-measures of central tendency and variability,  
Correlation, normal probability curve, *t*-test and *f*-test, chi-square, *z*-test.  
Hypothesis-formulation, type and testing.  
Writing research report.

Concept of test, measurement and evaluation.

Principle of measurement and evaluation.

Construction and classification of tests.

Criteria of test evaluation.

Concept and assessment of physical fitness, motor fitness, motor ability and motor educability.

Skill test for Badminton, Basket ball, Hockey, Lawn-tennis, Soccer, Volley ball.

Testing psychological variables- competitive anxiety, aggression, team cohesion, motivation, self-concept.

Anthropometric measurement and body composition.

Concept and principle of management.

Organisation and function of sports bodies.

Intramurals and extramurals.

Management of infrastructure, equipments, finance and personnel.

Methods and techniques of teaching.

Principles of planning Physical Education lessons.

Pupil-teacher interaction and relationship.

Concepts of techniques of supervision.

### (36) PHYSICS

**Basic Mathematical methods:** Calculus: Vector algebra and vector calculus. Linear algebra, matrices. Linear differential equations. Fourier series, Elementary complex analysis.

**Classical Dynamics:** Basic principles of classical dynamics. Lagrangian and Hamiltonian formalism. Symmetries and conservations laws. Motion in the central field of force. Collisions and scattering Mechanics of a system of particles. Small oscillations and normal modes. Wave motion – wave equation, phase velocity, group velocity, dispersion. Special theory of relativity – Lorentz transformations, addition of velocities, mass–energy equivalence.

**Electromagnetic:** Electromagnetics – Laplace and Poisson equations, boundary value problems. Magnetostatics – Ampere’s theorem, Biot–Savart law, electromagnetic induction. Maxwell’s equations in free space and in linear isotropic media. Boundary conditions on the fields at interface. Scalar and vector potentials. Gauge invariance. Electromagnetic waves – reflection and refraction, dispersion, interference, coherence, diffraction, polarization. Electrodynamics of a charged particle in electric and magnetic fields. Radiation from moving charges radiation from a dipole. Retarded potential.

**Quantum Physics and Applications:** Wave–particle duality. Heisenberg’s uncertainty Principle. The Schrodinger equation Particle in a box, Harmonic Oscillator, Tunneling through a barrier. Motion in a central potential, Orbital angular momentum. Angular momentum algebra, spin. Addition of angular moments. Time–independent perturbation theory. Fermi’s Golden Rule. Elementary theory of scattering in a central potential. Phase shifts, partial wave analysis. Born approximation. Identical particles, spin statistics connection.

**Thermodynamic and Statistical Physics:** Laws of thermodynamics and their consequences, Thermodynamics potentials and Maxwell’s relations. Chemical potential, phase equilibria.

Phase space, microstates and macrostates. Partition function. Free Energy and connection with thermodynamics quantities. Classical and quantum statistics. Degenerate electron gas. Blackbody radiation and Planck's distribution law, Bose– Einstein condensation. Einstein and Debye models for lattice specific heat.

**Experimental Design:** Measurement of fundamental constant:  $e$ ,  $h$ ,  $c$ . Measurement of High & Low Resistance,  $L$  and  $C$ . Detection of X-rays, Gamma rays, charged particles, neutrons etc: Ionization chamber, proportional counter, GM counter, Scintillation detectors. Solid State detectors. Emission and Absorption Spectroscopy. Measurement of Magnetic field, Hall effect, magnetoresistance. X-ray and neutron Diffraction. Vacuum Techniques: basic idea of conductance, pumping speed etc. Pumps: Mechanical Pump, Diffusion pump, Gauges; Thermocouple, Penning, Pirani, Hot cathode. Low Temperature: Cooling a sample over a range upto 4 K and measurement of temperature. Measurement of Energy and Time using electronic signals from the detectors and associated instrumentation. Signal processing, A/D conversion & multichannel analyzers. Time-of-flight technique; Coincidence Measurement: true to chance ratio, correlation studies. Error Analysis and Hypothesis testing; Propagation of errors, Plotting of Graph, Distribution, Least squares fitting, criteria for goodness of fits – chi square test.

**Electronics:** Physics of p–n junction. Diode as a circuit element; clipping, clamping: Rectification, Zener regulated power supply: Transistor as a circuit element: CC, CB and CE configuration. Transistor as a switch, OR, AND, NOT gates. Feed back in Amplifiers. Operational amplifier and its applications: inverting, non-inverting amplifier, adder, integrator, differentiator, wave form generator, comparator & Schmidt trigger. Digital integrated circuits – NAND & NOR gates as building blocks, X-OR Gate, simple combinational circuits, Half & Full adder, Flip-flop, shift register, counters Basic principles of A/D & D/A converters: Simple applications of A/D & D/A converters.

**Atomic & Molecular Physics:** Quantum states of an electron in an atom. Hydrogen atom spectrum Electron spin. Stern– Gerlach experiment Spin–orbit coupling, fine structure, relativistic correction, spectroscopic terms and selection rules, hyperfine structure. Exchange symmetry of wave functions. Pauli's exclusion principle, periodic table alkali – type spectra, LS and JJ coupling. Zeeman, Paschen–Back and Stark effects. X-Rays and Auger transitions, Compton effect Principles of ESR, NMR; Molecular Physics: Covalent ionic and Van der Waals interaction. Rotation/Vibration spectra. Raman Spectra, selection rules, nuclear spin and intensity alternation, isotope effects, electronic states of diatomic molecules, Frank–Condon principle. Lasers–spontaneous and simulated emission, optical pumping, population inversion, coherence (temporal and spatial) simple description of Ammonia maser, CO<sub>2</sub> and He–Ne Lasers.

**Condensed Matter Physics:** Crystal classes and systems, 2d & 3d lattices. Bonding of common crystal structures, reciprocal lattice, diffraction and structure factor, elementary idea about point defects and dislocations. Lattice vibrations, Phonons, specific heat of solids, free electron theory–Fermi statistics; heat capacity. Electron motion in periodic potential, energy bands in metals, insulators and semi-conductors; tight binding approximation, impurity levels in doped semi-conductors. Electronic transport from classical kinetic theory, electrical and thermal conductivity. Hall effect and thermo– electric power transport in semi-conductors. Di-electrics–Polarization mechanisms, Clausius–Mossotti equation, Piezo, Pyro and ferro electricity, Dia and Para magnetism; exchange interactions, magnetic order, ferro, antiferro

and ferrimagnetism. Super conductivity–basic phenomenology; Meissner effect, Type–1 & Type–2 Super conductors, BCS Pairing mechanism.

**Nuclear and Particle Physics:** Basic nuclear properties – size, shape, charge distribution, spin & parity, binding, empirical mass formula, liquid drop model.

Nature of nuclear force, elements of two–body problem, charge independence and charge symmetry of nuclear forces. Evidence for nuclear shell structure. Single particle shell model its validity and limitation, collective model. Interactions of charged particles and e.m. rays with matter. Basic principles of particle detectors – ionizations of chamber, gas proportional counter and GM counter, scintillation and semiconductor detectors. Radioactive decays, basic theoretical understanding. Nuclear reactions, elementary ideas of reaction mechanisms, compound, nucleus and direct reactions, elementary ideas of fission and fusion. Particle Physics: Symmetries and conservation laws, classification of fundamental forces and elementary particle, iso–spin, strangeness, Gell–Mann Nishijima formula. Quark model C.P.T. invariance in different interactions, parity–nonconservation in weak interaction.

### **(37) POLITICAL SCIENCE**

#### **1. Political Theory and Thought**

Ancient Indian Political Thought: Kautilya and Shanti Parva.

Greek Political Thought: Plato and Aristotle.

European Thought – I: Machiavelli, Hobbes, Locke, Rousseau.

European Thought – II: Bentham, J.S Mill, Hegel, Marx and Green.

Contemporary Political Thought – I: Lenin, Mao, Gramsci.

Contemporary Political Thought – II: Rawls, Nozic and Communitarians.

Modern Indian Thought: Gandhi, M.N. Roy, Aurobindo Ghosh, Joy Prakash Ambedkar, Savarkar.

Concepts and Issue – I: Medieval Political Thought: Church State Relationship and Theory of Two Swords.

Concepts of Issue – II: Behaviouralism and Post–Behaviouralism, Decline and Resurgence of Political Theory.

Democracy, Liberty and Equality.

#### **2. Comparative Politics and Political Analysis**

Evolution of Comparative Politics as a discipline; nature and scope.

Approaches to the study of comparative politics: Traditional, Structural – Functional, Systems and Marxist.

Constitutionalism: Concepts, Problems and Limitations.

Forms of Government: Unitary – Federal, Parliamentary – Presidential.

Organs of Government: Executive, Legislature, Judiciary – their interrelationship in comparative perspective.

Party Systems and Pressure Groups; Electoral Systems.

Bureaucracy – types and roles.

Political Development and Political Modernization.

Political Culture, Political Socialization and Political Communication.

Political Elite; Elitist theory of Democracy.

Power, Authority and Legitimacy.

Revolution: Theories and Types.

Dependency: Development and Under Development.

### 3. Indian Government and Politics

National Movement, Constitutional Developments and the Making of Indian Constitution.

Ideological Bases of the Indian Constitution, Preamble, Fundamental Rights and Duties and Directive Principles.

Constitution as Instrument of Socio-Economic Change, Constitutional Amendments and Review.

Structure and Process – I: President, Prime Minister, Council of Ministers, Working of the Parliamentary System.

Structure and Process – II: Governor, Chief Minister, Council of Ministers, State Legislature.

Panchayati Raj Institutions: Rural and Urban, their working.

Federalism: Theory and Practice in India; Demands of Autonomy and Separatist Movements; Emerging trends in Centre-State Relations.

Judiciary: Supreme Court, High Court, Judicial Review, Judicial Activism including Public Interest Litigation cases, Judicial Reforms.

Political Parties, Pressure Groups, Public Opinion, Media; Subaltern and Peasant Movements.

Elections, Electoral Behaviour, Election Commission and Electoral Reforms.

### 4. Public Administration

Development of Public Administration as a discipline; Approaches to the study of Public Administration: Decision-making, Ecological and Systems; Development Administration.

Theories of Organization.

Principles of organization: Line and staff, unity of command, hierarchy, span of control, centralization and decentralization, Types of organization – formal and informal; Forms of organization; department, public corporation and board.

Chief Executive: Types, functions and roles.

Personnel administration: Recruitment, Training, Promotion, Discipline, Morale; Employee-Employer Relations.

Bureaucracy: Theories, Types and Roles; Max Weber and his critics. Civil servant – Minister relationship.

Leadership, its role in decision-making; Communication.

Financial Administration: Budget, Audit, Control over Finance with special reference to India and UK.

Good Governance; Problems of Administrative Corruption; Transparency and Accountability; Right to Information.

Grievance Redressal Institutions: Ombudsman, Lokpal and Lokayukta.

### 5. International Relations

Contending Theories and Approaches to the study of International Relations; Idealist, Realist, Systems, Game, Communication and Decision-making.

Power, Interest and Ideology in International Relations; Elements of Power:

Acquisition, use and limitation of power, Perception, Formulation and Promotion of National Interest, Meaning, Role and Relevance of Ideology in International Relations.

Arms and Wars: Nature, causes and types of wars/conflicts including ethnic disputes; conventional, Nuclear/bio-chemical wars; deterrence, Arms race, Arms control and Disarmament.



Peaceful settlement of disputes, conflict resolution, Diplomacy, World-order and Peace studies.

Cold war, Alliance, Non-Alignment, End of Cold war, Globalization.

Rights and Duties of States in international law, intervention, Treaty law, prevention and abolition of war.

Political Economy of International Relations: New International Economic Order, North-South Dialogue, South-South Cooperation, WTO, Neo-colonialism and Dependency.

Regional and sub-regional organizations especially SAARC, ASEAN, OPEC, OAS.

United Nations: Aims, Objectives, Structure and Evaluation of the working of UN; Peace and Development perspectives; Charter Revision; Power-struggle and Diplomacy within UN, Financing and Peace-keeping operations.

India's Role in international affairs: India's relations with its neighbours, wars, security concerns and pacts, Mediatorial Role, distinguishing features of Indian Foreign Policy and Diplomacy.

## **(38) PSYCHOLOGY**

### **1. Perceptual Processes:**

Approaches to the study of Perception: Gestalt and Physiological approaches  
Perceptual Organisation: Gestalt, Figure and Ground, Laws of Organisation  
Perceptual Constancy: Size Shape and Brightness, Illusion; Perceptual of Depth and Movements.

Role of Motivation and Learning in Perception.

### **2. Learning Process:**

Classical Conditioning: Procedure, Phenomena and related issue

Instrumental learning: Phenomena, Paradigms and Theoretical issues

Reinforcement: Basic Variables and Schedules

Verbal Learning: Methods and Materials, Organizational Processes

### **3. Memory and Forgetting:**

Memory Processes: Encoding, Storage, Retrieval

Stages of Memory: Sensory Memory, Short-term Memory (STM) and Long-term Memory (LTM).

Episodic and Semantic memory

Models of Memory: Atkinson and Shiffrin, Craik and Lockhart, Turving

Long-term memory: Retrieval Cues, Flashbulb memory, Constructive Processes in Memory, Eyewitness Testimony, Autobiographical Memory.

### **4. Thinking and Problem Solving:**

Theories of thought processes: Associationism, Gestalt, Information Processing

Concept Formation: Rules and Strategies

Reasoning: Deductive and Inductive

Problem-solving: Type and Strategies

Role of Concept in thinking

Cognitive Strategies: Algorithms and Heuristics

Convergent and Divergent Thinking

Decision-making; impediments to problem-solving

Creative thinking and problem-solving

Language and thought

**5. Motivation and Emotion:**

Basic Motivation Concepts: Instincts, Needs, Drives, Incentives, Motivational Cycle.  
Approaches to the Study of Motivation: Psychoanalytical, Behaviouristic Cognitive, Humanistic.  
Biological Motives: Hunger, Thirst, Sleep and Sex  
Social Motives: Achievement, Affiliation, Approval  
Exploratory Behaviour and Curiosity  
Competence, Intrinsic Motivation and Attribution  
Physiological Correlates of Emotions  
Theories of Emotions: James-Lange, Canon-Bard, Schechter and Singer  
Components of Emotion: Physiological, Expressive and Cognitive  
Neural Mechanism of Emotion: Central and Peripheral  
Current Theories of Emotions and Facial Feedback Hypothesis

**6. Human Abilities:**

Intelligence: Biological, Social, Eco-cultural determinants  
Theories of Intelligence: Spearman, Thurston, Guilford  
Individual and Group Differences: Extent and Causes  
Measurement of Human Abilities

**7. Personality:**

Determinants of Personality: Biological and Socio-cultural  
Approaches to the study of Personality: Psychoanalytic, Neo-Freudian, Social Learning, Trait and Type, Cognitive Approaches  
Existential and Humanistic Theories of Personality: Frankl, Rollo May, Maslow, Rogers  
Personality Assessment: Psychometric and Projective Tests and Behavioural Measures.  
Self-concept: Origin and Development

**8. Psychological Statistics:**

Basic Concepts; use of statistics in Psychology; variables-continuous and categorical.  
Scales of measurement-nominal ordinal, interval and ratio  
Descriptive and inferential statistical; data organizing and processing of data  
Organizing data in frequency distribution  
Calculation of Mean, Median and Mode from raw and grouped data  
Concept of Variability  
Centiles and Percentiles Rank (PR)

**9. Research Methodology:**

Research Problems, Hypothesis, Variables and their Operationalisation  
Measurement in Psychological Research, Problem and Issues  
Types of Psychological Research, Survey Research, Sample Survey, Telephone Survey, Market Survey  
Methods of Psychological Research: Experimental, Quasi-experimental, Case Studies, Field Studies and Cross-Culture Studies.  
Methods of Data Collection: Organisation, Interview, Questionnaire, tests and scales.  
Non-parametric tests  
Ethical problems in Experimental Research

**10. Measurement and Testing:**

Test Construction: Item writing, Item Analysis

Test Standardization: Reliability, Validity and Norms

Types of Tests: Intelligence, Aptitude, Personality – Characteristics and Important Examples.

Attitude Scales and Interest Inventories

Educational Measurement and Evaluation

**11. Biological Basic of Behaviour:**

Receptors, Effectors and Adjuster Mechanisms

Neural Impulse: Origin, Conduction and Measurement

Sensory System: Vision and Audition

Human Nervous System: Structure and Functions

Methods of Physiological Psychology: Lesion and Brain Stimulation

Sleep and Waking: Stages of Sleep, Disorders of sleep and Physiological mechanisms of sleep and waking.

Endocrine System: Chemical and Glandular

**Specialised Course:**

**Social Psychology:**

I. Current Trends in Social Psychology – Past, Present and Future

Social Cognition – Person Perception

Social Influence – Conformity, Attitudes, Attitudes Change and Majority, Minority influences.

Social nature of self and identity prejudice and discrimination social Psychology of disadvantage and poverty.

**Developmental Psychology:**

**II.** Development Processes: Nature, Principles and Related Concepts – Maturity, Experience  
Factors in Development: Biogenic Psychogenic and Sociogenic.

Stage of Development: Theories of Development: Psychoanalytic Behaviouristic and Cognitive

Various aspects of Development: Sensory-motor, Cognitive, Language, emotional, Social and Moral.

**Organizational Psychology:**

**III.** Development of Industrial and Organisation Psychology

Selection Process in Organisation

Organisational Training

Performance Appraisal

Motivation and Work

Leadership

Work Environment, Work Values in Organisation

Organisational Behaviour: Theories, Socialisation, effectiveness

### Clinical Psychology:

IV. Psychopathology: Concepts, Classification and Causes: Clinical Diagnostics

Common Clinical Disorders

Freud's Theory of Neurosis, existential Perspectives on Psychopathology,

Beck's Cognitive Model of Depression

Mental Health: Intervention Models and Psychotherapies

Community Mental Health and Prevention

Indian Perspective on Psychotherapy

### V. Health Psychology:

Overview of Psychology and Health

What is Health: Viewpoints from History, Current Perspectives on Health and Illness

Stress and Coping: Meaning, Impact and Sources

The Development of Stress Models: Psychological Factors in Stress

Measuring Stress

Coping: Social Support, Personality

Control.

## (39) SANSKRIT

वैदिक सूक्त— सवितृ 1/35, मरुत् 1/85, रुद्र 2/33, मित्र 3/59, उषस् 4/51, मित्रावरुण 7/71, वरुण 7/86, सृष्टि 10/129, अक्षरसूक्त 10/39, मन्त्रार्थ/सूक्त सारांश

(क) अर्थसंग्रह—

(अ) भावना

(ब) विधि

(स) निषेध

(ख) निरुक्त— (प्रथम अध्याय)

(क) कालिदास (ख) भास (ग) भवभूति (घ) शूद्रक (ङ) विशाखदत्त (च) भारवि (छ) माघ (ज) श्रीहर्ष (झ) बाण (त्र) सुबुद्ध (ट) दण्डी (ठ) वर्णव्यवस्था (ड) आश्रमव्यवस्था (ढ) नारीशिक्षा

भाषिक वर्गीकरण—

आकृतिमूलक, पारिवारिक, भारोपीय, भाषापरिवार, धर्मपरिवर्तन के कारण एवं दिशा अर्थ परिवर्तन के कारण एवम् दिशा, लौकिक, वैदिक एवम् अवेस्ता की भाषा का वैशिष्ट्य, मध्यकालिक भारतीय आर्य भाषा— पालि, प्राकृत, अपभ्रंश

तर्कभाषा— प्रमाण निरूपण पर्यन्त

तत्त्व कौमुदी— कारिक 1 से 21 तक

वेदान्तसार— महावाक्ययार्थ

काव्यप्रकाश— (नवम् एवम् दशम् उल्लास)

वकोक्ति, पुनरुक्तवदाभास, अनुप्रास, यमक, श्लेष, उपमा, रूपक, उत्प्रेक्षा, समासोक्ति, अनन्वय, अर्थान्तरन्यास, दीपक, तुल्ययोगिता, विभावना, विशेषोक्ति, विरोधाभास, दृष्टान्त, निदर्शना, ससन्देह, प्रतिवस्तूपमा, भ्रान्तिमान, परिसंख्या, अपह्नुति, अप्रस्तुतप्रशंसा, काव्यलिंग, संसृष्टि, संकर

#### निम्नलिखित की सिद्धि प्रक्रिया—

राम, सर्व, विश्वपा, हरि सखि, क्रोष्टु, भानु, धातृ, गो, रमा, मति, गौरी, ज्ञान, मधवत्, तद्, अस्मद्, उपनाह, इदम्। तद्धित प्रकरण—शैषिकपर्यन्त

#### निम्नलिखित की सिद्धि प्रक्रिया—

(क) भू एवम्, एध् धातु  
(ख) कृत्य प्रक्रिया, पूर्वकृदन्त, तुमुन्, घत्र, क्त्वा, ल्यप्, ल्युट्

#### वेद वर्ग

1. ऋग्वेद द्वितीय मण्डल के सूक्त(मन्त्रों का अनुवाद, देवताओं की विशेषता)
2. स्वर प्रक्रिया(वैदिक)
3. शुक्ल यजुर्वेद(प्रथम तथा तृतीय अध्याय) माध्यन्दिन संहिता
4. वजसनेयि प्रतिशाख्य— एक से तीन
5. शतपथ ब्राह्मण प्रथम काण्ड— (सृक् सम्मार्जनम् पर्यन्त)
6. ऋक् प्रातिशाख्य 1, 2, 3, 6 पटल
7. निरुक्त द्वितीय तथा सप्तम अध्याय
8. बहिस्तून शिलालेख

#### साहित्य वर्ग

**काव्य—प्रकाश—** (प्रथम से अष्टम उल्लास) कारिकाओं की व्याख्या एवं प्रश्न काव्य—हेतु, काव्य प्रयोजन, काव्य जक्षण, काव्य वेद, अभिहितान्वयवाद एवम् अन्विताधिनवाद, शब्द—शक्तियाँ, ध्वनि भेद, रस सिद्धान्त (रस सूत्र की व्याख्यायें), गुणीभूतव्यंग्य के भेद, व्यंजना की अपरिहार्यता, दोष—स्वरूप, गुणालंकार स्वरूप एवं भेद

**ध्वन्यालोक— प्रथम उद्योत—** कारिकाओं की व्याख्या एवं प्रश्न ध्वनि के पूर्व कक्ष—स्वरूप एवं खण्डन, ध्वनि स्वरूप, वाच्य एवं व्यंग्य में अन्तर, अलंकारों में ध्वनि के अन्तर्भाव का निषेध, लक्षण एवं व्यंजना में भेद चतुर्थ उद्योत. कारिकाओं की व्याख्या एवं प्रश्न ध्वनि एवं गुणीभूत द्वारा काव्यार्थ की अनन्तता, शुद्ध काव्य की अनन्तता, रस—ध्वनि का महत्व एवं महाभारत के अंगी रस का निर्धारण, काव्य संवाद ।

**दशरूपक—** कारिकाओं की व्याख्या एवं प्रश्न नाट्यलक्षण, अर्थप्रकृतियाँ, कार्यावस्थायें(सन्ध्यंगो को छोड़कर), अर्थपक्षेपक नाट्यवृत्तियों, रूपकों के भेद एवं लक्षण, रस, स्वरूप, नाट्य में शान्तरस, रससिद्धान्त खण्डन मण्डन 37 वीं कारिका पर्यन्त ।

**रसगंगाधर—** प्रथम आनन (रस—स्वरूप निरूपण पर्यन्त) काव्य लक्षण— पण्डित राज का स्वभिमत, अन्य लक्षणों का आक्षेप

**कान्य कारण—** प्रतिभा का स्वरूप, प्रतिभा के कारण काव्य भेद— उत्तमोत्तम, उत्तम, मध्यम, अधम

रस-स्वरूप— स्वमतस्थापन, रसविषयक विविध सम्मतियाँ विप्रतिपत्तियाँ एवं समाधान

नैषधीयचरितम्— (प्रथम सर्ग) हिन्दी अनुवाद व्याख्या एवं प्रश्न

शिशुपालवधम्— (प्रथम सर्ग) हिन्दी अनुवाद एवं प्रश्न

नलचम्पू— प्रथम उच्छ्वास (वर्षावर्णन पर्यन्त हिन्दी एवं प्रश्न)

रत्नावली— (सम्पूर्ण) हिन्दी अनुवाद, संस्कृत व्याख्या एवं प्रश्न

### दर्शन वर्ग

#### 1. न्याय सूत्र, वात्स्यायन भाष्य से

- (क) प्रमाण
- (ख) सिद्धान्त
- (ग) अवयव
- (घ) वाद, जल्प, वितण्डा
- (ङ) हेत्वभास

#### 2. प्रशस्तपाद भाष्य?

- (अ) साधर्म्यवैधर्म्य
- (ब) द्रव्य
- (स) गुण
- (द) कर्म
- (य) सामान्य
- (र) विशेष
- (ल) समवाय
- (व) अभाव

#### 3. न्यायसिद्धान्तमुक्तावली से

- (अ) मंगलवार
- (ब) ईश्वर सिद्धि
- (स) इन्द्रव्यत्व सिद्धि
- (द) जाति बाधक
- (य) कारण
- (र) अन्यथासिद्ध
- (ल) लौकिक एवं अलौकिक सन्निकर्ष

1. योगसूत्र व्यास भाष्य से— पाद 1 तथा 2 से निरूपित सभी विषय

2. प्रज्ञा पारमिता

3. माण्डूक्योपनिषद् (कारिका सहित) सम्पूर्ण

#### 1. ब्रह्मसूत्रशांकर भाष्य से

(अ) प्रथम अध्याय प्रथम वाद ईक्षत्यधिकरण पर्यन्त

(ब) द्वितीय अध्याय के प्रथम, द्वितीय पाद से न्यायमत, वैशेषिकमत, जैनमत, बौद्धमत, भागवतमत, तथा पाशुपातमत का खण्डन तथा विलक्षणत्वाधिकरण

2. वेदार्थसङ्ग्रह— शांकरमत प्रतिक्रिये पर्यन्त।

3. पंचदशी— प्रथम प्रकरण से पंचम प्रकरण पर्यन्त।

## (40) SOCIOLOGY

**Concepts :** Community; Institution; Association; Social structure; Social system; Social action; Culture - Cultural change, diffusion, cultural lag, cultural relativism, acculturation; Assimilation; Integration; Social process; Norms and values, Status and role; role conflict; status-set; multiple roles, Role set; Status sequence; Social groups - Primary-Secondary, formal-informal, Ingroup/outgroup, Reference Group; Theories of Socialization, Anticipatory socialization; Conformity and Deviance

**Society :** Tribal, Rural Urban, Industrial, Post-industrial

**Social Institutions :** Marriage, Family, Kinship, Economy, Polity, Religion

**Social Stratification:** Social differentiation, Hierarchy and Inequality; Forms of Stratification: Caste, Class, Gender, ethnic; Theories of social stratification; Social mobility

**Social Change:** Diffusion, Evolution, Development, Growth, Progress, Revolution, Transformation, Social Development, Theories of social change; Social movements - SC/ST/OBC/others

**SOCIOLOGICAL THEORIES:** Structural, Functional, interactionist Symbolic interactionism, Conflict, Phenomenology and Ethnomethodology; Neo-functionalism and Neo-Marxism: Structuration and Post – Modernism

**RESEARCH METHODOLOGY :** Meaning of Social Research; Scientific method; Objectivity and Subjectivity, facts, theory and value.

**Quantitative methods:** Survey, Research Design and its types, Hypothesis, Sampling, Observation, Questionnaire, Schedule, Interview

**Qualitative Methods:** Participant Observation, Case Study, Content Analysis, Oral History, Life history; Narrations, Conversational analysis

**Statistics in Social Research:** Measures of Central Tendency; Measures of dispersion; Correlation analysis; Reliability and Validity

### SOCIOLOGY IN INDIAN CONTEXT

**Indian society :** Unity within Diversity

**Theoretical Perspectives :** Indological, Structural-Functional, Marxian, Civilizational and Subaltern Perspectives.

**Contemporary Issues :** (Social) Poverty, inequalities, inter- generational conflicts, family disorganization; (Developmental) slums, displacement, environmental problems (crimes and deviance) White collar crime; corruption; Drug addiction; Suicide

**Current Debates:** Tradition and Modernity; Nation Building, Secularism, Pluralism  
Indianisation of Sociology; Privatization of Education; Science and Technology.

### **RURAL SOCIOLOGY**

Rural-Urban continuum; Part society and part culture, Little Community, Universalization and Parochialization,

**Agrarian Institutions :** Types of Land ownership; Agrarian relations and Mode of production debate; Jajmani system, differentiation of peasantry; Peasant Studies

**Panchayati Raj System :** Rural leadership, Factionalism and Empowerment

**Rural Social Issues:** Bonded and Migrant labour; Agrarian unrest and Peasant movements: Old and New; cultivators' suicides;

**Rural Development and Change:** Social/Economic factors of Change; Contemporary rural development programmes

### **INDUSTRY AND SOCIETY**

**Concepts :** Division of Labour, Bureaucracy, Rationality, Production relations, Surplus value, Alienation

**Industry and Society :** Factory as a social system; Formal and Informal organization; affect of social structure on industry; Impact of industry on family, education, stratification and class conflict

**Industrial Relations:** Changing labour-management relations; Worker's participation in Management.

### **SOCIOLOGY OF DEVELOPMENT**

**Concepts:** Economic growth, Human development, Social development, Sustainable development

**Theories of development:** Liberal: Dependency: Centre- Periphery; uneven - development; World- system

**Paths of Development:** Socialist. Mixed, Gandhian, Capitalistic

**Consequences of development :** ethnic movements, socio-economic disparities

### **GENDER AND SOCIETY**

Gender as social construct; Social Structure and Gender Inequality; Theories of Gender relations (Liberalist, Radical, Socialist, Post- modernist); Gender and perspectives of Development; Women and Development in India, empowerment of women.

## **(41) STATISTICS**



**Probability Theory:** Probability space of a random experiment, probability measures, random variables as a measurable function,  $\sigma$ -field induced by a sequence of random variables, decomposition of distribution function in purely discrete, absolutely continuous and singular components,  $C_r$ -inequality, Cauchy–Schwartz inequality, Holder inequality, Minkowski inequality, Jensen inequality, Lyapunov inequality, Kolmogorov inequality, Hajek–Renyki inequality, Sequences of distribution functions, Helly Bray theorem, Different types of convergence of sequence of random variables, distribution function of random vectors, Weak and strong law of large numbers, Khinchin, Borel and Kolmogorov theorems, Borel–Cantelli lemmas and Zero–one law, Characteristic function, Inversion theorem, Continuity theorem, One dimensional central limit problem: Lindeberg–Levy, Lyapunov, Lindeberg–Feller theorems.

**Time Series Analysis:** Time series as a stationary or nonstationary stochastic process, time domain analysis based on correlogram, sample autocovariance function (acvf) and autocorrelation function (acf) at lag  $k$ , AR( $p$ ) process, MA( $q$ ) process, mixed ARMA( $p, q$ ) process, stationarity and invertibility conditions, ARIMA( $p, d, q$ ) model, estimation of parameters, tests for stationarity, frequency domain analysis based on the spectral density function, spectra of AR(1) and MA(1) models, periodogram and its relationship with acvf, forecasting by exponential smoothing and Box–Jenkins procedures.

**Multivariate Analysis:** Multivariate normal distribution, Characteristic function, Maximum likelihood estimators of the mean vector and covariance matrix, Multiple and partial correlation coefficients and their null sampling distributions, Wishart distribution Hotelling's  $T^2$ , Mahalanobis'  $D^2$  and their applications.

**Statistical Inference:** Radon Nikodyn theorem and derivative, Conditional expectation using Radon Nikodym derivative, Sufficiency, Fisher–Neyman–Halmos–Savage factorization criterion, minimal sufficiency Completeness, Bounded completeness, Ancillary statistics, Basu's theorem on independence of Statistics, Exponential family, Bhattacharya bound, Chapman Robbins and Kiefer (CRK) bound, Generalized Rao Cramer bound for the multiparameter case, Maximum likelihood estimation, Lehmann theorem for invariance, Cramer theorem for weak consistency, asymptotic normality, BAN and CAN estimators asymptotic efficiency, equivariant estimation, relation between confidence estimation and hypothesis testing, Generalized Neyman Pearson lemma, UMP tests for distributions with MLR, LR, tests and their properties UMPU tests, similar regions, Neyman structure, Invariant tests.

**Analysis of Variance and Design of Experiments:** Two–way classification with equal number of observations per cell and Tukey's test, general two–way classification, Analysis of covariance,  $2^n$ ,  $3_2$  and  $3_3$  factorial experiments, complete and partial confounding, Balanced Incomplete Block Design (BIBD), construction of BIBD, intra block and inter block analysis, Partially Balanced Incomplete Design (PBIBD), split plot design.

**Sampling Theory:** Varying probability sampling with and without replacement, cumulative total and Lahiri's methods of selection, Estimation of population mean, Desraj ordered estimates, Horwitz–Thompson estimator, Midzuno, and Narain system of sampling, post–stratification and deep stratification, double sampling in ratio and regression estimation, two stage and multi–stage sampling, basic idea of randomized response technique, nonsampling errors.

**Nonparametric Inference:** Asymptotic distribution of an order statistic, Sufficiency and completeness of n-tuple of order statistic, nonparametric estimation of distribution function and Glivenko–Cantelli fundamental theorem of statistics, one sample and two sample location tests, Application of U–statistic to rank tests, One sample and two sample Kolmogorov–Smirnov tests, Run tests, Pitman ARE.

**Econometrics:** Linear regression model, assumptions, estimation of parameters by least squares and maximum likelihood methods, test of hypothesis and confidence estimation for regression coefficients,  $R^2$  and adjusted  $R^2$ , use of extraneous information in terms of exact and stochastic linear restrictions, restricted restriction and mixed regression methods and their properties, point and interval predictors, multicollinearity consequences and solutions, estimation of parameters by generalized least squares in models with non–spherical disturbances, heteroscedasticity of disturbances, estimation under heteroscedasticity estimation under autocorrelated disturbances, errors in variable models, inconsistency of least squares method, instrumental variable method, seemingly unrelated regression equation (SURE) model and its estimation, simultaneous equations model, concept of structural and reduced forms, problem of identification, rank and order conditions of identifiability, indirect least squares, two stage least squares and limited information maximum likelihood estimation, idea of three stage least squares and full information maximum likelihood estimation.

**(42) URDU**

(Masnavi & Qasida)

Masnavi:	Qutub Mushtari, Bajal Kahani, Sahrul Bayan, Gulzar e Naseem, Zahe Ishq, Saqi nama-		
Qasida:	1	Uth Gaya Bahman o day Ka Sauda	
	2	Zahe Naseeb Agar Keejye Zauq	
	3	Dher guz jaluai yaktai Ghalib	
	4	Samka se chala Mohsin	

(Darama & Afsana)

Darama:	1	Inder Sabha	Anand
	2	Silver King	Agha Hasher
	3	Anar Kali	Imtiaz Ali Taj
	4	Tawliyy	Upendra Nath
Ashk	5	Zahak	Mohd Hasan

Afsana:	1	Prem Chnd, Krishma Candra , Minto, Bedi, Ismat chughtai. Q.A. Haider.
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(Marsiya)

	1	Qasam Kahe Di khao Satahi Hashim Ali
	2	Kaha Ashk ne yun Jeth ke Sauda
	3	Kis Noor ki Majlis men Zameer
	4	Bakhuda Fase Mandan Anees Jab Qate ki Musafati Shab Anees
	5	Paida Shua e Maher ki Dabeer
	6	Husavi Aur Inqilab Josh
	7	Sham e Ghareeban Javed Mazhari
	8	Islam Dean Azmat Ali Raza

(Tareekh Urdu Zaban o Adab)

- 1 Diftaten of Langvage.
- 2 Family of Language.
- 3 College of Urdu ( Fort eilliam, Delhi College)
- 4 Ali Garh Tahreek
- 5 Taraqqi Pasand Tahreek
- 6 Age of Ghalib
- 7 Dilhi School of Poetry
- 8 Lucknow School of Poetry
- 9 Modern age of Litt.
- 10 Age of Iqbal

(Ghazal)

Wali, Meer, Dard, Atish. Nasikh, Ghalib, Shjaed Fami, Badayuni, Hasrat, Firaq Gorakhpuri, Faiz, Nasi Kazmi-

(Nazm)

Nazar Akbarabadi: Holi ki Baharen, Barsat ki Baharen, Jadey ki Baharen, Kaljag, Admi Nama, Baldev ji ka mela, Share Ashob.

Hali: Intikhab U.P. Urdu Academy  
Akbar Allhabadi : British Raj, Barg w Kaleem , Labe Sahil Mauj, Khuda Hafiz .

Chakbast: Faryade Qaum, Khake Hind, Phool Mala, Alviday , Phool Mala, Gokhle.

Iqbal: Tulua Islam, Shma o Sahar, Masjid e Qurtuba, Zauq o Shauq, Shauq e Ummeed , Jebreel o Iblees.

Fakhta Josh: Baghawat , Rishwat, Naqqad, Fitir e Khanqah, Jangal ke Shahzadi, ke Awaz.

Faiz: All Poems of Daste Saba

Majaz: Awara, Rat aur Ratin.

Sardar Jafri: Ek khwab aur , Zindagi , Salam. Arzoo ke Sanam Khane .

Makhdoom: Yad Hai. Intizar. Hareli. Jang. Qzadi.

(Dastan aur Nawel)

- |          |   |                             |
|----------|---|-----------------------------|
| (Dastan) | 1 | Bagh o Bahar Meer Amman     |
|          | 2 | Fasanai Ajaif Rajjab Ali    |
|          | 3 | Gulshane Nau Bahar Mehjoor  |
|          | 4 | Fasanai Azad R.N. Shar Sher |

- |         |   |                            |
|---------|---|----------------------------|
| (Nowel) | 1 | Taubatun Nasooh Nazeer     |
|         | 2 | Firdaus Bareen A.H. Saroor |
|         | 3 | Umrao Jaan Ada Hadi Ruswa  |
|         | 4 | Gau Daan Premchand         |

	5	Teerhi Lakeer Ismat chughtai
(Tanqeed)	6	Aag ka darya Q.A. Haider

Mashriq aur Maghrib  
 Tanqeed ki Qismin  
 School of Tanqeed  
 Practical of Criticsim  
 Hali, Shibli, Azad, Ehtisham Husaini, Kaleemuddin Ahmad,  
 Ali Ahmad Sarver etc.

1	Ghalib
2	Iqbal
3	Prem chand
4	Meer Anees

### **(43) ZOOLOGY**

Principles of taxonomy as applied to the systematics and classification of the animal kingdom  
 Classification and interrelationship amongst the major invertebrate phyla; Minor invertebrate  
 phyla, Functional anatomy of the nonchordates; Larval forms and their evolutionary  
 significance.

Classification and comparative anatomy of protochordates and chordates; Origin, evolution  
 and distribution of chordates groups: Adaptive radiation.

Histology of mammalian organ systems, nutrition, digestion and absorption; Circulation  
 (open and closed circular, lymphatic systems, blood composition and function); Muscular  
 contractor and electric organs; Excretion and osmoregulation: Nerve conduction and  
 neurotransmitters major sense organs and receptors; Homeostatic (neural and hormonal);  
 Bioluminescence Reproduction.

Gametogenesis in animals: Molecular events during fertilization, Cleavage patterns and fate  
 maps, Concepts of determination, competence and induction, totipotency and nuclear transfer  
 experiments: Cell differentiation and differential gene activity: Morphogenetic determinants  
 in egg cytoplasm; Role of maternal contributions in early embryonic development: Genetic  
 regulations of early embryonic development in Drosophila; Homoeotic genes.

Feeding, learning, social and sexual behaviour of animals; Parental care; Circadian rhythms;  
 Mimicry; Migration of fishes and birds; Sociobiology; Physiological adaptation at high  
 altitude.

Important human and veterinary parasites (protozoans and helminthes); Life cycle and  
 biology of Plasmodium, Trypanosome, Ascaris, Wuchereria, Fasciola, Schistosoma and  
 Leishmania; Molecular, cellular and physiological basis of host – parasite interactions.

Arthropods and vectors of human diseases (mosquitoes, lice, fleas and ticks); Mode of  
 transmission of pathogens by vectors; Chemical, biological and environmental control of

anthropoid vectors: Biology and control of chief insect pests of agricultural importance; Plant host–insect interaction, insect pest management; useful; silkworm.

The law DNA constancy and C–value paradox; Numerical, and structural changes in chromosomes; Molecular basis of spontaneous and induced mutations and their role in evolution; Environmental mutagenesis and toxicity testing: Population genetics.

Structure of pro–and eukaryotic cells; membrane structure and function; intracellular compartments, protein sorting, secretory and endocytic pathways; Cytoskeleton; Nucleus; Mitochondria and chloroplasts and their genetic organisation; cell cycle; Structure and organisation of chromatin, polytene and lampbrush chromosomes; Dosage compensation and sex determination and sex–linked inheritance.

Interactions between environment and biota; Concept of habitat and ecological richness; Limiting factor; Energy flow, food chain, food web and trophic levels; Ecological pyramids and recycling biotic community–concept, structure, dominance, fluctuation and succession; N.P.C. and S cycles in nature.

Ecosystem dynamics and management; Stability and complexity of ecosystems; Speciation and extinctions; environmental impact assessment; Principles of conservation; Conservation strategies; sustainable development.

Physico–chemical properties of water; kinds of aquatic habitats (fresh water and marine): Distribution of and impact of environmental factors on the aquatic biota; Productivity, mineral cycles and biodegradation in different aquatic ecosystems; Fish and Fisheries of India with respect to the management of estuarine, coastal water systems and man–made reservoirs: Biology and ecology of reservoirs.

Structure, classification, genetics, reproduction and physiology of bacteria and viruses (of bacteria, plants and animals); Mycoplasma protozoa and yeast (a general account).

Microbial fermentation: Antibiotics, organic acids and vitamins; Microbes in decomposition and recycling processes; Symbiotic and asymbiotic N<sub>2</sub>–fixation; Microbiology of water, air, soil and sewage: Microbes as pathological agents in plants, animals and man; General design and applications of a biofermenter, Biofertilizer.

Antigen: Structure and functions of different classes of immunoglobulins; Primary and secondary immune response; Lymphocytes and accessory cells; Humoral and cell mediated immunity: MHC; Mechanism of immune response and generation of immunological diversity; Genetic control of immune response. Effector mechanisms: Applications of immune response, Effector, mechanisms: Applications of immunological techniques.

Enzyme Kinetics (negative and positive cooperativity): Regulation of enzymatic activity; Active sites; Coenzymes: Activators and inhibitors, isoenzymes, allosteric enzymes; Ribozyme and abzyme.

Van der Waals' electrostatic, hydrogen bonding and hydrophobic interaction; Primary structure and proteins and nucleic acid; Conformation of proteins and polypeptides (secondary, Tertiary, quaternary and domain structure); Reverse turns and Ramachandran plot; Structural polymorphism of DNA, RNA and three dimensional structure of rRNA;

Structure of carbohydrates, polysaccharides, glycoproteins and peptido-glycans; Helix-coil transition; Energy terms in biopolymer conformational calculations.

Glycolysis and TCA cycle: Glycogen breakdown and synthesis; Gluconeogenesis; interconversion of hexoses and pentoses; Amino acid metabolism; Coordinated control of metabolism; Biosynthesis of purines and pyrimidines; Oxidation of lipids; Biosynthesis of fatty acids; Triglycerides; Phospholipids; Sterols.

Energy metabolism (concept of free energy); Thermodynamic principle in biology; Energy rich bonds; Weak interactions; Coupled reactions and oxidative phosphorylations; Group transfer; Biological energy transducers; Bioenergetics.

Fine structure of gene, Eukaryotic genome organisation (structure of chromatin, coding and non-coding sequences, satellite DNA); DNA damage and repair, DNA replication, amplification and rearrangements.

Organization of transcriptional unit; Mechanism of transcription of prokaryotes and eukaryotes; RNA processing (capping, polyadenylation, splicing, introns and exons); Ribonucleoproteins, structure of mRNA; Genetic code and protein synthesis.

Regulation of gene expression in pro and eukaryotes; Attenuation and antitermination; Operon concept; DNA methylation; Heterochromatinization; Transposition; Regulatory sequences and transacting factors; Environmental regulation of gene expression.

Biochemistry and molecular biology of cancer; Oncogenes; chemical carcinogenesis; Genetic and metabolic disorders; Hormonal imbalances; Drug metabolism and detoxification; Genetic load and genetic counseling.

Lysogeny and lytic cycle in bacteriophages; Bacterial transformation; Host cell restriction; Transduction; Complementation; Molecular recombination; DNA ligases; Topoisomerases; Gyrase; Methylases; Nucleases; Restriction endonucleases; Plasmids and bacteriophage base vectors for cDNA and genomic libraries.

Principles and methods of genetic engineering and Gene targeting; Applications in agriculture, health and industry.

Cell and tissue culture in plants and animals; Primary culture; Cell line; Cell clones; Callus cultures; Somatic variation; Micropropagation; Somatic embryogenesis; Haploidy; Protoplast fusion and somatic hybridization; Cybrids; Gene transfer methods in plants and in animals; Transgenic biology; Allopheny; Artificial seeds; Hybridoma technology.

Structure and organisation of membranes; Glycoconjugates and proteins in membrane systems; ion transport,  $\text{Na}^+ / \text{K}^+$ -ATPase; Molecular basis of signal transduction in bacteria, plants and animals; Model membranes; Liposomes.

Principles and application of light phase contrast, fluorescence, scanning and transmission electron microscopy, Cytophotometry and flow cytometry, fixation and staining.

Principles and applications of gel-filtration, ion-exchange and affinity chromatography; Thin layer and gas chromatography; High pressure liquid (HPLC) chromatography; Electrophoresis and electrofocussing; Ultracentrifugation (velocity and buoyant density).

Principles and techniques of nucleic acid hybridization and Cot curves; Sequencing of Proteins and nucleic acids; Southern, Northern and South-Western blotting techniques; Polymerase chain reaction; Methods for measuring nucleic acid and protein interactions.

Principles of biophysical methods used for analysis of biopolymer structure X-ray diffraction, fluorescence, UV, ORD/CD, Visible, NMR and ESR spectroscopy; Hydrodynamic methods; Atomic absorption and plasma emission spectroscopy.

Principles and biophysical methods used for analysis of biopolymer structure, applications of tracer techniques in biology; Radiation dosimetry; Radioactive isotopes and half life of isotopes; Effect of radiation on biological system; Autoradiography; Cerenkov radiation; Liquid scintillation spectrometry.

Principles and practice of statistical methods in biological research, samples and populations; Basic statistics-average, statistics of dispersion, coefficient of variation; standard error; Confidence limits; Probability distributions (binomial, Poisson and normal; Tests of statistical significance; Simple correlation of regression; Analysis of variance.