

**FOUR-YEAR INTEGRATED B.Sc. B.Ed. PROGRAMME  
(CBCS)  
OF  
REGIONAL INSTITUTE OF EDUCATION,  
NCERT, BHUBANESWAR  
(UTKAL UNIVERSITY, BHUBANESWAR)**

**REGULATIONS AND SCHEME OF STUDIES**

**2017**

विद्यया ऽ मृतमश्नुते



एन सी ई आर टी  
NCERT

**REGIONAL INSTITUTE OF EDUCATION  
(National Council of Educational Research and Training)  
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**Table 1: PROGRAMME STRUCTURE**

**(L: Lecture, P: Practical, Semi: Seminar, Cr: Credit, CH: Contact Hours, W: Weeks)**

<b>Semester</b>	<b>CC</b>	<b>GE-I</b>	<b>GE-II</b>	<b>DSE</b>	<b>AECC</b>	<b>SEC</b>	<b>CBC*</b>	<b>Education</b>	<b>Total</b>
<b>I</b>	CC-1: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-I-1: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-II-1: 100 4(L)+2(P)=6 Cr: 4+2=6		AECC-1:100 4(L)=4 Cr: 4=4			PE-1:100, EPC-1:50 CH :4, 2 Cr: 4+2 =6	Marks: 400+150=550 CH: 24+4=28 Credit: 22+6=28
<b>II</b>	CC-2: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-I-2: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-II-2: 100 4(L)+2(P)=6 Cr: 4+2=6			SEC:100 2(L)+2(P)=4 Cr: 4		PE-2:100, CPS-1:50 CH:4, 2 Cr: 4+2=6	Marks: 400+150=550 CH: 22+6=28 Credit: 22+6=28
<b>III</b>	CC-3: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-I-3: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-II-3: 100 4(L)+2(P)=6 Cr: 4+2=6		AECC-2:100 4(L)=4 Cr: 4=4			PE-3:100, PE-4:100 CH:4,4 Cr: 4+4=8	Marks: 400+200=600 CH: 24+6=30 Credit: 22+8=30
<b>IV</b>	CC-4: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-I-4: 100 4(L)+2(P)=6 Cr: 4+2=6	GE-II-4: 100 4(L)+2(P)=6 Cr: 4+2=6	DSE-1:100 4(L)+2(P)=6 Cr: 4+2=6				PE-5:100,PE-6:50 CH:4,2 Cr: 4+2=6	Marks: 400+150=550 CH:24+6=30 Credit: 24+6=30
<b>V</b>	CC-5 & 6: 100x2 [4(L)+2(P)=6]x2 [Cr: 4+2=6]x2 CC-7&8: 100x2 [4(L)+2(P)=6]x2 [Cr: 4+2=6]x2							CPS2-1:100, CPS3-1:100, EPC-2:50 CH:4,4,4 Cr: 4+4+2=10	Marks: 400+250=650 CH: 24+12=36 Credit: 24+10=34
<b>VI</b>	CC-9&10: 100x2 [4(L)+2(P)=6]x2 [Cr: 4+2=6]x2 CC-11&12: 100x2 [4(L)+2(P)=6]x2 [Cr: 4+2=6]x2						CBC:100* 4(L)* Cr: 4*	CPS2-2:100, CPS3-2:100, FE-1:50 CH:4,4,2W Cr:4+4+2=10	Marks: 400+100*+250=650+100* CH: 24+4*+10+2W=34+4*+2W Credit: 24+10=34
<b>VII</b>								PE-7:100, EPC-3:50, EPC-4:50, FE-2:350 CH:4,2W,2W,16W Cr: 4+2+2+14=22	Marks: 000+550=550 CH: 4+20W Credit: 0+22=22
<b>VIII</b>	CC-13: 100 4(L)+2(P)=6 Cr: 4+2=6 CC-14: 100 4(Pr) Cr: 6			DSE-2 Project:100 CH: 4, Cr: 4				PE-8:100, EPC-5:50, EPC-6:50, EPC-7:50, FE-3:50 CH:4,2W,2,2,2W Cr: 4+2+2+2+2=12	Marks: 300+300=600 CH: 16+12+2W+2W=28+4W Credit: 16+12=28
<b>Total</b>	<b>Marks:14x100=1400</b> <b>CH:56+28=84</b> <b>Cr: 56+28=84</b>	400 CH:16+8=24 Cr: <b>24</b>	400 CH:16+8=24 Cr: <b>24</b>	2x100=200 CH:6+4=10 Cr: 6+4=10	2x100=200 CH:4+4=8 Cr: 4+4=8	<b>100</b> CH:4 Cr: <b>4</b>	<b>100*</b> CH:4* Cr: <b>4*</b>	<b>Marks: 2000</b> <b>CH: 56+24W</b> <b>Credit: 80</b>	<b>Marks:2700+100*+2000=4700+100*</b> <b>CH: 154+4*+56+24W=208+4*+24W</b> <b>Credit: 154+4*+80=234+4*</b>

CC: Core Course, GE: Generic Elective, DSE: Discipline Specific Elective, AECC: Ability Enhancement Compulsory Course, SEC: Skill Enhancement Course, CBC: Choice Based Course

**Total Marks = 2700+100\* (B.Sc.)+ 2000 (B.Ed.) = 4700+100\*      Total Credit = 154+4\* (B.Sc.) + 80 (B.Ed.) = 234+4\***

\* To be considered as an add-on course to the four-year integrated B.Sc.B.Ed. Programme

## Abbreviation

CC .....	Core Course (For Hons. Student)
GE .....	Generic Elective (For General Student)
DSE .....	Discipline Specific Elective
AECC .....	Ability Enhancement Compulsory Course
SEC .....	Skill Enhancement Course
CBC .....	Choice Based Course
PCM .....	Physics Chemistry Mathematics
CBZ .....	Chemistry Botany Zoology
SGPA .....	Semester Grade Point Average
CGPA .....	Cumulative Grade Point Average
LER .....	Low Energy Responses
HIR .....	High Irradiance Responses

# **REGULATIONS**

**Regulations of the Four-Year Integrated B.Sc.B.Ed. Programme of the  
Regional Institute of Education (NCERT), Bhubaneswar  
(CBCS)**

**1. Introduction**

The Four-Year Integrated B.Sc.B.Ed. Programme as a teacher education programme has been running successfully at the Regional Institute of Education (NCERT) Bhubaneswar (RIE) for a number of years. The RIE is a high quality institution of teacher education functioning since 1963. It caters to the needs of the states and union territory of eastern India namely Odisha, West Bengal, Bihar, Jharkhand, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, and Andaman & Nicobar Islands. It is a constituent Unit of the National Council of Educational Research and Training (NCERT), New Delhi, the apex body of school education in the country. The programme has been periodically reviewed and reformulated depending on changing education policies and teacher education frameworks. The latest version, formulated in 2010, was based on the National Curriculum Framework (NCF) – 2005 formulated by NCERT and the Curriculum Framework for Teacher Education – 2009 of the National Council of Teacher Education (NCTE). The programme is now being reformulated in accordance with the NCTE Regulations-2014 vide Notification Dated 28<sup>th</sup> November 2014 in The Gazette of India: Extraordinary, Part III-Sec. 4, Appendix-13. Further, the provisions of Choice-Based Credit System (CBCS) and Grading have also been incorporated in the programme, as stipulated by UGC.

**2. Salient Features of the Programme**

The four-year integrated B.Sc.B.Ed. programme aims at preparing quality teachers in science and mathematics for upper primary and secondary stages of education by integrating *general studies* comprising science and mathematics, *language studies* to enhance communication skills, and *professional studies* comprising foundations of education, pedagogy of school subjects, and practicum related to the tasks and functions of a school teacher. It maintains a balance between theory and practice, and coherence among the components of the programme, representing a wide knowledge base of a secondary school teacher. The programme shall be of four academic years consisting of eight semesters including school based experiences and internship-in-teaching. Student teachers shall, however, be permitted to complete the programme within a maximum period of six years from the date of admission to the programme. On successful completion of the programme, they may enter teaching profession or opt for higher education in their respective areas of interest.

**3. Objectives of Programme**

The 4-year integrated B.Sc.B.Ed. programme aims at enabling the student teachers to

- Develop knowledge and performance competencies in science and mathematics
- Understand the nuances of child psychology and how children learn.
- Get acquainted with the content and pedagogical aspects of the teaching learning process suitable for secondary level of school education
- Enhance the skill of communication
- Appreciate and apply the latest approach such as the constructivist approach to teaching learning
- Adopt innovative strategies in classroom processes

- Discover different human values inherent in content domains
- Use laboratory devices and processes effectively and efficiently
- Develop critical thinking, abstract reasoning, creativity and problem solving skills
- Address issues related to natural resources and promote eco-friendly practices & sustainability
- Use low-cost/no-cost materials to demonstrate scientific concepts
- Get functional familiarity with ICT and use it as a teaching learning tool
- Become effective teachers of science and mathematics at secondary level by imbibing appropriate professional values.

#### 4. **Streams**

Presently the B.Sc.B.Ed. programme has two streams namely PCM (Physics, Chemistry, Mathematics) and CBZ (Chemistry, Botany, Zoology) with equal number of seats.

#### 5. **Programme Structure**

Semester-wise and course-wise structure of the four-year integrated B.Sc.B.Ed. programme is shown in Table 1. The structure is common to all disciplines under B.Sc.B.Ed. Following the UGC guide lines, the different B.Sc. related courses to be offered in the programme are categorized as CC or Core Course, GE-I or Generic Elective-I, GE-II or Generic Elective-II, DSE or Discipline Specific Elective, AECC or Ability Enhancement Compulsory Course, SEC or Skill Enhancement Course, and CBC or Choice Based Course. The CBC component is designed such that it may be taken by any student enrolled in any programme. The student may opt for any one of the choice based courses to be offered by the institute. As the credit and grade associated with CBC are not to be included in those of the main programme, the CBC is marked with a star (\*) in Table 1.

**Choice Based Course (CBC):** CBC Courses have to be offered in Semester VI. A student has to opt any one of the CBC courses from any subject area of his/her choice.

- Chemistry and our life
- Renewable Energy and Energy Harvesting
- Food, Nutrition and Public Health
- General Mathematics
- Herbal plants for home gardening
- Basics of Social Sciences
- English (creativity in translation)
- Hindi Bhasha aur Sahitya ka Samanya Gyan
- Communicative language(Odia)
- Bangla Sahitya o Byakaran Gyana (Bengali)
- Educational Planning, Management and Leadership

#### 6. **Affiliating Body**

The programme is affiliated to Utkal University, Bhubaneswar, established by the Government of Odisha and functioning since 1943. The university has been accredited with A<sup>+</sup> grade by NAAC.

#### 7. **Medium of Instruction**

The medium of instruction for the programme is English except for the language courses.

#### 8. **Programme Duration**

The normal duration of the programme is eight semesters to be completed in four years.

The maximum time limit allowed for programme completion is six years.

Odd semester (1<sup>st</sup>, 3<sup>rd</sup>, 5<sup>th</sup>, 7<sup>th</sup>) is from July to December and even semester (2<sup>nd</sup>, 4<sup>th</sup>, 6<sup>th</sup>, 8<sup>th</sup>) is from January to June.

The respective semester-end examinations shall be normally held in November-December and April-May.

## 9. Number of Seats

The number of seats for the programme will be as per sanction of NCERT and approval of NCTE and Utkal University.

The seats are distributed among the states and union territory under the jurisdiction of RIE Bhubaneswar taking into account the central government reservation policies/NCERT guidelines as admissible from time to time.

## 10. (i) Provision of Honours/ Core Course (CC) and Generic Elective

Students in CBZ stream may opt for either Botany or Zoology for their honours course or core course (CC).

Students in PCM stream may opt for Physics or Chemistry or Mathematics for their honours course or core course (CC).

### Provision of Generic Electives (GE-1, GE-2)

Honours or Core Course (CC)	Generic Elective (GE-1, GE-2)
Botany	Zoology, Chemistry
Chemistry	Physics, Mathematics
Mathematics	Physics, Chemistry
Physics	Chemistry, Mathematics
Zoology	Botany, Chemistry

The generic electives for different core courses have been considered as above in view of the requirement of (i) a PCM teacher who should be strong in physics, chemistry, and mathematics, and (ii) a CBZ teacher who should be strong in botany, zoology and chemistry.

## 11. Eligibility and Admission

Candidates with 50% marks or equivalent grade in the senior secondary /higher secondary or +2 examination with Physics, Chemistry, Mathematics and or Biology are eligible for the programme. Reservations are available as per the existing norms approved by NCERT.

Admission shall be made on the basis of marks obtained in the qualifying examinations and in the entrance examination or any other selection process as per the policy of the NCTE/ NCERT/affiliating University from time to time.

On successful completion of a semester, the candidate shall be readmitted to the next semester on payment of the requisite fees.

## 12. Change of Subject

Once chosen, subject change is not permissible under any circumstances in a given semester or subsequent semesters.

## 13. Attendance

Minimum 80% attendance is required in each course and minimum 90% attendance is required in internship for being eligible to appear at semester examination.

Up to 15% waiver may be granted by VC on the recommendation of the Principal of the Institute on payment of usual fees prescribed by the University. If a student represents University/State/National/District in sports and games and NCC/NSS/Scout –Guides/cultural activities or any official activities, s/he is permitted to avail 30 days academic leave in an academic year based on the recommendation of the head of the institution.

There shall be no condonation if the attendance is below 65% in any course during any semester, for any reason.

A candidate who does not satisfy the requirement of attendance shall not be eligible to take the examination of the concerned semester, nor will be eligible to take admission to the next semester.

A candidate who fails to satisfy the requirement of attendance in a semester may repeat that semester in the subsequent academic year.

#### 14. Weightage (Percentage) Distribution for Evaluation

##### (i) Paper without Practical

<i>1<sup>st</sup> Internal Assessment</i>	<i>2<sup>nd</sup> Internal Assessment</i>	<i>Semester End</i>	<i>Total</i>
20	20	80	100
Average 20			

##### (ii) Paper without Practical

<i>1<sup>st</sup> Internal Assessment</i>	<i>2<sup>nd</sup> Internal Assessment</i>	<i>Semester End</i>	<i>Total</i>
10	10	40	<b>50</b>
10			

##### (iii) Paper with Practical

<i>1<sup>st</sup> Internal Assessment</i>	<i>2<sup>nd</sup> Internal Assessment</i>	<i>Semester End</i>		<i>Total</i>
		<i>Theory (A)</i>	<i>Practical (B)</i>	
15	15	60	25	100
Average 15				

##### (iv) Project

**100 marks**

#### 15. Grading System

A student's level of competence shall be categorized by a GRADE POINT AVERAGE, as specified below;

- **SGPA** – Semester Grade Point Average
- **CGPA** – Cumulative Grade Point Average

The following procedure shall be followed to calculate the Grade Point Average (GPA)

## i) Converting mark to grade

Marks Secured from 100	Grade Point	Letter Grade	Interpretation
100–90	10	'O'	Outstanding
89–80	9	'E'	Excellent
79–70	8	'A'	Very Good
69–60	7	'B'	Good
59–50	6	'C'	Fair
49–40	5	'D'	Pass
<40	0	'F'	Fail
<b>0</b>	<b>0</b>	<b>Ab</b>	<b>Absent</b>

## ii) Calculating SGPA and CGPA

Point = Integer equivalent for each letter grade

Credit (2,4,6,8) = Integer signifying the relative importance/ emphasis given to individual paper/ course in a semester as reflected in the course structure/ syllabus.

a) Credit point = Credit (in a paper) x grade point (secured in that paper)

b) Credit Index = Total Credit point of the course

c) Grade Point Average (for a course or subject) =  $\frac{\text{Credit Index}}{\text{Total Credit of the Course}}$

d) Semester Grade Point Average (SGPA) =  $\frac{\text{Credit Index for a Semester}}{\text{Total Credit of the Semester}}$

e) Cumulative Grade Point Average (CGPA) =  $\frac{\text{Credit Index of all previous Semesters up to a Semester}}{\text{Total Credit up to Semester}}$

**16. Scheme of Examination; Requirement for Pass; Results**

**16.1** In each semester and in each paper, a candidate has to appear at both the internal assessments and secure minimum 40% in theory and 50% in practical/internal assessment separately. Otherwise, the candidate shall not be allowed to fill up forms for the semester examination.

A special internal assessment may be held for those who fail to meet the above requirement or remain absent with prior permission from competent authority.

**16.2** There shall be a university examination at the end of each semester, comprising theory and practical, where ever applicable.

The practical examinations for odd semesters shall be conducted and evaluated internally at the end of the semester.

The practical examinations for even semesters shall be conducted and evaluated by both internal and external examiners at the end of the semester.

A candidate has to secure minimum 40% to pass in each of the theory and 50 % in practical papers separately and 40 % in aggregate in subject specialization (B.Sc) component to pass.

Candidate obtaining Grade F is considered Failed and will be required to clear the back paper(s) in the subsequent examinations within the stipulated time.

Candidate securing Grade C(Grade point 6) or above in Core/Honours papers in aggregate will be awarded Honours.

Candidate securing 60% and above in CC/Hons. Courses shall be awarded First Class and 50% and above, but less than 60% shall be awarded Second Class. Distinction shall be awarded to candidates securing minimum 60% in all papers of B.Sc component.

Candidate securing Grade B(Grade point 7) or above in each paper separately in first appearance will be awarded Honours with Distinction.

Any candidate with back paper(s) shall not be awarded Distinction.

The provision for Honours/Distinction is applicable to the B.Sc. component of the programme.

In B.Ed(Professional Education) component a candidate has to secure minimum 40% in theory and 50 % in practical/practicum separately and 50 % in aggregate to pass the examination.

In B.Ed(Professional Education) component 60% and above will be awarded first class and 50% to less than 60% will be awarded second class. Distinction will be awarded to those candidates who secure 60% and above marks in all papers of B.Ed component.

All other provisions as above apply to both the B.Sc. and B.Ed. components of the programme.

- 16.3** The details of grading system shall be printed on the backside of the Mark Sheet/ Grade Card.
- 16.4** The performance of a candidate in his/her Choice Based Course (CBC) in the form of mark/grade will be indicated in the Mark Sheet/ Grade Card but will not be reflected in SGPA or CGPA.
- 16.5** Final result of the candidate who fails to secure minimum pass mark/grade/percentage in CBC shall not affect the result of the candidate.

## **17. Repeat Examination**

- 17.1** If a candidate fails to clear any paper(s) in a semester in the first attempt, he/she is allowed to clear the back paper(s) in two more consecutive attempts. The candidate has to complete the programme within 6 (4+2) years at the most.
- 17.2** No improvement in a paper will be allowed if the candidate has secured pass mark in the paper.

## **18. Hard Case Rule**

- 18.1** If a candidate fails maximum in two written papers, by not more than 2% of total theory marks for the Examination, the minimum marks required to make up the deficiency in the written papers be added in order to enable the candidate to pass the examination. In such cases the deficiency in aggregate should not be taken into account.
- 18.2** 0.5% grace mark can be given for award of B Grade in each semester provided grace mark under 18.1 has not been awarded.

**19 19.1 for subjects without practical**

- a) Theoretical courses:** Full marks are 100 per course out of which 20 marks are allotted for internal assessment and 80 marks for semester end examination. Courses having 50 marks, out of which 10 marks are allotted for internal assessment and 40 marks for semester end examination.
- b) Practical Courses:** Full marks are 100 per course out of which 15 marks are allotted for internal assessment, 25 marks for practical and 60 marks for semester end examination.

**19.2 Pattern of question papers for students under CBCS in the Semester-end Examination**

- a) In the semester-end examination there will be two groups of questions. Group-A will be compulsory comprising 10 restricted answer type questions covering all units. Group-B will comprise long answer type questions covering all units with unit-wise alternatives to each question.
- b) For practical subjects, out of 60 marks in semester-end exam, Group-A will have 10 marks (1x10) and Group-B will have 50 marks. Alternative questions will be set unit-wise for long answer type questions in Group-B.
- c) For non-practical subjects, out of 80 marks, Group-A will have 10marks (1x10) and Group-B will have 70 marks. Alternative questions will be set unit-wise for long answer type questions in Group-B.
- d) For courses having 40 marks, Group-A will be compulsory comprising 10 restricted answer type questions (1x10=10 marks) covering all units. Group-B will comprise 30 marks comprising of long answer type questions covering all units with unit-wise alternatives to each question.

**20. Provision for Periodic Review**

Review of the programme will be made in every four year to identify and address the relevant issues.



**Table-4: Enhancing Professional Capacities (EPC)**

	<b>Enhancing Professional Capacities (EPC)</b>	Marks	I	II	III	IV	V	VI	VII	VIII
1	EPC 1: Understanding ICT and Its Application	50	EPC 1 (2CH) (2Cr)							
2.1	EPC 2: Learning to Function as a Teacher	50					EPC-2 (4CH) (2Cre)			
3	EPC 3: Arts in Education (2 weeks)	50							EPC3 (2Cr)	
4	EPC 4: ICT Practicum (2 weeks)	50							EPC 4 (2Cr)	
5	EPC 5: Understanding the Self (2 weeks)	50								EPC5 (2c)
6	EPC 6: Health, Yoga and Physical Education	50								EPC 6 (2CH) (2Cr)
7	EPC 7: Reading and Reflecting on Texts	50								EPC 7(2CH) (2Cr)
	<b>Total Marks/ Total Credit ( EPC)</b>	350/14								

**Table-5:Field Engagement**

	<b>Field Engagement (FE)</b>	Marks	I	II	III	IV	V	VI	VII	VIII
1	FE-1: Multicultural Placement (2 weeks)	<b>50</b>						<b>FE-1 (2Cr)</b>		
2	FE-2: Internship (16 weeks)	<b>350</b>							FE-2(14Cr)	
3	FE-3: Community work (2 weeks)	<b>50</b>								FE-3(2Cr)
	<b>Total Marks/ Total Credit (FE)</b>	<b>450/18</b>								
	Total Marks	<b>2000</b>	<b>150</b>	<b>150</b>	<b>200</b>	<b>150</b>	<b>250</b>	<b>250</b>	<b>550</b>	<b>300</b>
	Total Credit	<b>80</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>10</b>	<b>10</b>	<b>22</b>	<b>12</b>
	Total Hours Table-2+3+4+5	<b>56hours+ 24 weeks</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>10</b>	<b>10+ 2 weeks</b>	<b>16 weeks Internship +4 weeks workshop=20 weeks</b>	<b>8 CH+4 weeks</b>

\*CH-Contact hours, \*\*Cr-credits

**21.The Professional Education. Course (PEC) Component** consists of the following.

*(i) Perspectives in Education (PE)*

Perspectives in Education include courses on Basics in education, Childhood and growing up, Learning and teaching, Assessment for learning, Knowledge and curriculum, Schooling and socialization, Vision for Indian education and Inclusive education.

*(ii) Curriculum and Pedagogic Studies (CPS)*

These courses intend to facilitate student teachers to recognize the nature of knowledge in various subject areas (Bio science/Mathematics and physical science) and pursue to keep themselves abreast with advancements in their areas of specialization. In view of the requirement of hands on experiences, each of the courses is designed as Part I and II – to be spread over two semesters. Part I will help in developing understanding of and competence to render disciplinary knowledge into forms relevant to stage specific objectives and their pedagogic requirements. Part II will provide a comprehensive understanding of the teaching learning situations gained through intensive study of conceptual explanations, observation and analysis of real life classroom situations, simulations as well as on hands on experiences.

*(iii)Enhancing Professional Capacities (EPC)*

Running across the eight semesters specialized courses on learning to function as teachers, ICT and its application, health and yoga, understanding self, arts in education, library resources and reading and reflecting on texts are offered to enhance the professional capacities of the student teachers. These courses act as curricular resources, developing personal and professional self and provide inputs on arts and aesthetics, yoga. These courses are focused on developing reflection, issues of identity (both personal and professional), interpersonal relations all in the context of school. The field related experience guides the student teachers to view schools as sites for social change, it develops sensitivity to the fellow citizens through listening and empathizing.

*(iv) Engagement with the Field/Practicum (FE)*

The Programme shall provide sustained engagement with the self, the child, the community and the school, at different levels and through establishing close connections between different curricular areas. These curricular areas would serve as an important link between the perspective and curriculum and pedagogic studies and enhancing professional capacities in the form of tasks and assignments and internship.

School Internship would be a part of this broad curricular area and shall be designed to lead to develop a broad repertoire of perspectives, professional capacities, teacher sensibilities and skills. The curriculum shall provide for sustained engagement with learners and the school. Student-teachers shall be equipped to cater to diverse needs of learners in schools.

**22.Some Specific Modes of Learning Engagement Envisaged:**

- Overarching lectures cum discussion
- Use of narratives based on research and documentation
- Project reviews
- Case studies
- Use of video-clips and transcripts of classroom teaching
- Success stories/innovations
- Observation in schools and other field sites
- Recording of observations and experiences
- Interviews with school personnel

- Panel or group discussion on issues
- Individual projects
- Journal writing
- Using library and ICT resources

### **23. Enhancement of learning through School-based experiences**

Most courses require school experience for various purposes. Some significant aspects of these experiences are outlined:

- School visits and observations spread over the semesters, including
  - Observation visits
  - School attachment
  - Longer duration attachment, along with mentoring
- School as a site for practical learning linked with theory
- Single school visit for carrying out tasks related to more than one course
- Exposure to variety of schools in order to understand larger systemic issues
- School-based experience to learn not only classroom pedagogy, but also learning to function as a teacher in the school environment

# ABILITY ENHANCEMENT COMPULSORY COURSES

## SEMESTER-I

### Ability Enhancement Compulsory Course (AECC-I) Communicative English

Contact Hour per Week	:	4 per weeks
Credits	:	4
Examination duration	:	3 Hours
Maximum marks	:	100 (Terminal- 80, Sessional- 20)

Objectives: At the end of the course the students are expected to:

- Understand the basics of communication
- Distinguish between the types of communications and their applications
- Observe the various uses of communications
- Differentiate between verbal and non-verbal communications
- Identify the barriers to communications

#### Unit 1 : Introduction

1. Meaning, nature of communication.
2. Types of communication
  - Horizontal
  - Vertical
  - Interpersonal
  - Grapevine

#### Unit 2: Language of Communication

1. Verbal: spoken and written
2. Non-verbal:
  - Proxemics
  - Kinesics
  - Haptics
  - Chronemics
  - Paralinguistics

#### Unit 3: Barriers to communication

1. Semantic
2. Physical
3. Physiological
4. Cultural
5. Organization
6. Personal
7. Perceptual
8. Socio-psychological

#### Unit 4 : Overcoming barriers to communication

- Importance of Communication
- Communicative English

#### Transactinal Strategies:

- Lecture, group interaction, material review and presentation, etc.

#### Reference Books:

- Communicative books 1 and 2 – Sanghita Sen (Foundation / Cambridge UP)
- Written and spoken communication in English – Universities Press; First Edition (2007)

- Chapter 1 *Applying Communication Theory for Professional Life: A Practical Introduction* by Dainton and Zelley.
- Business Communication, Orient BlackSwan, 2012.
- <http://tsime.uz.ac.zw/claroline/backends/download.php?url=L0ludHJvX3RvX2NvbW11bmljYXRpb25fVGhlb3J5LnBkZg%3D%3D&cidReset=true&cidReq=MBA563>

**SEMESTER-III**  
**Ability Enhancement Compulsory Course**  
**AECC-III (Environmental Studies)**

Contact Hour per Week : 4 per weeks  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 100 (Terminal- 80, Sessional- 20)

**Objectives:** On completion of this course, the student-teachers shall be able to

- Understand the environment as an integral part of what they are learning and doing
- Develop sensitivity to and appreciation of the tremendous diversity in the natural and human world, and adding richness to every aspects of life and learning
- Understand the structure and functions of different ecosystems and the principle of cycling associated with it.
- Conserve natural resources and use it judicially.
- Follow eco-friendly practices and work for environmental sustainability
- Understand environmental laws and associated legislations.
- Participate in environmental protection and its improvement
- Attend the skills for solving environmental problems.
- Acquire the social values including strong feelings of concern for the environment and motivating for actively participating in its protection and improvement.

**Unit 1:Environment and Environmental Education:**

Environment and its importance (Atmosphere, Hydrosphere, Lithosphere and Biosphere). Environmental Education; Definition, Multidisciplinary nature, Environmental education with special reference to Indian view of Life.

Basic Environmental Concept, Ecology and Environmental Crises:

Ecosystem and its structure, species and community, Major ecosystems, (Energy flow in ecosystem, Food chain, Food web, Ecological pyramid). Biogeochemical Cycles, Factors affecting Environment.

Environmental Crises: Pollution, Soil erosion, Green house effect (Global warming), Acid rain, Extinction of Species. Energy crises.

**Unit 2 :Biodiversity and Natural Resources, Environmental Movements, Laws and Acts in India**

Concept of Biodiversity (Types, Importance, Threats and Conservation of Biodiversity). Natural Resources; Classification and Management of Natural Resources, Conservation of Forest and Wild life, Urbanization and its effect on Society; Communicable diseases; Transmission; Non-communicable diseases. Natural Disasters and Management, Sustainable Development.

Environmental movements in India, Role of women in Environmental movements, Environmental movements in Odisha. Environmental Laws and Acts ( Central Pollution Control Board, State Pollution Control Board, Green Tribunal, Wild life Protection Act 1972, Water Act 1974, Air Act 1981, Forest Conservation Act 1980, Environmental Protection Act 1986, Biodiversity Act 2002).

### **Unit 3: Curriculum, Methods and Technologies of Teaching Environment studies**

Designing and Developing Strategies for Environmental Education curriculum. Evaluation of Environment Education Resources and Materials

- Study Tours and Field Visits
- Role Play
- Poster Presentation
- Quiz
- Debate and Discussions
- Enquiry based method
- Project Method

### **Unit 4: Promotion of Environmental Education and Value Development**

- Role of Mass Media and Technology in Developing awareness about Environment and its protection.
- Role of NGOs and Government organizations in Developing Environmental Education, Ecoclubs, Museum of Natural History.
- Specially designed strategies for cleanings; "Swachh Bharat Abhiyan"
- Role of Education, Education for Sustainable Development
- Climate Change and Green Lifestyle
- Text book evaluation for the context on Environmental issues
- Visit to Nature Park, Environmentally Sensitive Areas

### **References**

- Purohit, S.S. and Ranjan, R. (2007) Ecology, Environment and Pollution. Agrobios Publication.
- Sharma, P.D. (2014) Ecology and Environment. 12<sup>th</sup> edition. Rastogi Publication.
- Hussain, M. (2014) Environment and Ecology. 3<sup>rd</sup> edition. Access Publication.
- Odum, E. (2004) Fundamentals of Ecology. 5<sup>th</sup> edition. Cengage Learning India Pvt. Ltd.
- Kormondy, E.J. (1995) Concepts of Ecology. 4<sup>th</sup> edition. Prentice Hall Publication.
- Satapathy, M.K. (2007) Education, Environment and Sustainable Development, Shipra Publications, New Delhi.
- Smith, T.M. and Smith, R.L. (2015) Elements of Ecology 9<sup>th</sup> edition. Pearson.
- Dash, D. and Satapathy, M.K. (2013) People Who Make A Change: Men and Women in Environmental Movement. Kunal Publication, New Delhi.
- Dash, M. and Dash, S. (2009). Fundamentals of Ecology 3<sup>rd</sup> edition. McGraw Hill Education.

## PROGRAM STRUCTURE: BOTANY (HONS.)

Sem-ester	AECC	CC (Hons) Botany	GE-I* Chemistry	GE-II* Zoology	DSE	SEC	Education	CBC*
I	AECC-1 Communicative English	CC-1 (Th+Pr)	GE-1 (Th+Pr)	GE-1 (Th+Pr)			PE-1 EPC-1	
II		CC-2 (Th+Pr)	GE-2(Th+Pr),	GE-2 (Th+Pr)		SEC-(Th+Pr)	PE-2 CPS-1	
III	AECC-3 (Environmental Studies)	CC-3 (Th+Pr)	GE-3(Th+Pr),	GE-3 (Th+Pr)			PE-3 PE-4	
IV		CC-4 (Th+Pr)	GE-4(Th+Pr),	GE-4 (Th+Pr)	DSE -I (Th+Pr)		PE-5 PE-6	
V		CC-5 (Th+Pr) CC-6 (Th+Pr) CC-7 (Th+Pr) CC-8 (Th+Pr)					CPS2-1 CPS3-1 EPC-2	
VI		CC-9 (Th+Pr) CC-10 (Th+Pr) CC-11(Th+Pr) CC-12(Th+Pr)					CPS2-2, CPS3-2, FE-1	CBC
VII							PE-7, EPC-3 EPC-4, FE-2	
VIII		CC-13 (Th+Pr) CC-14(Th+Pr)			DSE-II (Project)		PE-8, EPC-5, EPC-6, EPC-7, FE-3	

\*GE ( Chemistry) is equivalent to CC (Chemistry)

\*GE ( Zoology) is equivalent to CC (Zoology)

## BOTANY

### SCHEME OF EXAMINATION

#### Semester-I

<b>GE/CC1.1 :</b>	<b>Biodiversity (Microbes, Algae, Fungi and Archgoniate) (Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 : Microbes	
	Unit 2 : Algae & Fungi	
	Unit 3 : Introduction to Archegoniate and Bryophytes	
	Unit 4 : Pteridophytes and Gymnosperms	
<b>GE/CC1.2 :</b>	<b>Practical</b>	<b>25marks</b>

#### Semester-II

<b>GE/CC2.1 :</b>	<b>Plant physiology and metabolism (Terminal-60,Sessional - 15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 : Plant-water relations, Nutrition and Translocation.	
	Unit 2 : Photosynthesis, Carbon assiemelation, ATP-synthesis	
	Unit 3 : Enzymes, Nitrogen metabolism	
	Unit 4 : Plant growth regulators and photomorphy genesis.	
<b>SEC 1 :</b>	<b>Medicinal Botany(Terminal –40, Sessional – 10)</b>	<b>50marks</b>
	<b>Credit – 4 : (Theory – 02, Practical – 02)</b>	
	Unit 1 : History and Scope of Medicinal plants	
	Unit 2 : Conseravation of Medicinal plants.	
<b>SEC 2 :</b>	<b>Practical</b>	<b>50marks</b>
<b>GE/CC2.2 :</b>	<b>Practical</b>	<b>25 marks</b>

#### Semester-III

<b>GE/CC 3.1 :</b>	<b>Plant taxonomy, Ecology and Economic botany (Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 : Classifications system	
	Unit 2 : Plant families	
	Unit 3 : Ecology and Ecosystem	
	Unit 4 : Economic Botany	
<b>GE/CC3.2 :</b>	<b>Practical</b>	<b>25marks</b>

#### Semester-IV

<b>GE/CC4.1 :</b>	<b>Plant anatomy and Embryology(Terminal- 60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 : Tissues, secretary system	
	Unit 2 : Stem, leaf, root, vascular cambium and wood	
	Unit 3 : Anther, ovule, endosperm, embryo	
	Unit 4 : Pollination and fertilization	
<b>GE/CC4.2 :</b>	<b>Practical</b>	<b>25marks</b>

(Opt. any one)

<b>DSE-I (Choice-1)- I-1.1 : Economic Botany and Biotechnology</b>		
	<b>(Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Origin of cultivated Plants	
Unit 2 :	spices and beverages	
Unit 3 :	Introduction to Plant Biotech and tissue culture	
Unit 4 :	Recombinant DNA technology;	
<b>DSE I.1.2 :</b>	<b>Practical</b>	<b>25 marks</b>
<b>DSE-II (Choice-2)- I.2.1 :</b>		
	<b>(Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Introduction to Bioinformatics & Databases in Bioinformatics	
Unit 2 :	Biological Sequence Databases	
Unit 3 :	Sequence Alignments & Molecular Phylogeny	
Unit 4 :	Applications of Bioinformatics	
<b>DSE I.2.2 :</b>	<b>Practical</b>	<b>25marks</b>
<b><u>Semester-V</u></b>		
<b>CC 5.1 :</b>	<b>Mycology and phytopathology(Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Ascomycota	
Unit 2 :	Allied fungi, Applied mycology	
Unit 3 :	Symbiotic association	
Unit 4 :	Phytopathology	
<b>CC 5.2 :</b>	<b>Practical</b>	<b>25 marks</b>
<b>CC 6.1 :</b>	<b>Plant morphology and systematics (Terminal-60,Sessional-15)</b>	<b>75 marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Taxonomy	
Unit 2 :	Taxonomy	
Unit 3 :	Taxonomy	
Unit 4 :	Phylogeny of angiosperms	
<b>CC 6.2 :</b>	<b>Practical</b>	<b>25marks</b>
<b>CC 7.1 :</b>	<b>Biomolecules and cell biology(Terminal-60,Sessional-15)</b>	<b>75 marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Biomolecules, carbohydrates, lipids, proteins, nucleic acids	
Unit 2 :	Bioenergetics, enzymes	
Unit 3 :	The cell, cell division, cell wall and plasma membrane	
Unit 4 :	Cell organelles, Nucleus, cytoskeleton, chloroplast, mitochondria, peroxisome	
<b>CC 7.2 :</b>	<b>Practical</b>	<b>75 marks</b>
<b>CC 8.1</b>	<b>Economic botany(Terminal-60, Sessional-15)</b>	<b>75marks</b>
	<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
Unit 1 :	Origin of cultivated plants	
Unit 2 :	Cereals, legumes, sugars and starches	
Unit 3 :	Spices, beverages, drug yielding plants	

<b>CC 8.2 :</b>	Unit 4 : <b>Practical</b>	Oils and fats, essential oils, natural rubber, timber plants fibers	<b>35marks</b>
 <b>Semester-VI</b>			
<b>CC 9.1</b>	<b>Biodiversity, ecology and phytogeography (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Introduction, water, light, temperature, wind and fire	
	Unit 2 :	Loss and management of biodiversity	
	Unit 3 :	Conservation of biodiversity	
	Unit 4 :	Phytogeography	
<b>CC 9.2 :</b>	<b>Practical</b>		<b>25 marks</b>
<b>CC 10.1</b>	<b>Plant physiology and biochemistry (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Nutrient uptake, plant growth regulator	
	Unit 2 :	Physiology of flowering, phytochrome	
	Unit 3 :	Concept of metabolism, carbohydrate metabolism, carbon assimilation	
	Unit 4 :	Lipid metabolism, nitrogen metabolism, mechanism of signal transduction	
<b>CC 10.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 11.1</b>	<b>Plant breeding and biostatistics (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Methods of crop improvement	
	Unit 2 :	Quantitative inheritance and crop improvement	
	Unit 3 :	Measures of central tendency	
	Unit 4 :	Statistical inference	
<b>CC 11.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 12.1</b>	<b>Plant molecular biology (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Nucleic acids, The Structures of DNA and RNA	
	Unit 2 :	The Nucleosome-Chromatin structure, The replication of DNA	
	Unit 3 :	Central dogma and genetic code, Mechanism of Transcription, Processing and modification of RNA	
	Unit 4 :	Translation (Prokaryotes and eukaryotes, Regulation of transcription in prokaryotes and eukaryotes	
<b>CC 12.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CBC* :</b>	<b>Herbal Plants For Home Gardening (Terminal-80, Sessional-20)</b>		<b>100 marks</b>
	Unit 1 :	Introduction to the gardening	
	Unit 2 :	Maintainance of Herbal Garden	
	Unit 3 :	Cultivation of Herbals	
	Unit 4 :	Propogation of Herbals	

**Semester-VIII**

<b>CC 13.1</b>	<b>Plant Genetics and breeding (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Mendelian genetics and its extension, Extra chromosomal Inheritance	
	Unit 2 :	Linkage, crossing over and chromosome mapping	

	Unit 3 :	Variation in chromosome number and structure, Gene mutations	
	Unit 4 :	Fine structure of gene, Population and Evolutionary Genetics	
<b>CC 13.2 :</b>	<b>Practical</b>		<b>25 marks</b>
<b>CC 14.1</b>	<b>Plant biotechnology(Terminal-60, Sessional-15)</b>		<b>75 marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Plant Tissue Culture	
	Unit 2 :	Recombinant DNA technology I	
	Unit 3 :	Recombinant DNA technology II	
	Unit 4 :	Applications of Biotechnology	
<b>CC 14.2 :</b>	<b>Practical</b>		<b>25 marks</b>
<b>DSE II :</b>	<b>Project(4 Cr)</b>		<b>100marks</b>

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

### Objectives:

On completion of the course the students will be able to:

- Update course contents by introducing recent developments in plant sciences as per CBCS model curriculum of UGC in plant science.
- Prepare the curriculum as such that it can attract, enthuse, sustain and promote the interest of learners for selecting Botany honours and allied disciplines as their career.
- Ensure that the curricula are not overloaded. Minimizing the descriptive aspects and eliminating repetition of contents between under graduate and post graduate syllabi is the major objective.
- Provide the students of Bachelor's programme in Botany (Honours), an opportunity to opt one or more courses in allied disciplines to help them pursue specialization / research in interdisciplinary areas.
- Make provision for improvement in the quality of laboratory and field work able to appreciate the beauty and variety of form, structure, function and ecological significance of plants and their biological services.
- increase the awareness of about the over exploitation and use to which plants have been subjected by human greed and to expertise in conservation of nature and natural resources and in the protection of endangered plant species.
- provide for the mobility of students among institutions and different disciplines so as to acquaint with the latest trends and techniques adopted in the field of applied botany.
- Identify and View the morphology, description and economic importance of microbes, cryptogams, phenogams and its diversity.
- Identify the structural complexity of conducting tissue and its significance of stellar evolution. Distinguish the genetic control of life processes.
- Know economic importance and use of plants and specific plant parts in daily life Skills about collection and preservation of local Flora.
- Recognize the importance of living fossils and its origin and evolution of naked seed plants.
- Understand the internal structure of various systems like of shoot, root and complex tissues. And anomalous growth and structure.
- Observe the various structures with regard to plant morphology of reproductive botany of Angiosperms.

- Know the basic principles on physiology and metabolism, growth and development in plants.
- Distinguish the biology of Nitrogen fixation and the process of growth and development.
- Identify natural resources for conservation and management of with regard to sustainable development.
- Demonstrate the technique of plant breeding in crop improvement.
- Understand the principles and technique of plant tissue culture, molecular biology and biotechnology of transgenic plants. Applied aspects of Plant biotechnology.

## BOTANY

### Semester I

#### **GE/CC1.1: BIODIVERSITY (Microbes, Algae, Fungi and Archgoniate)**

Contact Hour per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75 (Terminal- 60, Sessional- 15)

**Unit 1: Introduction to microbial world, nutrition, growth and metabolism.** Discovery, physiochemical and biological characteristics; classification (Baltimore), general structure with special reference to viroids and prions; replication (general account), DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV). Bacteria, general characteristics, types-archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts), cell structure, nutritional types, reproduction-vegetative, asexual and recombination (conjugation, transformation and transduction).

**Unit 2: Algae:** General characteristics; Ecology and distribution; Range of thallus organization and reproduction; Classification of algae; Morphology and life-cycles of the following: *Oedogonium*, *Vaucheria*, *Polysiphonia*. Economic importance of algae.

**Fungi:** Introduction- General characteristics, ecology and significance, range of thallus organization, cell wall composition, nutrition, reproduction and classification; True Fungi- General characteristics, ecology and significance, life cycle of *Rhizopus* (Zygomycota) *Penicillium* (Ascomycota), *Puccinia* (Basidiomycota);

**Symbiotic Associations-Lichens:** General account, reproduction and significance; Mycorrhiza: ectomycorrhiza and endomycorrhiza and their significance

**Unit 3: Introduction to Archegoniate:** Unifying features of archegoniate, Transition to land habit, Alternation of generation.

**Bryophytes:** General characteristics, adaptations to land habit, Classification, Range of thallus organization. Classification, morphology, anatomy and reproduction of *Marchantia*, *Anthoceros* and *Funaria*. (Developmental details not to be included).

**Unit 4: Pteridophytes:** General characteristics, classification, Early land plants (*Rhynia*). Classification (up to 11 family), morphology, anatomy and reproduction of *Selaginella*, *Equisetum* and *Marselia*. (Developmental details not to be included). Heterospory and seed habit, stellar evolution.

**Gymnosperms:** General characteristics, classification. Classification (up to class), morphology, anatomy and reproduction of *Cycas* and *Pinus*. (Developmental details not to be included).

**GE/CC1.2:Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Electron micrographs/Models of viruses – T-Phage and TMV, Line drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root Nodule.
3. Gram staining.
4. Endospore staining with malachite green using the (endospores taken from soil bacteria).
5. Algae: Vegetative and reproductive structures of the following taxa through temporary preparations and permanent slides: *Oedogonium*, *Vaucheria* , and *Polysiphonia*.
6. Fungi: Vegetative and reproductive structures of the following taxa through temporary preparataion and permanent slides: *Rhizopus*.*Penicillium* and *Puccinia*.
7. Morphology (vegetative and reproductive structures) and anatomy of the following taxa through temporary preparations and permanent slides: Bryophytes: *Marchantia*, *Anthoceros* and *Funaria*.
8. Pteridophytes: Morphology (vegetative and reproductive structures) and anatomy of the following taxa through temporary preparations and permanent slides: *Selaginella*, *Equisetum* and *Marsilea*.
9. Gymnosperms: Morphology (vegetative and reproductive structures) and anatomy of the following taxa through temporary preparations and permanent slides: *Cycas* and *Pinus*

**Reference Books :**

1. H.D.Kumar (1999) Introductory phycology, affiliated East-West press Pvt.Ltd delhi 2<sup>nd</sup> edition.
2. Pelczar, M.J. (2001) Microbiology, 5th edition, Tata McGraw-Hill Co, New Delhi.
3. Gangulee Das and Dutta., College Botany Vol.1, Central Book Dept. Calcutta.
4. Parihar, N.S. An Introduction to Bryophyta Central Book Depot, Allhabad, 1965.
5. Vasishta B.R. Bryophyta. S. Chand and Co. New Delhi.
6. Gangulee, H.C. and Kar A.K. College Botany Vol.II, New Central Book Agency, Calcutta.
7. Pandey, B. P. 2001. College Botany, Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant
8. Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd, New Delhi.
9. Pandey, B. P. 2006. College Botany, Vol. II: Pteridophyta, Gymnosperms and Paleobotany.S. Chand & Company Ltd, New Delhi.
10. Sambamurthy, A. V. S. S. 2006. A Textbook of Algae. I. K. International Pvt. Ltd., New Delhi.

## Semester II

### **GE/CC 2.1: PLANT PHYSIOLOGY AND METABOLISM**

Contact Hour per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75 (Terminal- 60, Sessional- 15)

**Unit 1 :Plant-water relations:** Importance of water, water potential and its components; Transpiration and its significance; Factors affecting transpiration; Root pressure and guttation.

**Unit 2 :Mineral nutrition:** Essential elements, macro and micronutrients; Role of essential elements; Transport of ions across cell membrane, active and passive transport, carriers, channels and pumps, mineral deficiency symptoms, chelating agents. Translocation in phloem: Composition of phloem sap, girdling experiment; Pressure flow model; Phloem loading and unloading.

**Unit 3:Photosynthesis:** Photosynthetic Pigments (Chl a, b, xanthophylls, carotene); Photosystem I and II, reaction center, antenna molecules; Electron transport and mechanism of ATP synthesis; C3, C4 and CAM pathways of carbon fixation; Photorespiration.

**Unit 4:Plant growth regulators:** Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene. Plant response to light and temperature: Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), red and far red light responses on photomorphogenesis; Vernalization.

### **GE/CC2.2: Practical**

Contact Hour Per Week	: 2
Examination duration	: 3 Hours
Maximum marks	: 250 (Exp. 15, Viva-5, Record-5)

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Determination of water [potential of given tissue (potato tuber) by weight method.
3. Study of effect of wind velocity and light on the rate of transpiration in excised twig/ leaf.
4. Calculation of stomatal index and stomatal frequency from the two surfaces of leaves of a mesophyte and xerophyte.
5. Chemical separation of photosynthetic pigments.
6. Effect of carbon dioxide on the rate of photosynthesis.
7. To compare the rate of respiration in different parts of a plant.

### **Reference Books :**

1. Taiz, L., Zeiger, E., Muller, I.M. and Murphy, A (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.

**SEC 1.1 : MEDICINAL BOTANY**

Contact Hours per Week :	4
Credit :	4
Examination Duration :	3 Hours
Maximum Marks :	50 (Terminal-40, Sessional-10)

**Unit 1:**

History, Scope and Importance of Medicinal Plants. Indigenous Medicinal Sciences; Definition and Scope-Ayurveda: History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments, Siddha: Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine. Unani: History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations. Conservation of endangered and endemic medicinal plants. Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens.

**Unit-2 :**

Propagation of Medicinal Plants: Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding. Ethnobotany and Folk medicines. Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany. folk medicines of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.

**Reference Books :**

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.
2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.
3. Ethnobiology – R.K.Sinha & Shweta Sinha – 2001. Surabhe Publications – Jaipur.
4. Tribal medicine – D.C. Pal & S.K. Jain 1998, Naya Prakash, 206, Bidhan Sarani, Calcutta – 700 006.
5. Contribution to Indian ethno botany – S.K. Jain 1995, 3rd edition, Scientific publishers, P.B.No. 91, Jodhpur, India.
6. A Manual of Ethno botany – S.K.Jain, 1995, 2<sup>nd</sup> edition. Practical: Field study of Herbal preparation of Joshi, S. G. 2000. Medicinal Plants. Oxford and IBH, New Delhi.
7. Kokate, C. and Gokeale- Pharmacognacy- Nirali Prakashan, New Delhi.
8. Rastogi, R. R. and B. N. Mehrotra. 1993. Compendium of Indian Medicinal Plants. Vol. I & Vol. II. CSIR, Publication and Information Directorate, New Delhi.
9. Sivarajan, V. V. and I. Balasubramanian. 1994. Ayurvedic Drugs and their Plant Sources. Oxford and IBH, New Delhi.

**SEC1. 2 : Practicals**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 50 ( Expt-25, Viva-15, Record-10)

1. Preparation of nursery bed and polybag filling.
2. Preparation of potting mixture – Potting and repotting.
3. Field work in cutting, grafting, budding, layering.
4. Identification and use of garden tools and implements.
5. Laying out drip irrigation, sprinklers.
6. Topiary and pruning.
7. Preparation of vermicompost.
8. Propagation of the medicinal plants through pot culture.
9. Identification and agronomic aspects of medicinal plants in the botanical garden.

**Semester III****GE/CC3.1: PLANT TAXONOMY, ECOLOGY AND ECONOMIC BOTANY**

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15) T

**Unit 1: Taxonomy:**

Basic concepts, Systems of classification: Bentham and Hooker's and Engler and Prantl systems of classification: Principles, outline, merits and demerits. Brief account of Plant collection and herbarium techniques and important herbaria of world

**Unit 2 :**Diagnostic features and economic importance of families Ranunculaceae Brassicaceae, Fabaceae, Solanaceae Cucurbitaceae, Asteraceae and Poaceae.

**Unit3: Ecosystems:** Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Functional aspects of ecosystem: Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles; Cycling of Carbon, Nitrogen and Phosphorus. Interaction between abiotic, biotic and Environment of the Ecosystem, Self sustenance

**Unit 4: Economic Botany:** General account, Botany and cultivation of Rice, Soybean, Jute and Groundnut

**GE/CC 3.2: Practical**

Credit-2

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Saturation capacity and field capacity of different soil samples and rapid test for texture of soils.
2. pH and rapid field tests of soils for carbonates, chlorides.
3. Density and porosity and rate of infiltration of water in undisturbed soils.
4. Determination of minimal area of quadrat size by species area curve method.
5. Quantitative analysis of herbaceous vegetation for frequency; density and abundance.
6. Morphological adaptations of hydrophytes and xerophytes.
7. Submission of 20 herbarium.

8. Study of economic importance of Rice, Groundnut and Jute.
9. Systematic study of locally available plants belonging to the families prescribed in theory syllabus (Minimum of one plant representative for each family) (18 h)
10. Detailed morphological and anatomical study of medicinally important part(s) of locally available plants (a minimum 10 plants) used in traditional medicine. (12 h)

#### Reference Books :

1. Porter, C.L. ( ): Taxonomy of flowering Plants, Eurasia Publishing House, New Delhi.
2. Lawrence, G.H.M. (1953): Taxonomy of Vascular Plants, Oxford & IBH Publishers, New Delhi, Calcutta.
3. Jefferey, C.(1968) : An Introduction to Plant Taxonomy J.A. Churchill, London.
4. Mathur, R.C. (1970): Systematic Botany (Angiosperms) Agra Book Stores- Lucknow, Ajmer, Allahabad, Delhi.
5. Maheswari,P(1963) :Recent Advances in the Embryology of Angiosperms(Ed., ) International Society of Plant Morphologists- University of Delhi.
6. Swamy. B.G.L. & Krishnamoorthy. K.V.(1980):From flower to fruitTata McGraw Hill Publishing Co., Ltd., New Delhi.
7. Odum, E.P. (2005). Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5<sup>th</sup> edition.
8. Kormondy, E.J. (1996). Concepts of ecology. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.
9. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

### Semester IV

#### GE/CC4.1: PLANT ANATOMY AND EMBRYOLOGY

Contact Hour Per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75 (Terminal- 60, Sessional- 15)

#### Unit 1:

**Anther:** Anther wall: Structure and functions, microsporogenesis, callose deposition and its significance. Pollen viability, storage and germination; Abnormal features. **Ovule:** Structure; Types; Special structures—endothelium, obturator, aril, caruncle and hypostase; Female gametophyte—megasporeogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (details of *Polygonum* type); **Embryo:** General pattern of development of dicot and monocot embryo.

#### Unit 2 :

**Pollination and fertilization:** Pollination types and significance; adaptations; structure of stigma and style; path of pollen tube in pistil; double fertilization. **Seed:** Structure, importance and dispersal mechanisms. **Polyembryony and apomixes:** Introduction; Classification; Causes and applications.

#### Unit 3:

**Tissues:** Classification of tissues; Simple and complex tissues (no phylogeny); **Vascular Cambium and wood:** Structure, function and seasonal activity of cambium; Secondary growth in root and stem (Normal and anomalous), Sapwood and heartwood; Early and late wood, Dendrochronology. **Secretory System:** Hydathodes, cavities, lithocysts and laticifers.

#### Unit 4:

**Stem:** Organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cytohistological zonation); Types of vascular bundles; Structure of dicot and monocot stem. **Leaf:** Structure of dicot and monocot leaf, Kranz anatomy. **Root:** Organization of root apex (Apical cell theory, Histogen theory, Korper-Kappe theory); Quiescent

centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermises and origin of lateral root.

### GE/CC4.2: Practical

Contact Hour Per Week : 2

Examination duration : 3 Hours

Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Study of vascular tissue of angiospermic plants by tissue macerations technique.
2. Anatomical details through permanent slides/temporary stain mounts/ museum specimens with the help of suitable examples.
3. Study of permanent slide of Apical meristem of root, shoot and vascular cambium. Distribution and types of parenchyma, collenchyma and sclerenchyma.
4. Stem: monocot, dicot - primary and secondary growth; periderm; lenticels.
5. Anomalous secondary growth in Bignonia, Boerhavia, Amaranthus, Bouganivillea and Draceana
6. Leaf: isobilateral, dorsiventral, C4 leaves (Kranz anatomy).
7. Anther: Wall and its ontogeny.
8. Ovule: Types-anatropous, orthotropous, amphitropous/campylotropous, circinotropous, Unitegmic, bitegmic.
9. Embryogenesis: Study of development of dicot embryo through permanent slides; dissection of developing seeds for embryos at various developmental stages; Study of suspensor through electron micrographs.
10. Primary structure: Root - *Cicer*, *Canna*; Stem - *Tridax*, *Sorghum*
11. Secondary structure: Root - *Tridax* sp.; Stem - *Pongamia*
12. Stomatal types using epidermal peels.
13. Pollen viability test using *in-vitro* germination (*Catharanthus*).
14. Isolation and mounting of embryo (using *Symopsis* / *Senna* / *Crotalaria*).

### Reference Books :

1. Bhojwani, S.S. & Bhatnagar, S.P. (2011). Embryology of Angiosperms. Vikas Publication House Pvt.Ltd. New Delhi. 5th edition.
2. Bhojwani, S. S. and S. P. Bhatnagar. 2000. The Embryology of Angiosperms (4th Ed.), Vikas Publishing House, Delhi.
3. Davis, P. H. and V. H. Heywood. 1963. Principles of Angiosperm Taxonomy. Oliver and Boyd, London.
4. Esau, K. 1971. Anatomy of Seed Plants. John Wiley and Son, USA.
5. Johri, B. M. 1984. Embryology of Angiosperms. Springer-Verlag, Berlin.
6. Pandey, B. P. 2007. Botany for Degree Students: Diversity of Seed Plants and their Systematics, Structure, Development and Reproduction in Flowering Plants. S. Chand & Company Ltd, New Delhi.

**(Opt. any one)****DSE-I (Choice-1)- I.1.1 : Economic Botany and Biotechnology**

Contact Hours per Week :	4
Credit :	4
Examination Duration :	3 Hours
Maximum Marks :	75 (Terminal-60, Sessional-15)

**Unit 1:** Origin of Cultivated Plants : Concept of centres of origin, their importance with reference to Vavilov's work. Cereals Wheat -Origin, morphology, uses Legumes General account with special reference to Gram and soybean

**Unit 2:Spices**

General account with special reference to clove and black pepper (Botanical name, family, part used, morphology and uses); Beverages, Tea (morphology, processing, uses) Oils and Fats : Groundnut Fibre Yielding Plants; Cotton (Botanical name, family, part used, morphology and uses.

**Unit 3:** Introduction to biotechnology; Plant tissue culture . Micropropagation ; haploid production through androgenesis and gynogenesis; brief account of embryo & endosperm culture with their applications

**Unit 4:****Recombinant DNA Techniques.**

Blotting techniques: Northern, Southern and Western Blotting, DNA Fingerprinting; Molecular DNA markers i.e. RAPD, RFLP, SNPs; DNA sequencing, PCR and Reverse Transcriptase-PCR.

**DSE I.1.2 : Practicals**

Contact Hours Per Week :	2
Examination Duration :	3 Hours
Maximum Marks :	25 ( Expt-15, Viva-5, Record-5)

1. Study of economically important plants : Wheat, Gram, Soybean, Black pepper, Clove Tea, Cotton, Groundnut through specimens, sections and microchemical tests
2. Familiarization with basic equipments in tissue culture.
3. Study of aseptic conditions in the lab.
4. Sterilization of various plant materials.
5. Inoculation and incubation of callus, suspension
6. Process of somatic embryogenesis and germination.
7. Study through photographs: Anther culture, somatic embryogenesis, endosperm and embryo culture; micropropagation.
8. Study of molecular techniques: PCR, Blotting techniques, AGE and PAGE.

**Reference Books :**

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.
2. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.

**DSE-II (Choice-2)- I.2.1 : Bioinformatics**

Contact Hours per Week	:	4
Credit	:	4
Examination Duration	:	3 Hours
Maximum Marks	:	75 (Terminal-60, Sessional-15)

**Unit 1: Introduction to Bioinformatics** : Introduction, Branches of Bioinformatics, Aim, Scope and Research areas of Bioinformatics.

**Databases in Bioinformatics** : Introduction, Biological Databases, Classification format of Biological Databases, Biological Database Retrieval System.

**Unit 2: Biological Sequence Databases** : National Center for Biotechnology Information (NCBI): Tools and Databases of NCBI, Database Retrieval Tool, Sequence Submission to NCBI, Basic local alignment search tool (BLAST), Nucleotide Database, Protein Database, Gene Expression Database. EMBL Nucleotide Sequence Database (EMBL-Bank): Introduction, Sequence Retrieval, Sequence Submission to EMBL, Sequence analysis tools.

DNA Data Bank of Japan (DDBJ): Introduction, Resources at DDBJ, Data Submission at DDBJ.

Protein Information Resource (PIR): About PIR, Resources of PIR, Databases of PIR, Data Retrieval in PIR.

Swiss-Prot: Introduction and Salient Features

**Unit 3:**

**Sequence Alignments** : Introduction, Concept of Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Percent Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

**Molecular Phylogeny** : Methods of Phylogeny, Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction

**Unit 4 :Applications of Bioinformatics :**

Structural Bioinformatics in Drug Discovery, Quantitative structure-activity relationship(QSAR) techniques in Drug Design, Microbial genome applications, Crop improvement.

**DSE I.2.2 : Practicals**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Nucleic acid and protein databases.
2. Sequence retrieval from databases.
3. Sequence alignment.
4. Sequence homology and Gene annotation.
5. Construction of phylogenetic tree.

**Reference Books :**

1. Ghosh Z. and Bibekanand M. (2008) Bioinformatics: Principles and Applications. Oxford University Press.
2. Pevsner J. (2009) Bioinformatics and Functional Genomics. II Edition. Wiley-Blackwell.

3. Campbell A. M., Heyer L. J. (2006) Discovering Genomics, Proteomics and Bioinformatics. \_II Edition. Benjamin Cummings.

### **Semester V**

#### **CC 5.1: MYCOLOGY AND PHYTOPATHOLOGY**

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

**Unit 1 :Fungi** :General characterises; Status of Slime molds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; life cycle and classification with reference to *Aspergillus* and *Peziza*.

**Unit 2 :Applied Mycology:** Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides).

**Unit 3 :Symbiotic associations:** Lichen – Occurrence; General characteristics; Growth forms and range of thallus organization; Nature of associations of algal and fungal partners; Reproduction. Mycorrhiza- Ectomycorrhiza, Endomycorrhiza and their significance.

**Unit 4 :Phytopathology:** Terms and concepts; Host- Pathogen relationships; prevention and control of plant diseases, and role of quarantine. Bacterial diseases – *Citrus canker and angular leaf spot disease of Cotton*. Viral diseases – *Tobacco Mosaic viruses, vein clearing*. Fungal diseases – *Early and late blight of potato, Black stem rust of wheat, white rust of crucifers*.

#### **CC5.2: Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Temporary slide preparation and culture of Yeast.
2. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates.
3. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides.
4. Mycorrhizae: ectomycorrhiza and endo mycorrhiza (Photographs)
5. Phytopathology: Study of bacterial diseases; Citrus Canker; Viral diseases: TMV, Fungal diseases: Early blight of potato, White rust of crucifers Tikka disease of groundnut, Blast of rice, Smut and rust of Wheat, and Red rot of Sugarcane through section cutting.

#### **Reference Books :**

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons(Asia) Singapore. 4th edition.
2. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India.

**CC6.1: PLANT MORPHOLOGY AND SYSTEMATICS**

Contact Hour Per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75(Terminal- 60, Sessional- 15)

**Unit 1 :Plant Morphology**

- I. **Morphological description of a flowering plant-** Plant Habit  
 Root: Types Modifications - Definition with examples -  
 Stem: Habit - Modification - Under ground, Aerial, Subaerial with examples  
 Leaves: Lamina, Phyllotaxy; shapes of lamina and types.
- II. Inflorescence: racemose, cymose and specialised .Flower: Flower as a modified shoot. -
- III. Fruits - Types, classification with examples; Seed structure - dicot and monocot - albuminous and exalbuminous, - types and adaptations.

**Unit 2 :Taxonomy:** Salient features and comparative account of Bentham & Hooker and Engler & Prantle. Current concepts in Angiosperm Taxonomy: Embryology in relation to taxonomy, Cytotaxonomy, Chemotaxonomy and Numerical Taxonomy. Nomenclature and Taxonomic resources: An introduction to ICBN, Vienna code - a brief account. Herbarium: Concept, techniques and applications.

**Unit 3 :Taxonomy:** Diversity of Flowering Plants: Diagnostic features and economic importance of the families: Malvaceae, Acanthaceae, Rosaceae, , Rubiaceae, Euphorbiaceae, Rutaceae, Papaveraceae, , Myrtaceae, Apiaceae, ,Asclepiadaceae, Apocynaceae, Lamiaceae.

**Unit 4 :Taxonomy:** Diversity of Flowering Plants: Diagnostic features and economic importance of the families: Apiaceae, Asclepiadaceae, Lamiaceae, Solanaceae, Asteraceae, Liliaceae orchidaceae and Poaceae.

**CC6.2: Practical**

Contact Hour Per Week	: 2
Examination duration	: 3 Hours
Maximum marks	: 25 (Exp. 15, Viva-5, Record-5)

1. Study of vegetative and floral characters of the following families (Description, V.S.flower, section of ovary, floral diagram/s, floral formula/e and systematic position according to Bentham & Hooker's system of classification):
2. Ranunculaceae - *Ranunculus*, *Delphinium*
3. Brassicaceae - *Brassica*, *Alyssum* / *Iberis*
4. Myrtaceae - *Eucalyptus*, *Callistemon*
5. Umbelliferae - *Coriandrum* / *Anethum* / *Foeniculum*
6. Asteraceae - *Sonchus/Launaea*, *Vernonia/Ageratum*, *Eclipta/Tridax*
7. Solanaceae - *Solanum nigrum/Withania*
8. Lamiaceae - *Salvia/Ocimum*
9. Euphorbiaceae - *Euphorbia hirta/E.milii*, *Jatropha*
10. Liliaceae - *Asphodelus/Lilium/Allium*
11. Poaceae - *Triticum/Hordeum/Avena*
12. Field visit (local) - Subject to grant of funds from the university.
13. Mounting of a properly dried and pressed specimen of any wild plant with herbarium label(to be submitted in the record book)

**Reference Books :**

1. Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.

### CC7.1: BIOMOLECULES AND CELL BIOLOGY

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

#### Unit 1 :

**Biomolecules:** Types and significance of chemical bonds; Structure and properties of water; pH and buffers. **Enzymes:** Structure of enzyme: holoenzyme, apoenzyme, cofactors, coenzymes and prosthetic group; Classification of enzymes; Features of active site, substrate specificity, mechanism of action (activation energy, lock and key hypothesis, induced - fit theory), Michaelis-Menten equation, enzyme inhibition and factors affecting enzyme activity.

#### Unit 2 :

**Carbohydrates:** Nomenclature and classification; Role of monosaccharides (glucose, fructose, sugar alcohols-mannitol and sorbitol); Disaccharides (sucrose, maltose, lactose), Oligosaccharides and polysaccharides (structural-cellulose, hemicelluloses, pectin, chitin, mucilage; storage -starch, insulin) **Proteins:** Structure of amino acids; Peptide bonds; Levels of protein structure-primary, secondary, tertiary and quaternary; Isoelectric point; Protein denaturation and biological roles of proteins.

#### Unit 3 :

**Lipids:** Definition and major classes of storage and structural lipids. Storage lipids. Fatty acids structure and functions. Essential fatty acids. Triacylglycerols structure, functions and properties. **Nucleic acids:** Structure of nitrogenous bases; Structure and function of nucleotides; Types of nucleic acids; Structure of A, B, Z types of DNA; Types of RNA; Structure of tRNA.

#### Unit 4 :

**Cell wall and plasma membrane:** Chemistry, structure and function of Plant Cell Wall. Overview of membrane function; fluid mosaic model; Chemical composition of membranes; Membrane transport-Passive, active and facilitated transport, endocytosis and exocytosis. **Chloroplast, mitochondria and peroxisomes:** Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Endoplasmic Reticulum, Golgi Apparatus, Lysosomes.

### CC 7.2: Practical

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Qualitative tests for carbohydrates, reducing sugars, non-reducing sugars, lipids and proteins.
2. Quantitative estimation of sugars and proteins.
3. Study of plant cell structure with the help of epidermal peel mount of Onion/*Rhoeo*/*Crinum*.
4. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf.
5. Measurement of cell size by the technique of micrometry.
6. Counting the cells per Unit volume with the help of haemocytometer. (Yeast/pollen grains).
7. Study of cell and its organelles with the help of electron micrographs.
8. Study different stages of mitosis and meiosis using aceto carmine and aceto orcin method.

### Reference Books :

1. Tymoczko JL, Berg JM and Stryer L (2012) *Biochemistry: A short course*, 2nd ed., W.H. Freeman
2. Nelson DL and Cox MM (2008) *Lehninger Principles of Biochemistry*, 5th Edition, W.H. Freeman and Co.
3. Karp, G. (2010). *Cell Biology*, John Wiley & Sons, U.S.A. 6th edition.

4. Hardin, J., Becker, G., Skliensmith, L.J. (2012). Becker's World of the Cell, Pearson Education Inc. U.S.A. 8th edition.
5. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C; Sinauer Associates, MA.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

### CC8.1: ECONOMIC BOTANY

Contact Hour Per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75(Terminal-60, Sessional- 15)

**Unit 1 :Origin of Cultivated Plants:** Concept of Centers of Origin, their importance with reference to Vavilov's work. Examples of major plant introductions; Crop domestication and loss of genetic diversity; evolution of new crops/varieties, importance of germplasm diversity.

**Unit 2 :Cereals :**Wheat and Rice (origin, morphology, processing & uses), brief account of millets.**Legumes:** General account, importance to man and ecosystem. **Sugars & Starches:** Morphology and processing of sugarcane, products and by-products of sugarcane industry. Potato – morphology, propagation & uses.

**Unit 3 :Spices:** Listing of important spices, their family and part used, economic importance with special reference to fennel, saffron, clove and black pepper. **Beverages:** Tea, Coffee (morphology, processing & uses).

**Unit 4 :Timber yielding plants :**General account with special reference to teak and pine. **Tobacco:** Tobacco (Morphology, processing, uses and health hazards). **Fibres:** Classification based on the origin of fibres, Cotton and Jute (morphology, extraction and uses).

### CC 8.2: ECONOMIC BOTANY Practical

Contact Hour Per Week	: 2
Examination duration	: 3 Hours
Maximum marks	: 25 (Exp. 15, Viva-5, Record-5)

1. Cereals: Wheat (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: Soya bean (habit, fruit, seed structure, micro-chemical tests).
3. Sugars & Starches: Sugarcane (habit sketch; cane juice- micro-chemical tests), Potato (habit sketch, tuber morphology, T.S. tuber to show localization of starch grains, w.m. starch grains, micro-chemical tests).
4. Spices: Black pepper, Fennel and Clove (habit and sections).
5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Oils & Fats: Coconut- T.S. nut, Mustard-plant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habit sketch of *Rosa*, *Vetiveria*, *Santalum* and *Eucalyptus* (specimens/photographs).
8. Drug-yielding plants: Specimens of *Digitalis*, *Papaver* and *Cannabis*.
9. Tobacco: specimen and products of Tobacco.
10. Woods: *Tectona*, *Pinus*: Specimen, Section of young stem.
11. Fibre-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fibre and test for cellulose), Coir (specimen, transverse section of stem, test for lignin on transverse section of stem and fibre).

**Reference Books :**

1. Kochhar, S.L. (2011). Economic Botany in the Tropics, MacMillan Publishers India Ltd., New Delhi. 4th edition.

**Semester VI****CC9.1: BIODIVERSITY, ECOLOGY AND PHYTOGEOGRAPHY**

Contact Hour Per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75 (Terminal- 60, Sessional- 15)

**Unit 1 :**

**Biodiversity Management:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss, Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations, Biodiversity information management and communication.

**Unit 2 :**

**Biodiversity Conservation :** Conservation of genetic diversity, species diversity and ecosystem diversity, *In situ* and *ex situ* conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.

**Unit 3 :**

**Ecology :** Concept of ecology, Autecology, Synecology, system ecology, Levels of organization. Inter-relationships between the living world and the environment, the components of environmental, concept of hydrosphere and lithosphere and dynamism, homeostasis. **Water:** Importance: States of water in the environment; Atmospheric moisture; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Water in soil; Water table.

**Unit 4 :**

**Phytogeography:** Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phytogeographical division of India; Local Vegetation.

**CC 9.2: Practical**

Contact Hour Per Week	: 2
Examination duration	: 3 Hours
Maximum marks	: 25 (Exp. 15, Viva-5, Record-5)

1. Soil organic matter in different soil samples by titration method
2. pH and rapid field tests of soils for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency.
3. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
4. Study of biotic interactions of the following: Stem parasite (*Cuscuta*), Root parasite (*Orobanche*) Epiphytes, Predation (Insectivorous plants).

**Reference Books**

1. Kochhar, S.L. (2012). Economic Botany in Tropics, MacMillan & Co. New Delhi, India.
2. Wickens, G.E. (2001). Economic Botany: Principles & Practices. Kluwer Academic Publishers, The Netherlands.
3. Chrispeels, M.J. and Sadava, D.E. (2003). Plants, Genes and Agriculture. Jones & Bartlett Publishers.
4. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.

5. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation.
6. Anamaya Publications, New Delhi.
7. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
8. Vasudevan, N. (2006). Essentials of Environmental Science. Narosa Publishing House, New Delhi.
9. Singh, J. S., Singh, S.P. and Gupta, S. (2006). Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
10. Rogers, P.P., Jalal, K.F. and Boyd, J.A. (2008). An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

### CC10.1: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

#### Unit 1 :

**Nutrient Uptake:** Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, active absorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport.

**Plant growth regulators:** Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid.

#### Unit 2 :

**Physiology of flowering:** Photoperiodism, flowering stimulus, florigen concept, vernalization, seed dormancy.

**Phytochrome:** Discovery, chemical nature, role of phytochrome in photomorphogenesis, low energy responses (LER) and high irradiance responses (HIR), mode of action.

#### Unit 3 :

**Concept of metabolism:** Introduction, anabolic and catabolic pathways, regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and Isozymes). **Carbohydrate metabolism:** Synthesis and catabolism of sucrose and starch.

**Carbon assimilation:** Historical background, photosynthetic pigments, role of photosynthetic pigments (chlorophylls and accessory pigments), antenna molecules and reaction centres, photochemical reactions, photosynthetic electron transport, PSI, PSII, Q cycle, CO<sub>2</sub> reduction, photorespiration, C<sub>4</sub> pathways; Crassulacean acid metabolism; Factors affecting CO<sub>2</sub> reduction.

#### Unit 4 :

**Lipid metabolism:** Synthesis and breakdown of triglycerides,  $\beta$ -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination,  $\alpha$  oxidation.

**Nitrogen metabolism:** Nitrate assimilation, biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Ammonia assimilation and transamination.

**Mechanisms of signal transduction:** Calcium, phospholipids, cGMP, NO.

### CC 10.2: Practical

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Determination of osmotic potential of plant cell sap by plasmolytic method.
2. Study of the effect of various environmental factors on transpiration in an excised twig/leaf.
3. Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.

4. Demonstrate activity of Urease and Peroxidase.
5. To study the phenomenon of seed germination (effect of light).
6. To study the Induction of Amylase activity in germinating barley grains.
7. Demonstration of absorption spectrum of photosynthetic pigments.

**Reference Books :**

1. Hopkins, W.G. and Huner, A. (2008). Introduction to Plant Physiology. John Wiley and Sons. U.S.A. 4th edition.
2. Taiz, L., Zeiger, E. (2015). Plant Physiology and Development. Sinauer Associates Inc. USA. 6th edition.
3. Bajracharya D. (1999). Experiments in Plant Physiology-A Laboratory Manual. Narosa Publishing House, New Delhi.

**CC11.1: PLANT BREEDING AND BIostatISTICS**

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75(Terminal- 60, Sessional- 15)

**Unit 1 :Methods of crop improvement:** Introduction: Centres of origin and domestication of crop plants, plant genetic resources; Acclimatization; Selection methods: For self pollinated, cross pollinated and vegetatively propagated plants; Hybridization.

**Unit 2 :Quantitative inheritance and crop improvement:** Quantitative inheritance concepts Concept. Genetic basis of inbreeding depression and heterosis; Applications. Role of mutations; Polyploidy as methods of crop improvement.

**Unit-3** Measures of central tendency - mean, median, mode, geometric mean - merits & demerits. Measures of dispersion - range, standard deviation, mean deviation, quartile deviation - merits and demerits; Co- efficient of variations.

**Unit-4** Statistical inference - hypothesis - simple hypothesis - student 't' test-chi square test.

**CC 11.2: Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Exp. 15, Viva-5, Record-5)

1. Emasculation technique.
2. Selfing and cross hybridization process.
3. Pollen maturity test.
4. Calculation of mean, standard deviation and standard error.
5. Calculation of correlation coefficient values and finding out the probability.
6. Calculation of 'F' value and finding out the probability value for the F value.
7. T-test and Chi square test.
8. Regression analysis.

**Reference Books :**

1. Singh, B.D. (2005). Plant Breeding: Principles and Methods. Kalyani Publishers. 7th edition.
2. Chaudhari, H.K. (1984). Elementary Principles of Plant Breeding. Oxford – IBH. 2nd edition.
3. The Principles of scientific research, Freedman, P. New York, Pergamon Press.
4. Statistics for Biologists, Campbell, R.C., 1998. Cambridge University Press.

**CC12.1 PLANT MOLECULAR BIOLOGY**

Contact Hour Per Week : 4  
 Credits : 4  
 Examination duration : 3 Hours  
 Maximum marks : 75(Terminal- 60, Sessional-15)

**Unit-1**

**Nucleic acids: Carriers of genetic information:** Historical perspective; DNA as the carrier of genetic information (Griffith's, Hershey & Chase, Avery, McLeod & McCarty, Fraenkel-Conrat's experiment. The Structures of DNA and RNA / Genetic Material.

**Unit 2: The Nucleosome-Chromatin structure-** Euchromatin, Heterochromatin-Constitutive and Facultative heterochromatin. The replication of DNA: Chemistry of DNA synthesis (Kornberg's discovery); General principles – bidirectional, semi-conservative and semidiscontinuous replication, RNA priming.

**Unit 3: Central dogma and genetic code:** Key experiments establishing-The Central Dogma (Adaptor hypothesis and discovery of mRNA template), Genetic code (deciphering & salient features) Mechanism of Transcription: Transcription in prokaryotes; Transcription in eukaryotes.

**Unit 4: Translation (Prokaryotes and eukaryotes):** Various steps in protein synthesis, proteins involved in initiation, elongation and termination of polypeptides. Regulation of transcription in prokaryotes and eukaryotes: Principles of transcriptional regulation; Prokaryotes: Regulation of lactose metabolism and tryptophan synthesis in *E. coli*. Eukaryotes: transcription factors, heat shock proteins.

**CC 12.2: Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25(Exp. 15, Viva-5, Record-5)

1. Preparation of LB medium and raising *E. coli*.
2. Isolation of genomic DNA from *E. coli*/ Plant Tissues.
3. DNA isolation and RNA estimation by orcinol method.
4. DNA estimation by diphenylamine reagent/UV Spectrophotometry.
5. Study of DNA replication mechanisms through photographs (Rolling circle, Theta replication and semi-discontinuous replication).
6. Study of structures of prokaryotic RNA polymerase and eukaryotic RNA polymerase II through photographs.
7. Native and SDS gel electrophoresis of proteins.
8. Agarose gel electrophoresis of DNA.

**Reference Books :**

1. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington.
2. Cooper, G.M. and Hausman, R.E. 2009 The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3. Watson J.D., Baker, T.A., Bell, S.P., Gann, A., Levine, M., Losick, R. (2007). Molecular Biology of the Gene, Pearson Benjamin Cummings, CSHL Press, New York, U.S.A. 6th edition.
4. Snustad, D.P. and Simmons, M.J. (2010). Principles of Genetics. John Wiley and Sons Inc., U.S.A. 5<sup>th</sup> edition.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. Benjamin Cummings. U.S.A. 9th edition.
6. Russell, P. J. (2010). iGenetics- A Molecular Approach. Benjamin Cummings, U.S.A. 3rd edition.
7. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). Introduction to Genetic Analysis. W. H. Freeman and Co., U.S.A. 10th edition.

**Semester VIII****CC13.1 PLANT GENETICS**

Contact Hour Per Week	:	4
Credits	:	4
Examination duration	:	3 Hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit-1:Mendelian genetics and its extension** Mendelism: History; Principles of inheritance; Chromosome theory of inheritance; Autosomes and sex chromosomes; Probability and pedigree analysis; Incomplete dominance and codominance; Multiple alleles, Lethal alleles.

**Unit-2:Extrachromosomal Inheritance:** Chloroplast mutation: Variegation in Four o'clock plant; Mitochondrial mutations in yeast; Maternal effects-shell coiling in snail; Infective heredity- Kappa particles in *Paramecium*.

**Unit-3:Linkage, crossing over and chromosome mapping:** Linkage and crossing over-Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Numericals based on gene mapping; Sex Linkage.

**Unit-4:Variation in chromosome number and structure:** Deletion, Duplication, Inversion, Translocation, Position effect, Euploidy and Aneuploidy

**CC 13.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Exp.15, Viva-5, Record-5)

1. Mitosis and Meiosis through temporary squash preparation (Onion, Maize, Rheo, Vicia, Cicer, Trigonella).
2. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
3. Chromosome mapping using test cross data.
4. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
5. Blood Typing: ABO groups & Rh factor.
6. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
7. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.

**Reference Books :**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). Principles of Genetics, John Wiley & sons, India. 8th edition.

**CC-14.1 PLANT BIOTECHNOLOGY**

Contact Hour Per Week	: 4
Credits	: 4
Examination duration	: 3 Hours
Maximum marks	: 75 (Terminal- 60, Sessional-15)

**Unit-1**

**Plant Tissue Culture** :Introduction to Biotechnology – Plant Tissue Culture – History, Principle – Totipotency, differentiation, dedifferentiation, dedifferentiation. Facilities of Tissue culture laboratory, M.S Media, Preparation, Sterilization techniques, Preparation of Explants,.Types of culture – Meristem, Organ; Callus and Cell suspension culture; Protoplast Isolation and culture somatic hybridization and its significance; Somatic embryogenesis and synthetic seeds.

**Unit-2:Techniques of Tissue Culture** : Haploid production – Anther and pollen culture, its significance;Embryo culture and Embryo rescue Micropropagation – Multiple shoot culture and large scale propagation of crop plants, Somaclonal variation – Disease free plants; Production of secondary metabolites in Bioreactors.Application of tissue culture in Biodiversity and conservation

**Unit-3:Gene transfer methods in plants:**

Direct methods of gene transfer – Biolistics, Lipofection, Electroporation, Microinjection – Advantages and disadvantages

Vector mediated gene transfer-*Agrobacterium* mediated gene transfer – T DNA, Ti plasmid and Ri plasmid derived vector systems

Process of transfer - Bacterial colonization, Induction of virulence, generation of TDNA transfer complex, T-DNA transfer, Integration of TDNA into plant genome.

**Unit-4:Agricultural Biotechnology** :, Application of transgenic plants Bt cotton, Golden rice; Herbicide resistant plants and Biosafety concern

Environmental Biotechnology: Biodiversity and conservation; Waste management and Bioremediation

Food biotechnology – SCP, Improved food and food products, edible vaccination.

**CC 14.2: Practical**

Contact Hour Per Week	: 2
Examination duration	: 3 Hours
Maximum marks	: 25 (Exp. 15, Viva-5, Record-5)

1. Preparation of MS medium.
2. Demonstration of *in vitro* sterilization and inoculation methods using leaf and nodal explants of, *Datura*, *Brassica*, *Carrot*, *Mung bean*, *Trigonella* etc.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts.
5. Study of steps of genetic engineering for production of Bt cotton, Golden rice, Flavr Savr
6. Tomato through photographs.
7. Isolation of plasmid DNA.
8. Demonstration of the technique of organ culture
9. DNA isolation
10. Demonstration of preparation of synthetic seeds
11. Visit to a leading biotechnology institute locally – submission of report.

**Reference Books:**

1. Bhojwani, S.S. and Razdan, M.K., (1996). Plant Tissue Culture: Theory and Practice. Elsevier ScienceAmsterdam. The Netherlands.
2. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms. Vikas Publication HousePvt. Ltd., New Delhi. 5th edition.
3. Chawla, H.S. (2010). Introduction to Plant Biotechnology.Oxford & IBH Publishing Co.Pvt. Ltd., NewDelhi.
4. Brown TA (2006) Gene cloning and DNA anlysis; Blackwell scientific publishers
5. Dubey RC Introduction to Plant Biotechnology; S Chand & Co
6. Purohit SS (2003) Agricultural Biotechnology, Agrobios (India)
7. Dovstekel (2005) Microarray Bioinformatics; Cambridge University press
8. Razdan MK (1995) Introduction to Plant Tissue Culture. Oxford & IBHpublishing Co. Pvt. Ltd.
9. Lewin B (2004) Genes VIII. Oxford University Press

**DSE II: PROJECT CUM SEMINAR**

Contact Hours per Week : 4  
 Credit : 4  
 Maximum Marks : 100

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

## PROGRAM STRUCTURE: CHEMISTRY (HONS.)

Sem-ester	AECC	CC (Hons) Chemistry	GE-I* Mathematics	GE-II* Physics	DSE	SEC	Education	CBC*
I	AECC-1 Communicative English	CC-1 (Th+Pr)	GE-1 (Th+Pr)	GE-1 (Th+Pr)			PE-1 EPC-1	
II		CC-2 (Th+Pr)	GE-2(Th+Pr),	GE-2 (Th+Pr)		SEC (Th+Pr)	PE-2 CPS-1	
III	AECC-2 (Environmental Studies)	CC-3 (Th+Pr)	GE-3(Th+Pr),	GE-3 (Th+Pr)			PE-3 PE-4	
IV		CC-4 (Th+Pr)	GE-4(Th+Pr),	GE-4 (Th+Pr)	DSE -I (Th+Pr)		PE-5 PE-6	
V		CC-5 (Th+Pr) CC-6 (Th+Pr) CC-7 (Th+Pr) CC-8 (Th+Pr)					CPS2-1 CPS3-1 EPC-2	
VI		CC-9 (Th+Pr) CC-10 (Th+Pr) CC-11(Th+Pr) CC-12(Th+Pr)					CPS2-2, CPS3-2, FE-1	CBC
VII							PE-7, EPC-3 EPC-4, FE-2	
VIII		CC-13 (Th+Pr) CC-14(Th+Pr)			DSE-II (Project)		PE-8, EPC-5, EPC-6, EPC-7, FE-3	

\*GE (Mathematics) is equivalent to CC (Mathematics)

\*GE (Physics) is equivalent to CC (Physics)

## CHEMISTRY

### SCHEME OF EXAMINATION

#### Semester I:

**GE/CC 1.1 (Inorganic and Organic chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1 :	Inorganic	(a) Atomic structure (b) Periodicity of element
Unit 2:	Inorganic	Chemical Bonding-I and Molecular shape
Unit 3:	Organic	a) Introduction to organic chemistry & Basics of Organic Reactions b) Aliphatic hydrocarbons
Unit 4:	Organic	Stereoisomerism

**GE/CC 1.2: Practical 25 marks**

#### Semester II:

**GE/CC 2.1 (Organic and Physical Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1:	Organic	Aromatic hydrocarbons and reactions of Benzene derivatives
Unit 2:	Organic	a) Alkyl and Aryl halides b) Alcohols, Phenols
Unit 3:	Physical	Gaseous State of Matter
Unit 4:	Physical	Chemical and ionic equilibrium

**GE/CC 2.2: Practical 25 marks**

**SEC 1: Soil Chemistry (Terminal-40, Sessional-10) 50 marks**  
**Credits-4 (Theory-02, Practical-02)**

Unit 1:	Chemical Properties of soil
Unit 2:	Mineral nutrition of crops

**SEC 2 : Practical 50 marks**

#### Semester III:

**GE/CC 3.1 (Inorganic and Physical Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1:	Inorganic	a) General principles of Metallurgy b) Chemistry of s and p block elements
Unit 2:	Inorganic	Chemistry of transition metals -I
Unit 3:	Physical	First law of thermodynamics and thermochemistry
Unit 4:	Physical	(a) Colligative properties of dilute solutions (b) Conductance-I

**GE/CC 3.2: Practical 25 marks**

#### Semester IV:

**GE/CC 4.1 (Inorganic, Organic and Physical Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 : (Theory-04, Practical-02)**

Unit 1:	Inorganic	Coordination Chemistry
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Unit 2:	Organic	Aldehydes and Ketones (Aliphatic and Aromatic)	
Unit 3:	Organic	(a) Carboxylic acids and their derivatives (b) Alicyclic compounds	
Unit 4:	Physical	Chemical kinetics-I	
<b>GE/CC 4.2: Practical</b>			<b>25 marks</b>

**(Opt. any one)**

**DSE-I(Choice-1) I.1.1: Green Chemistry (Terminal-60, Sessional-15) 75 marks**  
**Credits-6: (Theory-04, Practical-02)**

Unit 1:	(a) Introduction to green chemistry (b) Future Trends in Green Chemistry
Unit 2:	Principles of Green Chemistry and Designing a Chemical synthesis
Unit 3:	Examples of Green Synthesis/ Reactions-I
Unit 4:	Examples of Green Synthesis/ Reactions-II

**DSE-I.1.2: Practical 25 marks**

**DSE-II (Choice-2) I.2.1: Polymer Chemistry (Terminal-60, Sessional-15) 75 marks**  
**Credits-6: (Theory-04, Practical-02)**

Unit 1:	Nature and Structure
Unit 2:	(a) Properties of polymers (b) Kinetics of polymerisation
Unit 3:	Polymer solution
Unit 4:	(a) Crystallisation and crystallinity (b) Glass transition Temperature

**DSE-I.2.2: Practical 25 marks**

**Semester V:**

**CC 5.1 (Inorganic Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1:	Compounds of s-p block elements
Unit 2:	Chemical bonding-II (MOT, VBT, Metallic bonding)
Unit 3:	Chemistry of transition Metals-II
Unit 4:	(a) Chemistry of Lanthanides and Actinides (b) Nobel gas

**CC 5.2: Practical 25 marks**

**CC 6.1: (Analytical and Physical Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1:	Analytical	Principles Molecular Spectroscopy-I
Unit 2:	Analytical	Application of Organic spectroscopy-I
Unit 3:	Physical	(a) Second law of Thermodynamics (b) Systems of Variable composition
Unit 4:	Physical	Chemical Kinetics-II

**CC 6.2: Practical 25 marks**

**CC 7.1: (Organic Chemistry) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1:	Types of Organic Reactions
Unit 2:	(a) Active methylene compounds, dithianes and enamines (b) Sulfur containing compounds
Unit 3:	(a) Nitrogen containing functional groups (b) Diazonium salts
Unit 4:	Carbohydrates

**CC 7.2: Practical 25 marks**

<b>CC 8.1: (Inorganic, Organic and Physical Chemistry)</b>		<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
		<b>Credits-6 (Theory-04, Practical-02)</b>	
Unit 1:	Inorganic	Nuclear Chemistry	
Unit 2:	Organic	Heterocyclic Compounds	
Unit 3:	Organic	Polynuclear Aromatic Hydrocarbons	
Unit 4:	Physical	Catalysis	
<b>CC 8.2: Practical</b>			<b>25 marks</b>
<b><u>Semester VI:</u></b>			
<b>CC 9.1 (Inorganic Chemistry)</b>		<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
		<b>Credits-6 (Theory-04, Practical-02)</b>	
Unit 1:		Magnetic properties and electronic spectra of transition Metal complexes	
Unit 2:		Bioinorganic chemistry	
Unit 3:		Organometallic Compounds	
Unit 4:		Thermodynamics and Kinetic aspects of metal complexes	
<b>CC 9.2: Practical</b>			<b>25 marks</b>
<b>CC 10.1 (Organic Chemistry)</b>		<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
		<b>Credits-6 (Theory-04, Practical-02)</b>	
Unit 1:		Amino acids and Proteins	
Unit 2:		Synthetic dyes	
Unit 3:		Pharmaceutical compounds	
Unit 4:		Alkaloids and Terpenes	
<b>CC 10.2: Practical</b>			<b>25 marks</b>
<b>CC 11.1 (Physical Chemistry)</b>		<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
		<b>Credits-6 (Theory-04, Practical-02)</b>	
Unit 1:		Conductance-II	
Unit 2:		Electrochemistry-I	
Unit 3:		Electrochemistry-II	
Unit 4:		Phase Equilibrium	
<b>CC 11.2 : Practical</b>			<b>25 marks</b>
<b>CC 12.1 (Analytical and Physical Chemistry)</b>		<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
		<b>Credits-6 (Theory-04, Practical-02)</b>	
Unit 1:	Analytical	Principles Molecular Spectroscopy-II	
Unit 2:	Analytical	Application of Organic spectroscopy II	
Unit 3:	Physical	(a) Liquid State of Matter	
		(b) Third Law of Thermodynamic	
Unit 4:	Physical	a) Quantum Chemistry	
		b) Photochemistry	
<b>CC 12.2: Practical</b>			<b>25 marks</b>
<b>CBC: Chemistry and our life</b>			<b>100 marks</b>
Unit 1:		Food Chemistry (Water, Beverage, Kitchen, Fire chemistry)	
Unit 2:		Chemistry in day-to-day life (Tooth paste, soap, cosmetics)	
Unit 3:		Chemistry in Health and Disease	

- Unit 4: (a) Plastics and polymers  
(b) Fuel Chemistry (Battery and Petrochemicals)

**Semester VIII:**

**CC 13.1 (Analytical, Inorganic and Organic chemistry)**  
(Terminal-60, Sessional-15) **75 marks**

**Credits-6 (Theory-04, Practical-02)**

- Unit 1: Analytical Chromatography  
 Unit 2: Inorganic (a) Inorganic Polymers  
(b) Non-aqueous solvents  
 Unit 3: Organic (a) Lipids, fats, oils and detergents  
(b) Nucleic acids  
 Unit 4: Organic (a) Enzymes  
(b) Concept of energy in Biosystems

**CC 13.2 : Practical** **25 marks**

**CC 14.1 (Inorganic, Organic and Physical Chemistry)**  
(Terminal-60, Sessional-15) **75 marks**

**Credits-6 (Theory-04, Practical-02)**

- Unit 1: Inorganic (a) Organometallic compounds-II  
(b) Catalysis by Organometallic Compounds  
 Unit 2: Organic (a) Organic Polymers  
(b) Petroleum and Petrochemicals  
 Unit 3: Physical Solid State of Matter  
 Unit 4: Physical Colloids and Surface chemistry

**CC 14.2 : Practical** **25 marks**

**DSE-II:PROJECT (Cr-4)** **100 marks**

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

### General Objectives (Theory)

**The objective of the syllabus is to enable the students to**

- Understand the quantum chemistry, structure of atom, concept of orbitals, explain different types of chemical bonds and predict/explain the geometry of molecules.
- Understand the synthesis, structure/bonding, reactions and mechanism for different classes of organic compounds.
- Know Chemistry of the elements belonging to different blocks in periodic table.
- Understand Chemical and ionic equilibria.
- Understand metallurgy and processes involved in extraction of metals from their ores.
- Understand the laws of thermodynamics and thermochemistry.
- Describe Properties of solution and colligative properties.
- Know Coordination chemistry, kinetics and stability of transition metal complexes.
- Illustrate Principles and applications of UV-VIS, IR, NMR and mass spectroscopy and elucidate the explain structure of organic compounds based on these data.
- Understand Nuclear chemistry and various internuclear processes.
- Explain Bioinorganic chemistry and role of metals in biological processes and the role of enzymes in biochemistry.
- Describe Electrochemical processes.
- Explaining Different states of matter, phases and their equilibria, different surface phenomena.
- Understand Laws of photochemistry and application.
- Understand the chemistry of inorganic and organic polymer.
- Conduct Separation of mixture of organic compounds using different chromatographic techniques.
- Identify the cation and anions present in a salt mixture.
- Calibrate different apparatus in laboratory and prepare different standard solutions.
- Prepare, separate/extract, Identify, analyze and estimate different inorganic and organic compounds.
- Perform estimations of different chemical entities in solution.
- Measure different physical parameter of a system like surface tension, viscosity, pH etc.
- Study kinetics of different chemical reactions.
- Develop skills in conductometry, potentiometry, polarimetry and colorimetry.

# CHEMISTRY

## Semester- I

### **GE/CC 1.1: Inorganic and Organic Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### **Unit 1: (a) Atomic Structure**

Recapitulation of Bohr's Theory, Sommerfeld's model, wave nature of matter, de Broglie's equation, Heisenberg's uncertainty principle, probability and shapes of orbitals, Schrodinger's wave equation. Significance of  $\Psi$  and  $\Psi^2$ . Quantum numbers, probability distribution curves. Shapes of s, p, d, f orbitals, Hund's rule of maximum multiplicity rule, Calculation of exchange energy, Pauli's exclusion principle, Aufbau principle, electronic configuration of atoms.

**(b) Periodicity of Elements:** s, p, d, f block elements, the long form of periodic table. Detailed discussion of the following properties of the elements, with reference to s & p-block. (a) Effective nuclear charge, shielding or screening effect, Slater rules, variation of effective nuclear charge in periodic table. (b) Atomic radii (van der Waals) (c) Ionic and crystal radii. (d) Covalent radii (octahedral and tetrahedral) (e) Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy. (f) Electron gain enthalpy, trends of electron gain enthalpy. (g) Electronegativity, Pauling's/ Mulliken's/ Alfred-Rachow's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

### **Unit 2: Chemical bonding-I and Molecular shape**

General characteristics of ionic bonding. Energy considerations in ionic bonding: lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR theory and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements.

Concept of resonance and resonating structures in various inorganic and organic compounds.

MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (excluding the idea of s-p mixing). Comparison of VB and MO approaches.

### Unit 3: a) Introduction to organic chemistry and Basics of organic reactions

(i) Classification, IUPAC nomenclature of organic compounds. (ii) Electronic Displacements: Inductive, electromeric, resonance and mesomeric effects, hyperconjugation and their applications; Dipole moment; Organic acids and bases; their relative strength.

Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges; Electrophiles and Nucleophiles; Nucleophilicity and basicity; Types, shape and their relative stability of Carbocations, Carbanions, Free radicals and Carbenes.

#### b) Aliphatic Hydrocarbons

Orbital representation of methane, ethene, ethyne.

**Alkanes:** (Upto 5 Carbons). Methods Preparation: Wurtz reaction, Kolbe's synthesis, Corey-House synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

**Alkenes:** (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis-alkenes (Partial catalytic hydrogenation) and Trans alkenes (Birch reduction). Reactions: cis-addition (alk.  $\text{KMnO}_4$ ) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymercuration-demercuration, Hydroboration-oxidation.

**Alkynes:** (Upto 5 Carbons) Preparation: Acetylene from  $\text{CaC}_2$  and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

**Reactions:** formation of metal acetylides, addition of bromine and alkaline  $\text{KMnO}_4$ , ozonolysis and oxidation with hot alk.  $\text{KMnO}_4$ . Hydration to form carbonyl compounds, alkylation of terminal alkynes.

### Unit 4: Stereoisomerism

Concept of isomerism, Types of isomerism.

**a) Geometrical Isomerism-** determination of configuration of geometric isomers, cis-trans, sequence rules and E & Z system of nomenclature, geometric isomerism in oximes and alicyclic compounds.

**b) Optical isomerism-** elements of symmetry, molecular chirality, writing the Fischer projection and flying wedge formulae. Illustration of inter-conversion of one type of structural representation into another type of formulae. Enantiomers, dia-stereomers, stereogenic centre, optical activity, properties of enantiomers, optical purity, chiral and achiral molecules with two stereogenic centres, threo and erythro designation, meso compounds, inversion, retention and racemization, Resolution of enantiomers by salt forming method.

Relative and absolute configuration, D, L and R, S systems of nomenclature.

**c) Conformational isomerism-** conformational analysis of ethane and n-butane: conformations of cyclohexane, axial and equatorial bonds. Newman Projection and Sawhorse projection. Difference between configuration and conformation.

**GE/CC 1.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

**Inorganic Chemistry:**

Qualitative analysis of inorganic salt mixture containing 4 radicals (only colourless salts in absence of interfering ions).

**Semester II****GE/CC 2.1: Organic and Physical Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Aromatic hydrocarbons and reactions of benzene derivatives**

**Aromatic hydrocarbon:** Structure of benzene, kekule structure, resonance structure, resonance energy calculation and molecular orbital structure. C-C bond length of benzene and stability. Aromaticity, Huckel rule, Aromatic ions, antiaromaticity and non aromaticity. Aromatic electrophilic substitution, mechanism, role of sigma and pi complexes, energy profile diagram, mechanism of nitration, halogenations, sulphonation, mercuration and Friedel craft's reaction. Substitution of mono substituted benzenes, activating and deactivating substituents, directive effects of the groups and its theory, ortho-para ratio, substitution of disubstituted benzene.

**Unit 2: (a) Alkyl and Aryl Halides:** Nomenclature and classes of alkyl and aryl halides, methods of preparation and chemical reactions (substitution, elimination and miscellaneous reactions).

**b) Alcohols and Phenols:**

**Alcohols:** Classification, Monohydric alcohols-nomenclature, methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding, acidic nature, reactions of alcohols. Dihydric alcohols-nomenclature, methods of formation, chemical reactions of vicinal glycols, oxidation cleavage, (lead acetate, and periodic acid). Trihydric alcohols-nomenclature and methods of formation, chemical reactions of glycerol.

**Phenols:** Nomenclature, structure and bonding, preparation of phenols. Physical properties and acidic character. Effect of substituents on acidity, comparison of acidic strengths of alcohols and phenols. Resonance stabilization of phenoxide ion. Reactions of phenol-Electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Claisen rearrangement, Gatterman synthesis. Hauben-Hoesch reaction. Lederer Manasse reaction, Reimer-Tiemann reaction.

**Unit3: Gaseous State of Matter:**

Kinetic molecular theory, derivation of kinetic gas equation, deduction of gas laws from kinetic gas equation, gas constant. Behavior of real gases, van der Waals equation of state. Qualitative discussion of Maxwell's distribution of molecular velocities and energies (derivation excluded), Molecular velocities-root mean square, average, most probable velocities (derivations excluded). Liquefaction of gases and critical phenomena, Laws of corresponding state, collision number, collision diameter, mean free path.

**Unit4: Chemical and Ionic equilibria**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between  $\Delta G$  and  $\Delta G^\circ$ , Le-Chatelier's principle. Relationships between  $K_p$ ,  $K_c$  and  $K_x$  for reactions involving ideal gases. Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle. Acid-Base indicator.

**GE/CC 2.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

**Inorganic Chemistry:**

Qualitative analysis of Inorganic Salt mixtures (four radicals, coloured salts), including interfering cations and anions and insoluble inorganic salts.

**SEC 1 : SOIL CHEMISTRY**

Contact Hour per Week	:	2
Credits	:	2
Terminal Examination duration	:	2 hours
Maximum Marks	:	50 (Terminal-40, Sessional-10)

**Unit 1:Introduction to Soil science :** Components of Soil, Soil Profile, Soil Physical properties, Soil Texture, Textural classes, particle size analysis, soil structure, classification, soil aggregates, significance, bulk density and particle density of soils and porosity, their significance and manipulation, soil compaction, soil color, elementary knowledge of soil classification of India, retention and potentials, soil moisture constants, soil colloids, properties, types and significance, adsorption of ions, ion exchange, CEC & AEC, factors influencing ion exchange and its significance. Soil organic matter, composition, decomposability, Humus, fractionations of organic matter, carbon cycle, C:N ratio.

**Unit 2:Soil Chemistry, Soil fertility, nutrient management :** Soil as a source of plant nutrients, essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, problem soils – Acid, salt affected and calcareous soils, characteristics, nutrient availabilities, reclamation – mechanical, chemical and biological methods. Fertilizers and insecticides and their effect on soil

water and air, soil fertility – different approaches for soil fertility evaluation. Methods of soil testing – chemical methods, critical levels of different nutrients in soil.

## **SEC 2 : Soil Chemistry**

### **Practicals**

Contact Hours Per Week	:	2
Credit	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	50 ( Expt-25, Viva-15, Record-10)

1. Collection and processing of soil for analysis.
2. Soil texture and mechanical analysis.
3. Determination of bulk density and particle density, water holding capacity.
4. Estimation of available N, P, K, S and Zn in soils, Determination of organic carbon, pH and EC (Soluble cations and anions in soil water extracts).

### **Reference Books :**

1. Text Book of Soil Science- Biswas T.D and Mukherjee. S.K. Tata McGrawHill Publishing company, New Delhi.
2. The nature and properties of soil – N. C. Brady & Ray R. Well.
3. Soil and soil fertility – C.M. Thomson & F.R. Troesh.
4. Fundamentals of soil science - Indian Society of soil science, New Delhi.

## **Semester III**

### **GE/CC3.1: Inorganic and Physical Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### **Unit 1:**

- a) General principles of Metallurgy:** Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process.

**b) Chemistry of s- and p-Block Elements**

Allotropy in C, S, and P, and catenation. Oxidation states with reference to elements in unusual and rare oxidation states (like carbides and nitrides), and their relative stability inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.

**Unit 2: Chemistry of Transition metals-I**

General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties, ability to form complexes. Stability of various oxidation states and e.m.f. (Latimer & Frost-Ebsworth diagrams). Difference between the first, second and third transition series.

**Unit 3:****First law of Thermodynamics**

Definition of thermodynamic terms: system, surrounding etc. Types of systems, intensive and extensive properties. State and path functions and their differentials. Thermodynamic process. Concept of heat and work.

First law of Thermodynamic: Statement, definition of internal energy and enthalpy. Heat capacity, heat capacity at constant volume and pressure and their relationship. Calculation of  $w$ ,  $q$ ,  $dU$  &  $dH$  for the expansion of ideal gases under isothermal and adiabatic conditions for reversible process.

Thermochemistry: Standard state, standard enthalpy of formation- Hess's law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization, Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy, Kirchhoff's equation.

**Unit 4:****a) Colligative properties**

Dilute solutions; lowering of vapour pressure, Raoult's and Henry's Laws and their applications. Excess thermodynamic functions. Thermodynamic derivation using chemical potential to derive relations between the four colligative properties [(i) relative lowering of vapour pressure, (ii) elevation of boiling point, (iii) Depression of freezing point, (iv) osmotic pressure] and amount of solute. Applications in calculating molar masses of normal, dissociated and associated solutes in solution.

**b) Conductance-I**

Arrhenius theory of electrolytic dissociation. Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Molar conductivity at infinite dilution. Kohlrausch law of independent migration of ions. Applications of conductance measurement: (i) degree of dissociation of weak electrolytes, (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts, (iv) conductometric titrations, and (v) hydrolysis constants of salts.

**GE/CC 3.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

**Objectives**

On completion of course, students will be able to

1. Calibrate fractional weights, pipettes,
2. Prepare standard solution
3. To estimate various metal in their sample solutions

**Inorganic Chemistry:**

1. Preparation of solution in ppm by dilution
2. Preparation of standard solution of solid and liquid compounds and dilution of 0.1 M to 0.001 M
3. Determination of alkali content of antacid tablets using HCl
4. Estimation of calcium content in chalk as calcium oxalate by permanganometry
5. Estimation of hardness of water by EDTA/Mg<sup>2+</sup> estimation by EDTA
6. Estimation of ferrous and ferric by dichromate method

**Semester IV****GE/CC 4.1: Inorganic, Organic and Physical Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Coordination Chemistry:**

Werner's theory, IUPAC nomenclature of coordination compounds, isomerism in coordination compounds. Stereochemistry of complexes with 4 and 6 coordination numbers. Valence bond theory (inner and outer orbital complexes), electroneutrality principle and back bonding. Crystal field theory (CFSE) in weak and strong fields, pairing energies, factors affecting the magnitude of 10 Dq in Octahedral and tetrahedral complexes, tetragonal distortions from octahedral geometry Jahn-Teller theorem, square planar geometry. Qualitative aspect of Ligand field and MO Theory.

**Unit 2: Aldehydes and Ketones (Aliphatic and Aromatic):**

Structure, reactivity and preparation;

Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives with mechanism; Mechanisms of Aldol and Benzoin condensation, Knoevenagel condensation, Claisen-

Schmidt, Perkin, Cannizzaro and Wittig reaction, Benzil-Benzilic acid rearrangements, haloform reaction, substitution reactions, oxidations and reductions (Clemmensen, Wolff-Kishner);

Addition reactions of unsaturated carbonyl compounds: Michael addition.

### Unit 3:a) Carboxylic acids and their derivatives

Preparation, physical properties and reactions of monocarboxylic acids: Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids (succinic and phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids)

Preparation and reactions of acid chlorides, anhydrides, esters and amides; Comparative study of nucleophilic substitution at acyl group -Mechanism of acidic and alkaline hydrolysis of esters, Claisen condensation, Dieckmann and Reformatsky reactions, Hofmann-bromamide degradation and Curtius rearrangement.

#### b) Alicyclic compounds

- i) Cycloalkanes, structure, method of formation, chemical reaction, Bayer-strain theory and its limitations, ring strain in small rings.
- ii) cycloalkenes: method of preparation and chemical reactions of cyclo alkenes.

### Unit 4: Chemical kinetics-I

The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half-life of a reaction. General method for determination of order of a reaction (differential method, integration method, method of half life period and isolation method). Concept of activation energy and its calculation from Arrhenius equation.

Theories of Reaction Rates: Collision theory based on hard-sphere model. Transition State Theory theory of bimolecular reactions steady state approximation. Comparison of the two theories (qualitative treatment only).

#### GE/CC 4.2: Practical

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

1. Identification of organic compounds (containing single functional group) through functional group analysis, determination of boiling point/melting point

#### DSE- I (Choice-1) I.1.1 : Green Chemistry

Contact Hour per Week	: 4
Credits	: 4
Terminal Examination duration	: 3 hours
Maximum marks	: 75 (Terminal- 60, Sessional- 15)

#### Unit 1 : a) Introduction to Green Chemistry

What is Green Chemistry? Need for Green Chemistry. Goals of Green Chemistry. Limitations/Obstacles in the pursuit of the goals of Green Chemistry.

#### b) Future Trends in Green Chemistry

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; oncovalent derivatization; Green chemistry in sustainable development.

### **Unit 2 : Principles of Green Chemistry and Designing a Chemical synthesis**

Twelve principles of Green Chemistry with their explanations and examples; Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/ minimization of hazardous/ toxic products; designing safer chemicals – different basic approaches to do so; selection of appropriate auxiliary substances (solvents, separation agents), green solvents, solventless processes, immobilized solvents and ionic liquids; energy requirements for reactions - use of microwaves, ultrasonic energy; selection of starting materials; avoidance of unnecessary derivatization – careful use of blocking/protecting groups; use of catalytic reagents (wherever possible) in preference to stoichiometric reagents; designing of biodegradable products; prevention of chemical accidents; strengthening/ development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes.

### **Unit 3 :Examples of Green Synthesis/ Reactions-I**

- Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural.
- Microwave assisted reactions in water: Hofmann Elimination, Hydrolysis (of benzyl chloride, benzamide, n-phenyl benzamide, methylbenzoate to benzoic acid), Oxidation (of toluene, alcohols).

Microwave assisted reactions in organic solvents: Esterification, Fries rearrangement,

Orthoester Claisen Rearrangement, Diels-Alder Reaction, Decarboxylation

Microwave assisted solid state reactions: Deacetylation, Deprotection. Saponification of esters, Alkylation of reactive methylene compounds, reductions, synthesis of nitriles from aldehydes; anhydrides from dicarboxylic acid; pyrimidine and pyridine derivatives; 1,2-dihydrotriazine derivatives; benzimidazoles.

- Ultrasound assisted reactions: Esterification, saponification, substitution reactions, Alkylations, oxidation, reduction, coupling reaction, Cannizzaro reaction, Strecker synthesis, Reformatsky reaction.

### **Unit 4 :Examples of Green Synthesis/ Reactions-II**

Selective methylation of active methylene group using dimethylcarbonate: Solid-state polymerization of amorphous polymers using diphenylcarbonate; Use of "Clayon", a nonmetallic oxidative reagent for various reactions; Free Radical Bromination; Role of Tellurium in organic syntheses; Biocatalysis in organic syntheses.

### **DSE I.1.2: Practical**

Contact Hours Per Week : 2

Examination Duration : 3 Hours

Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

#### **1. Safer starting materials**

The Vitamin C clock reaction using Vitamin C tablets, tincture of iodine, hydrogen peroxide and liquid laundry starch.

Effect of concentration on clock reaction

Effect of temperature on clock reaction. (if possible)

#### **2. Avoiding waste**

- Acetylation of primary amine (Acetanilide)
  - Base catalysed aldol condensation (Synthesis of diebenzal propanol)
  - Halogen addition to C=C (Bromination of trans-stilbene)
  - Rearrangement reaction (Benzyl-benzilic acid rearrangement)
- 3. Use of enzymes as catalysts**  
Benzoin condensation using Thiamine Hydrochloride as a catalyst instead of cyanide
- 4. Diels Alder reaction in water**  
Reaction between furan and maleic acid in water and at room temperature rather than in benzene and reflux.
- 5. Alternative sources of energy**  
Solvent free, microwave assisted one pot synthesis of phthalocyanine complex of copper (II).
- 6.** Photoreduction of benzophenone to benzopinacol in the presence of sunlight.

### Reference Books :

1. V.K. Ahluwalia & M.R. Kidwai: New Trends in Green Chemistry,
2. P.T. Anastas & J.K. Warner: Oxford Green Chemistry- Theory and Practical, University Press (1998).
3. A.S. Matlack: Introduction to Green Chemistry, Marcel Dekker (2001).
4. M.C. Cann & M.E. Connelly: Real-World cases in Green Chemistry, American Chemical Society, Washington (2000).
5. M.A. Ryan & M. Tinnensand, Introduction to Green Chemistry, American Chemical Society, Washington (2002).
6. Anastas, P.T & Warner, J.C. *Green Chemistry: Theory and Practice*, Oxford University Press (1998).
7. Kirchoff, M. & Ryan, M.A. *Greener approaches to undergraduate chemistry experiment*. American Chemical Society, Washington DC (2002).
8. Ryan, M.A. *Introduction to Green Chemistry*, Tinnensand; (Ed), American Chemical Society, Washington DC (2002).
9. Sharma, R.K.; Sidhwani, I.T. & Chaudhari, M.K. I.K. *Green Chemistry Experiment: A monograph International Publishing House Pvt Ltd. New Delhi*. Bangalore C ISBN 978-93-81141-55-7 (2013).
10. Cann, M.C. & Connelly, M. E. *Real world cases in Green Chemistry*, American Chemical Society (2008).
11. Cann, M. C. & Thomas, P. *Real world cases in Green Chemistry*, American Chemical Society (2008)

### DSE-II (Choice-2) I.2.1 : Polymer Chemistry

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### Unit 1: Nature and Structure

Different schemes of classification of polymers, Polymer nomenclature, Molecular forces and chemical bonding in polymers, Texture of Polymers. Structure Property relationships. Criteria for synthetic polymer formation, classification of polymerization processes. Relationships between functionality, extent of reaction and degree of polymerization. Bifunctional systems, Poly-functional systems.

**Unit 2:****(a) Properties of polymers (Physical, thermal, Flow & Mechanical Properties)**

Brief introduction to preparation, structure, properties and application of the following polymers: polyolefins, polystyrene and styrene copolymers, poly(vinyl chloride) and related polymers, poly(vinyl acetate) and related polymers, acrylic polymers, fluoro polymers, polyamides and related polymers. Phenol formaldehyde resins (Bakelite, Novalac), polyurethanes, silicone polymers, polydienes, Polycarbonates, Conducting Polymers, [polyacetylene, polyaniline, poly(p-phenylenesulphide polypyrrole, polythiophene)].

**(b) Kinetics of polymerization**

Mechanism and kinetics of step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations, Mechanism and kinetics of copolymerization, polymerization techniques.

**Unit 3 : Polymer solution**

Criteria for polymer solubility, Solubility parameter, Thermodynamic of polymer solutions, entropy, enthalpy, and free energy change of mixing of polymer solutions, Flory-Huggins theory, Lower and Upper critical solution temperatures. Determination of molecular weight of polymers ( $M_n$ ,  $M_w$ , etc): by end group analysis, viscometry, light scattering and osmotic pressure methods. Molecular weight distribution and its significance. Polydispersity index.

**Unit 4:**

**(a) Crystallisation and crystallinity:** Determination of crystalline melting point and degree of crystallinity, Morphology of crystalline polymers, Factors affecting crystalline melting point.

**(b) Glass transition Temperature:** Free volume theory, WLF equation, Factors affecting glass transition temperature ( $T_g$ )

**DSE I.2.2 : Practical**

Contact Hours Per Week : 2

Examination Duration : 3 Hours

Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

**1. Polymer synthesis**

1. Free radical solution polymerization of styrene (St) / Methyl Methacrylate (MMA) / Methyl Acrylate (MA) / Acrylic acid (AA).

a. Purification of monomer

b. Polymerization using benzoyl peroxide (BPO) / 2,2'-azo-bis-isobutyronitrile (AIBN)

2. Preparation of nylon-66 and nylon-6

1. Interfacial polymerization, preparation of polyester from isophthaloyl chloride (IPC) and phenolphthalein

a. Preparation of IPC

b. Purification of IPC

c. Interfacial polymerization

3. Redox polymerization of acrylamide
4. Precipitation polymerization of acrylonitrile
5. Preparation of urea-formaldehyde resin
6. Preparations of novalac resin/resold resin.
7. Microscale Emulsion Polymerization of Poly(methylacrylate).

## 2. Polymer characterization

1. Determination of molecular weight by viscometry:
  - (a) Polyacrylamide-aq. NaNO<sub>2</sub> solution
  - (b) (Poly vinyl propylidene (PVP) in water
2. Determination of the viscosity-average molecular weight of poly(vinyl alcohol) (PVOH) and the fraction of "head-to-head" monomer linkages in the polymer.
3. Determination of molecular weight by end group analysis: Polyethylene glycol (PEG) (OH group).
4. Testing of mechanical properties of polymers.
5. Determination of hydroxyl number of a polymer using colorimetric method.

## 3. Polymer analysis

1. Estimation of the amount of HCHO in the given solution by sodium sulphite method
  2. Instrumental Techniques
  3. IR studies of polymers
  4. DSC analysis of polymers
  5. Preparation of polyacrylamide and its electrophoresis
- \*at least 7 experiments to be carried out.

## Reference Books :

1. Billmeyer, F. W. *Textbook of Polymer Science*, John Wiley & Sons, Inc.
2. Gowariker, V. R.; Viswanathan, N. V. & Sreedhar, J. *Polymer Science*, New Age International (P) Ltd. Pub.
3. *Seymour's Polymer Chemistry*, Marcel Dekker, Inc.
4. G. Odian: *Principles of Polymerization*, John Wiley.
5. F.W. Billmeyer: *Text Book of Polymer Science*, John Wiley.
6. P. Ghosh: *Polymer Science & Technology*, Tata Mcgraw-Hill.
7. R.W. Lenz: *Organic Chemistry of Synthetic High Polymers*.

## Semester V

### CC 5.1: Inorganic Chemistry

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### CC 5.1: Inorganic Chemistry

#### Unit 1: Compounds of s and p Block Elements

Complex formation tendency of s and p block elements. Hydrides and their classification-ionic, covalent and interstitial. Basic beryllium acetate and nitrate.

Study of the following compounds with emphasis on structure, bonding, preparation, properties and uses.

Boric acid and borates, boron nitrides, borohydrides (diborane) and graphitic compounds, silanes, Oxides and oxyacids of nitrogen, interhalogen compounds, polyhalide ions, pseudohalogens and basic properties of halogens.

Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.

Hydrides of nitrogen ( $\text{NH}_3$ ,  $\text{N}_2\text{H}_4$ ,  $\text{N}_3\text{H}$ ,  $\text{NH}_2\text{OH}$ )

Oxoacids of P, S and Cl.

Halides and oxyhalides:  $\text{PCl}_3$ ,  $\text{PCl}_5$ ,  $\text{SOCl}_2$  and  $\text{SO}_2\text{Cl}_2$ .

## Unit 2:

### Chemical bonding-II:

- a) Covalent bonding, valence bond and molecular orbital approaches, LCAO-MO treatment of  $\text{H}_2^+$ . Qualitative extension to  $\text{H}_2$ . Comparison of LCAO-MO and VB treatments of  $\text{H}_2$  (only wavefunctions, detailed solution not required) and their limitations. Refinements of the two approaches (Configuration Interaction for MO, ionic terms in VB). Qualitative description of LCAO-MO treatment of heteronuclear diatomic molecules ( $\text{HF}$ ,  $\text{LiH}$ ,  $\text{CO}$ ,  $\text{NO}$  and  $\text{NO}^+$ ). Localised and non-localised molecular orbitals treatment of triatomic ( $\text{BeH}_2$ ,  $\text{H}_2\text{O}$ ) molecules. Qualitative MO theory and its application to  $\text{AH}_2$  type molecules.
- b)
  - i) Metallic Bond: Electron-gas theory, valency bond theory and band theory. Semiconductors and insulators, defects in solids.
  - ii) Weak Chemical Forces: van der Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces, Hydrogen bonding (theories of hydrogen bonding, valence bond treatment) Effects of chemical force, melting and boiling points, solubility energetics of dissolution process.

### Chemistry of transition metals- II

Chemistry of Ti (+2 and +4), V (+3 and +5), Cr, Mn (+2, +4 and +7), Fe (+2 and +3) and Co (+2 and +3) (excluding their metallurgy)

## Unit 4:

- a) **Chemistry of Lanthanides and Actinides:** Electronic configuration, oxidation states, colour, spectral and magnetic properties, lanthanide contraction, separation of lanthanides (ion-exchange method only).
- b) **Noble gases:** Occurrence and uses, rationalization of inertness of noble gases, Clathrates; preparation and properties of  $\text{XeF}_2$ ,  $\text{XeF}_4$  and  $\text{XeF}_6$ ; Nature of bonding in noble gas compounds (Valence bond treatment and MO treatment for  $\text{XeF}_2$ ). Molecular shapes of noble gas compounds (VSEPR theory).

### CC 5.2: Practical

Contact Hours Per Week : 2

Examination Duration : 3 Hours

Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

#### 1. Iodometry and Iodimetry

- i) Estimation of available chlorine in bleaching powder iodometrically.
- ii) Estimation of copper using thiosulphate.

## 2. Inorganic preparations

- i) Cuprous Chloride,  $\text{Cu}_2\text{Cl}_2/\text{Cu}_2\text{I}_2$
- ii) Preparation of Manganese(III) phosphate,  $\text{MnPO}_4 \cdot \text{H}_2\text{O}$
- iii) Preparation of Aluminium potassium sulphate  $\text{K}_2\text{SO}_4\text{Al}_2(\text{SO}_4)_2 \cdot 24\text{H}_2\text{O}$  (Potash alum).
- iv) Pot. Trioxalate Chromate (III)
- V) Tetracupric ammonium sulphate
- VI) Preparation of cis and trans  $[\text{Co}(\text{en})_2\text{Cl}_2]^+$

### CC 6.1: Analytical and Physical Chemistry

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### Unit 1: Principle Molecular spectroscopy-I

Interaction of electromagnetic radiation with molecules and various types of spectra; Born-Oppenheimer approximation.

Rotation spectroscopy: Selection rules, intensities of spectral lines, determination of bond lengths of diatomic and linear triatomic molecules, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands, degrees of freedom for polyatomic molecules, modes of vibration, concept of group frequencies.

Vibration-rotation spectroscopy: diatomic vibrating rotator, P, Q, R branches.

Raman spectroscopy: Qualitative treatment of Rotational Raman effect; Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines; their intensity difference, rule of mutual exclusion.

Electronic spectroscopy: Franck-Condon principle, electronic transitions, singlet and triplet states, fluorescence and phosphorescence, dissociation and predissociation, calculation of electronic transitions of polyenes using free electron model.

### Unit 2: Application of Organic Spectroscopy-I

General principles Introduction to absorption and emission spectroscopy.

*UV Spectroscopy:* Types of electronic transitions,  $\lambda_{\text{max}}$ , Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of  $\lambda_{\text{max}}$  of the following compounds: Conjugated dienes: acyclic and alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.

*IR Spectroscopy:* Fundamental and non-fundamental molecular vibrations; IR absorption positions of O, N and S containing functional groups; Effect of H-bonding, conjugation, resonance and ring

size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.

### Unit 3:a)Second law of Thermodynamics

Second Law: Concept of entropy; thermodynamic scale of temperature, statement of the second law of thermodynamics; molecular and statistical interpretation of entropy. Calculation of entropy change for reversible and irreversible processes.

Free Energy Functions: Gibbs and Helmholtz energy; variation of S, G, A with T, V, P; Free energy change and spontaneity. Relation between Joule-Thomson coefficient and other thermodynamic parameters; inversion temperature; Gibbs-Helmholtz equation; Maxwell relations; thermodynamic equation of state.

### b) Systems of variable compositions

Partial molar quantities, dependence of thermodynamic parameters on composition; Gibbs-Duhem equation, chemical potential of ideal mixtures, change in thermodynamic functions in mixing of ideal gases.

### Unit 4:Chemical Kinetics II

(i) Opposing reactions (ii) parallel reactions and (iii) consecutive reactions and their differential rate equations (steady-state approximation in reaction mechanisms) (iv) chain reactions.

Temperature dependence of reaction rates; Arrhenius equation; activation energy. Collision theory of reaction rates, Lindemann mechanism, qualitative treatment of the theory of absolute reaction rates.

### CC 6.2: Practical

Contact Hours Per Week : 2  
Examination Duration : 3 Hours  
Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

### Spectrophotometry

1. To determine the strength of  $\text{KMnO}_4$  solution using spectrophotometer.
2. To determine the concentration of HCl against 0.1 N NaOH spectrophotometrically.
3. To find the strength of given ferric ammonium sulfate solution of (0.05 M) by using EDTA spectrophotometrically.
4. To find out the strength of  $\text{CuSO}_4$  solution by titrating with EDTA spectrophotometrically.
5. To determine the concentration of Cu(II) and Fe(III) solution spectrophotometrically by titrating with EDTA.

### Polarimetry

To determine the specific rotation of optically active compounds.

**CC 7.1: Organic Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:****Types of organic reactions**

Types of organic reactions and their mechanisms, nucleophilic substitution (SN1 and SN2) and electrophilic substitution, addition ( $ad_N$  and  $ad_E$ ), elimination ( $E_1$ ,  $E_2$ ,  $E_{1CB}$ ) reactions. Oxidation (oxidation of aldehydes, Bayer-Villiger's oxidation of ketones), reduction (MPV,  $LiAlH_4$ ,  $NaBH_4$ , PDC and PCC) and rearrangement reactions with mechanism- Pinacol-pinacolone, Beckmann, Benzidine and Fries rearrangement.

**Unit 2 a) Active methylene compounds, Dithiane and enamines**

Acidity of  $\alpha$ -Hydrogens, synthesis of ethyl acetoacetate, Claisen condensation, Keto-enol tautomerism of ethyl acetoacetate, synthetic applications of ethyl acetoacetate and diethyl malonate.

Alkylation of 1,3-dithianes, alkylation and acylation of enamines.

**b) Sulfur containing compounds**

Preparation and reactions of thiols, thioethers and sulfonic acids.

**Unit 3. Nitrogen containing functional groups**

Methods of preparations of nitroalkanes and nitroarenes, chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution of nitroarenes and their reductions in acidic, alkaline and neutral medium. Preparation and important reactions of nitriles and isonitriles.

Structure and nomenclature of amines, Physical properties and stereochemistry of amines, structural features affecting basicity of amines, separation of a mixture of primary, secondary and tertiary amines (Hoffman method and Hinsberg method). Preparation of alkyl and aryl amines (reduction of nitrocompounds, nitriles, reductive amination of aldehyde and ketonic compounds), Gabriel Phthalimide reaction, Hoffmann exhaustive methylation, Hoffmann Bromamide reaction, Mannich reaction and nitrous acid test for distinction of primary, secondary and tertiary amines.

**Diazonium salts:** Preparation and their synthetic applications.

**Unit 4. Carbohydrates**

Classification and their biological importance.

Monosaccharides: Configuration of monosaccharides, structure elucidation and derivation of configurations of glucose and fructose, epimers, evidences for cyclic structure, mechanism of mutarotation, Cyclic structure of glucose, fructose, anomers, Haworth projections and conformation of D-glucose, determination of ring size of glucose, Interconversions of aldoses and ketoses; Killiani-Fischer synthesis and Ruff degradation; mechanism of osazone formation. Formation of glycosides.

Disaccharides – Structure elucidation of sucrose, lactose and maltose.

Polysaccharides – Elementary treatment of starch, cellulose and glycogen.

**CC 7.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

Preparations of the following compounds

1. Aspirin, Iodoform, Methyl orange, m-dinitrobenzene, p-nitroacetanilide
2. Saponification value of an oil.
3. Determination of Iodine number of an oil.
4. Preparation of sodium polyacrylate.
5. Preparation of urea formaldehyde.

**CC 8.1: Inorganic, Organic and Physical Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Inorganic: Nuclear Chemistry**

Application of radioisotopes. Nuclear process, Nuclear binding energy, stability of nucleus, energies changes in nuclear reactions, concept of nuclear cross section and its importance, Bethe notations, nuclear fission and fusion, Uses of nuclear radiations, radiation-sterilization, radiation energy for chemical synthesis. Application of radio isotopes, Isotopes, their separation and applications.

**Unit 2 :Heterocyclic compounds**

Classification and nomenclature, Structure, aromaticity in 5-membered and 6-membered rings containing one heteroatom; Synthesis, reactions and mechanism of substitution reactions of: Furan, Pyrrole, thiophene (Paal-Knorr synthesis, Knorr pyrrole synthesis), Pyridine (Hantzsch synthesis), Pyrimidine, Structure elucidation of indole, Fischer's indole synthesis and Madelung synthesis), Structure elucidation of quinoline and isoquinoline.

Derivatives of furan: Furfural and furoic acid.

**Unit 3 :Polynuclear aromatic hydrocarbons**

Reactions of naphthalene, phenanthrene and anthracene, elucidation of their structure, preparation of  $\alpha$  and  $\beta$ -naphthols, structural elucidation of anthraquinone and alizarins.

**Unit 4 :Catalysis**

Types of catalyst, specificity and selectivity, mechanisms of catalyzed reactions at solid surfaces; effect of particle size and efficiency of nanoparticles as catalysts. Enzyme catalysis, Michaelis-Menten mechanism, acid-base catalysis.

**CC 8.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 (Expt-15, Viva-6, Record-4)

**I) Thermochemistry**

- Determination of heat capacity of a calorimeter for different volumes using change of enthalpy data of a known system (method of back calculation of heat capacity of calorimeter from known enthalpy of solution or enthalpy of neutralization).
- Determination of heat capacity of the calorimeter and enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
- Calculation of the enthalpy of ionization of ethanoic acid.
- Determination of heat capacity of the calorimeter and integral enthalpy (endothermic and exothermic) solution of salts.
- Determination of basicity/proticity of a polyprotic acid by the thermochemical method in terms of the changes of temperatures observed in the graph of temperature versus time for different additions of a base. Also calculate the enthalpy of neutralization of the first step.
- Determination of enthalpy of hydration of copper sulphate.
- Study of the solubility of benzoic acid in water and determination of  $\Delta H$ .

II) Estimation of  $\text{Al}^{3+}/\text{Ca}^{2+}/\text{Mg}^{2+}$  using EDTA (Erio T or other suitable indicator)

**Semester-VI****CC 9.1: Inorganic Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Magnetic poperties and electronic spectra of transition metal complexes**

**Magnetic properties:** Types of magnetic behavior, Curie law, methods of determining magnetic susceptibility, spin only formula L-S coupling, correlation of  $\mu_s$  and  $\mu_l$  values. Orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.

**Electronic spectra:** Types of electronic transition, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series, Orgel-energy level diagram for  $d^1$  and  $d^9$  states, discussion of the electronic spectrum of hexaaqua titanium (III) complex  $[\text{Ti}(\text{H}_2\text{O})_6]^{+3}$ .

**Unit-2:Bio-inorganic Chemistry**

A brief introduction to bio-inorganic chemistry. Essential and trace elements in biological processes. Metalloporphyrins with special reference to haemoglobin and myoglobin. Role of metal ions present in biological systems with special reference to  $\text{Na}^+$ ,  $\text{K}^+$  and  $\text{Mg}^{2+}$  ions: Na/K pump; Role of  $\text{Mg}^{2+}$  ions in energy production and chlorophyll. Role of  $\text{Ca}^{2+}$  in blood clotting, stabilization of protein structures and structural role (bones).

**Unit 3: Organometallic compounds-I**

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands.

Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT.  $\pi$ -acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding.

Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.

Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Structure and aromaticity. Comparison of aromaticity and reactivity with that of benzene.

**Unit 4: Thermodynamics and Kinetic aspects of metal complexes**

A brief outline of thermodynamic stability of metal complexes and the factors affecting the stability. Thermodynamic and Kinetic stability. Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes, Kinetics of octahedral substitution, Crystal field effects and reaction rates, Mechanism of substitution in octahedral complexes.

**CC 9.2: Practical**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 (Expt-15, Viva-5, Record-5)

**Gravimetric Analysis:**

- i. Estimation of nickel (II) using Dimethylglyoxime (DMG).
- ii. Estimation of copper as  $\text{CuSCN}$
- iii. Estimation of iron as  $\text{Fe}_2\text{O}_3$  by precipitating iron as  $\text{Fe}(\text{OH})_3$ .
- iv. Estimation of Al (III) by precipitating with oxine and weighing as  $\text{Al}(\text{oxine})_3$  (aluminium oxinate).
- v) Estimation of Ba as  $\text{BaSO}_4$
- vi) Estimation of Pb as  $\text{PbSO}_4$

**CC 10.1: Organic Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1:****Amino Acids, Peptides and Proteins**

Amino acids and their classification.  $\alpha$ -Amino Acids – General methods of Synthesis, ionic properties and reactions. Zwitterions,  $pK_a$  values, isoelectric point and electrophoresis.

Study of peptides: classification, determination of their primary structures-end group analysis, methods of peptide synthesis. Synthesis of peptides using N-protecting, C-protecting and C-activating groups, Solid-phase synthesis

Structure of peptides and proteins, labels of proteins structure, protein denaturation.

**Unit2: Synthetic Dyes**

Classification, Colour and constitution; Mordant and Vat Dyes; Chemistry of dyeing.

Synthesis and applications of: Azo dyes – Methyl Orange and Congo Red (mechanism of Diazo Coupling); Triphenyl Methane Dyes -Malachite Green, Rosaniline and Crystal Violet; Phthalein Dyes – Phenolphthalein and Fluorescein; Natural dyes –structure elucidation and synthesis of Alizarin and Indigo; Edible Dyes with examples.

**Unit 3:Pharmaceutical compounds**

Classification, structure and therapeutic uses of antipyretics: Paracetamol (with synthesis), Analgesics: Ibuprofen (with synthesis), Antimalarials: Chloroquine (with synthesis). An elementary treatment of Antibiotics and detailed study of chloramphenicol, Medicinal values of curcumin (haldi), azadirachtin (neem), vitamin C and antacid (ranitidine).

**Unit 4:Alkaloids and Terpenes**

**Alkaloids:** Natural occurrence, Isolation, Classification,General properties and their physiological action. General structure determination.Hoffmann's exhaustive methylation, Emde's modification, Structure elucidation and synthesis of quinine and Nicotine.Medicinal importance of Nicotine, Hygrine, Quinine, Morphine, Cocaine, and Reserpine.

**Terpenes:** Occurrence, isolation, properties (physical and chemical) classification, isoprene rule; Elucidation of stucture and synthesis of Citral.

**CC 10.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

**Organic preparations**

- i. Acetylation of aniline,  $\beta$ -naphthol and resorcinol by any one method:
    - a. Using conventional method.
    - b. Using green approach
  - ii. Benzoylation of aniline and  $\beta$ -naphthol/resorcinol/p-cresol) by Schotten-Baumann reaction.
  - iii. Bromination of Acetanilide by
    - a. Conventional methods
    - b. using green approach (Bromate-bromide method)
  - iv. Nitration of Salicylic acid by green approach (using ceric ammonium nitrate)
- The above derivatives should be prepared using 0.5-1g of the organic compound. The solid samples must be collected and may be used for recrystallization, melting point and TLC.

**CC 11.1: Physical Chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Conductance-II**

Ionic velocities, mobilities and their determinations, transference numbers and their relation to ionic mobilities, determination of transference numbers using Hittorf and Moving Boundary methods.

**Unit 2 :Electrochemistry-I**

Quantitative aspects of Faraday's laws of electrolysis, rules of oxidation/reduction of ions based on half-cell potentials, applications of electrolysis in metallurgy and industry. Chemical cells, reversible and irreversible cells with examples. Electromotive force of a cell and its measurement, Nernst equation; Standard electrode (reduction) potential and its application to different kinds of half-cells. Application of EMF measurements in determining free energy, enthalpy and entropy of a cell reaction, (ii) equilibrium constants, and (iii) pH values.

**Unit 3 :Electrochemistry-II**

Concentration cells with and without transference, liquid junction potential; determination of activity coefficients and transport numbers. Qualitative discussion of potentiometric titrations (acid-base, redox, precipitation). Dry cell, Lead-acid storage cell, fuel cell, Corrosion.

**Unit 4 :Phase Equilibrium**

Concept of phases, components and degrees of freedom, derivation of Gibbs Phase Rule for nonreactive and reactive systems; Clausius-Clapeyron equation and its applications to solid-liquid, liquid-vapour and solid-vapour equilibria,

Phase diagram for one component systems (water and sulphur system), with applications.

Phase diagrams for two component systems; simple eutectic, Pb-Ag system, desilverization of lead.

*Binary solutions:* Gibbs-Duhem-Margules equation, its derivation and applications to fractional distillation of binary miscible liquids, ideal and non-ideal, azeotropes, ethanol-water systems. partial miscibility of liquids, Lower and upper consolute temperatures, effect of impurity on consolute temperatures. Phenol-water, trimethylamine-water, nicotine-water systems.

Nernst distribution law: its derivation and applications.

### CC 11.2: Practical

Contact Hours Per Week : 2

Examination Duration : 3 Hours

Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

#### Conductometry

- I. Determination of cell constant
- II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.
- III. Perform the following conductometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base
  - iii. Strong acid vs. weak base

#### Potentiometry

- I Perform the following potentiometric titrations:
  - i. Strong acid vs. strong base
  - ii. Weak acid vs. strong base
  - iii. Dibasic acid vs. strong base

### CC 12.1: Analytical and Physical Chemistry

Contact Hour per Week : 4

Credits : 4

Terminal Examination duration : 3 hours

Maximum marks : 75 (Terminal- 60, Sessional- 15)

#### Unit 1 :Principle of Molecular spectroscopy-II

Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmorprecession, chemical shift and low resolution spectra, different scales, spin-spin coupling and high resolution spectra, interpretation of PMR spectra of organic molecules.

Electron Spin Resonance (ESR) spectroscopy: Its principle, hyperfine structure, ESR of simple radicals. Mass spectroscopy.

### Unit 2 :Application of Organic Spectroscopy-II

*NMR Spectroscopy:* Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects in alkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.

Mass Spectroscopy- Basic principle, Fragmentation pattern, Instrumentation, Determination of m/e ratio. Application of Mass Spectroscopy on CH<sub>4</sub>, C<sub>2</sub>H<sub>6</sub>, *n*-butane and *neo*-pentane.

Applications of IR, UV and NMR for identification of simple organic molecules.

### Unit 3 :a) Liquid state of matter

Qualitative treatment of the structure of the liquid state; Radial distribution function; physical properties of liquids; vapour pressure, surface tension and coefficient of viscosity, and their determination. Effect of addition of various solutes on surface tension and viscosity. Explanation of cleansing action of detergents. Temperature variation of viscosity of liquids and comparison with that of gases. Qualitative discussion of structure of water.

Liquid crystals, classification and structure of nematic and cholesteric phase.

b) **Third Law of Thermodynamics:** Nernst Heat theorem. Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules from heat capacity data.

### Unit 4 : a)Quantum chemistry

Heisenberg Uncertainty principle; wavefunctions, probability distribution functions, nodal properties, Postulates of quantum mechanics, quantum mechanical operators, Schrödinger equation and its application to free particle and "particle-in-a-box" (rigorous treatment), quantization of energy levels, zero-point energy. Qualitative treatment of simple harmonic oscillator model of vibrational motion: Setting up of Schrödinger equation and discussion of solution and wavefunctions. Extension to three dimensional boxes, separation of variables, degeneracy.

Qualitative treatment of hydrogen atom and hydrogen-like ions: setting up of Schrödinger equation in spherical polar coordinates, radial part, quantization of energy (only final energy expression). Average and most probable distances of electron from nucleus.

b) **Photo-Chemistry:** Characteristics of electromagnetic radiation, Lambert-Beer's law and its limitations, physical significance of absorption coefficients. Laws of photochemistry ( Grothus-Drapper law, Stark-Einstein law), Jablonski diagram depicting various processes occurring in the excited state, quantum yield, actinometry, examples of low and high quantum yields, photochemical equilibrium and the differential rate of photochemical reactions, photosensitised reactions, quenching. Role of photochemical reactions in biochemical processes, photostationary states, chemiluminescence. Qualitative description of fluorescence and phosphorescence, Non radiative processes (internal conversion, intersystem crossing).

### CC 12.2: Practical

Contact Hours Per Week : 2

Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

**1. Surface tension measurements.**

- Determine the surface tension by (i) drop number (ii) drop weight method.
- Study the variation of surface tension of detergent solutions (SDS) with concentration.

**2. Viscosity measurement using Ostwald's viscometer.**

- Determination of viscosity of aqueous solutions of (i) polymer (polyvinyl alcohol) (ii) ethanol and (iii) sugar at room temperature.
- Study the variation of viscosity of sucrose solution with the concentration of solute.

**3. pH metry**

- Study the effect on pH of addition of HCl/NaOH to solutions of acetic acid, sodium acetate and their mixtures.
- Preparation of buffer solutions of different pH. (i) Sodium acetate-acetic acid (ii) Ammonium chloride-ammonium hydroxide, (iii) Sodium dihydrogen phosphate, (iv) disodium monohydrogen phosphate.
- Determination of dissociation constant of a weak acid.

**Semester VIII**

**CC 13.1: Analytical, Inorganic and Organic chemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :**

**Chromatography**

Principle, steps involved in chromatography, Separation of mixtures by following chromatography techniques (column, paper and thin layer)

**Paper Chromatography:** Separation of mixture of

- cations of group-I/group-II,
- amino acid (viz. arginine, glutamic acid, lysine, aspartic acid),
- D-glucose, D-xylose and lactose,
- alizarin red, methyl red, methyl orange.

**Column Chromatography:** Separation of mixture of:

- methylene blue and malachite green,
- $Pb^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$ ,  $Bi^{3+}$  or mixture of  $Ag^{2+}$ ,  $Pb^{2+}$ ,  $Hg^{2+}$
- chlorophylls and carotenoids from spinach.

**TLC:** Separation of mixture of:

- e-ink pigments in black ink, blue ink and red ink.

- ii) dyes containing malachite green, fluorescein, rhodamin B.
- iii) phenolic mixtures like phloroglucinol, resorcinol, o/m-nitrophenol.
- iv) amino acids in a mixture.

**Unit 2:****a) Inorganic Polymers**

Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicones and siloxanes. Borazines, silicates and phosphazenes.

**b) Non-aqueous solvents**

Classification of solvents: liquid ammonia solvent system with reference to a) acid-base reactions, b) solvolysis, c) precipitation reactions.

**Unit 3:****a) Lipids, fats, oils and detergents**

Introduction to lipids, classification.

Oils and fats: Common fatty acids present in oils and fats, Omega fatty acids, Trans fats, Hydrogenation, Saponification value, Iodine number.

Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

**b) Nucleic acids**

Components of nucleic acids, Nucleosides and nucleotides; Structure, synthesis and reactions of: Adenine, Guanine, Cytosine, Uracil and Thymine; Structure of polynucleotide.

**Unit 4:****a) Enzymes**

Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes.

Mechanism of enzyme action (taking trypsin as example), factors affecting enzyme action, coenzymes and cofactors and their role in biological reactions, specificity of enzyme action (including stereospecificity), enzyme inhibitors and their importance, phenomenon of inhibition (competitive, uncompetitive and non-competitive inhibition including allosteric inhibition).

**b) Concept of energy in Biosystems:**

Introduction to metabolism (catabolism and anabolism). Concept of hydrolyses of ATP and ADP and coupling reaction.

Overview of catabolic pathways of fat and protein.

Interrelationship in the metabolic pathways of protein, fat and carbohydrate. Caloric value of food, standard caloric content of food types.

**CC 13.2: Practical**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Checking the calibration of the thermometer
2. Chromatography
  - a. Separation of a mixture of two amino acids by ascending and horizontal paper chromatography
  - b. Separation of a mixture of two sugars by ascending paper chromatography
  - c. Separation of a mixture of o-and p-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC)
  - d. Paper chromatographic separation of following metal ions:
    - (i) Ni (II) and Co (II)
    - (ii) Fe (III) and Al (III)

### CC 14.1: Inorganic, Organic and Physical Chemistry

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit 1:

##### a) Organometallic compounds-II

Metal Alkyls: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). Species present in ether solution of Grignard reagent and their structures, Schlenk equilibrium.

##### b) Catalysis by Organometallic Compounds

Study of the following industrial processes and their mechanism:

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Hydroformylation (Co salts)
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Synthesis gas by metal carbonyl complexes

#### Unit 2:a)Organic polymers

Introduction and classification including di-block, tri-block and amphiphilic polymers;

Number average molecular weight, Weight average molecular weight, Degree of polymerization, Polydispersity Index.

Polymerisation reactions -Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes; Preparation and applications of plastics – thermosetting (phenol-formaldehyde, Polyurethanes) and thermosoftening (PVC, polythene);

Fabrics – natural and synthetic (acrylic, polyamido, polyester); Rubbers – natural and synthetic: Buna-S, Chloroprene and Neoprene; Vulcanization; Polymer additives; Introduction to liquid crystal polymers; Biodegradable and conducting polymers with examples.

##### b) Petroleum and petrochemicals

Origin of petroleum, composition, refining, reforming, fractionation, cracking, knocking, octane number, cetane number, kerosene, naphtha, LPG, synthetic petrol, petrochemicals.

### Unit 3: Solid State of matter

Nature of the solid state, law of constancy of interfacial angles, law of rational indices, Miller indices, elementary ideas of symmetry, symmetry elements and symmetry operations, qualitative idea of point and space groups, seven crystal systems and fourteen Bravais lattices; X-ray diffraction, Bragg's law, a simple account of rotating crystal method and powder pattern method. Analysis of powder diffraction patterns of NaCl, CsCl and KCl. Defects in crystals. Glasses and liquid crystals.

### Unit 4: Colloidal and Surface Chemistry

Definition of colloids, classification of colloids, solids in liquids (sols): Properties-kinetic optical and electrical stability of colloids, protective action; Hardy-Schulze law, gold number, liquids in liquids (Emulsions): types of emulsions, preparation, emulsifier, liquid in solid (gels): classification, preparation and properties, general application of colloids.

Adsorption: Types of adsorption, Freundlich, Langmuir and Gibb's adsorption isotherm.

### CC 14.2: Practical

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

- I. Distribution of acetic/ benzoic acid between water and cyclohexane.
- II. Study the equilibrium of at least one of the following reactions by the distribution method:
 
$$\text{I}_2(\text{aq}) + \text{I}^- \rightarrow \text{I}_3^-(\text{aq})$$

$$\text{Cu}^{2+}(\text{aq}) + n\text{NH}_3 \rightarrow [\text{Cu}(\text{NH}_3)_n]^{2+}$$
- III. Study the kinetics of the following reactions.
  - 1) Integrated rate method:
    - a. Acid hydrolysis of ethyl acetate with hydrochloric acid.
    - b. Saponification of ethyl acetate.
  - 2) Compare the strengths of HCl and H<sub>2</sub>SO<sub>4</sub> by studying kinetics of hydrolysis of methyl acetate.

### Adsorption

- I. Verify the Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

**DSE II: Project-cum-Seminar**

Contact Hours per Week : 4  
 Credit : 4  
 Maximum Marks : 100

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

**Reference Books****Physical Chemistry**

1. Principles for physical Chemistry- Puri, Sharma and Pathania
2. Physical chemistry – Bahl and Tuli
3. Physical chemistry-S. Glasstone
4. Physical chemistry (vol I to V) K. L. Kapoor
5. Physical chemistry-Soni, Dharmarah and Dash
6. Physical chemistry-P.C. Rakhit
7. Thermodynamics for chemists- S. Glasstone
8. Electrochemistry- S. Glasstone
9. Physical chemistry- Atkins
10. Basic physical chemistry- G. M. Barrow
11. Physical chemistry (solved Problems) Dogra and Dogra
12. Problems in Physical chemistry- Pahari and Pahari

**Inorganic Chemistry**

1. Concise Inorganic chemistry- J. D. Lee
2. Advanced Inorganic chemistry- R. D. Madan
3. Inorganic chemistry-Pur, Sharma, Kalia
4. Selected Topics in Inorganic Chemistry- Malik, Tuli and Madan
5. Inorganic Chemistry- J.E. Huheey
6. Inorganic chemistry- Meissler and Tarr
7. Nuclear chemistry-H. J. Arnikar
8. Nuclear Chemistry. U. N. Dash
9. Advanced Inorganic Chemistry- F. A. Cotton and Wilkinson
10. Theoretical Inorganic Chemistry- Day and Selbin
11. Inorganic Chemistry-R.L. Dutta
12. Magnetochemistry- R.L. Carlin

**Organic chemistry**

1. Advanced Organic Chemistry-Bahl and Bahl
2. Advanced organic chemistry-Jagadamba singh and L.D. S. Yadav
3. Organic Reaction Mechanism-P.S. Kalsi
4. Organic chemistry-R. K. Bansal'
5. Organic Chemistry-Mukherjee, Singh and Kapoor
6. Organic Chemistry-I.L. Finar (Part 1 & 2)
7. Organic Chemistry-R.T. Morison and R. N. Boyd
8. Organic Chemistry-Clayden, Greeves, Warren and Wothers
9. Organic Chemistry-Solomon
10. Stereochemistry, Conformation and Mechanism-P.S. Kalsi
11. Stereochemistry of carbon compounds-D. Nasipuri
12. Advanced organic chemistry-Reactions, mechanism and structure, Jerry March
13. Advanced Organic chemistry-F. A. Carey and R. J. Sundberg
14. Reaction Mechanism in Organic Chemistry-S.M. Mukherjee and S. P. Singh
15. A Guidebook of mechanism in organic chemistry-Peter Sykes
16. Organic Chemistry-P.Y. Bruice

### **Spectroscopy**

1. Spectroscopy-P.S. Kalsi
2. Spectroscopy, Y. R. Sharma
3. Spectroscopic Identification of Organic Compounds- Silverstein and Bassler
4. Fundamentals of Molecular Spectroscopy- C. N. Banwell

### **General Chemistry**

1. University General Chemistry-C.N.R. Rao
2. Chemistry-Raymond and Chang

### **Practical**

1. Inorganic qualitative Analysis- A.I. Vogel
2. Inorganic Quantitative Analysis- A.I. Vogel
3. A text book of Practical Organic Chemistry-A. I. Vogel
4. Laboratory annual in Organic Chemistry- R.K. Bansal
5. Experimental Organic Chemistry (Vol.I and II)- Singh, Gupta and Bajpai.
6. Practical Organic Chemistry-I.L. Finar.
7. Handbook of Organic Analysis, Qualitative and Quantitative. M. T. Clarke.
8. Practical Chemistry- Gurdeep Raj Chatawal
9. A Complete Course in Practical Chemistry- Y. R. Sharma and R.C. Acharya.

# PHYSICS

## PROGRAM STRUCTURE: PHYSICS (HONS.)

Sem-ester	AECC	CC (Hons) Physics	GE-I* Mathematics	GE-II* Chemistry	DSE	SEC	Education	CBC*
I	AECC-1 Communicative English	CC-1 (Th+Pr)	GE-1 (Th+Pr)	GE-1 (Th+Pr)			PE-1 EPC-1	
II		CC-2 (Th+Pr)	GE-2(Th+Pr),	GE-2 (Th+Pr)		SEC (Th+Pr)	PE-2 CPS-1	
III	AECC-2 (Environmental Studies)	CC-3 (Th+Pr)	GE-3(Th+Pr),	GE-3 (Th+Pr)			PE-3 PE-4	
IV		CC-4 (Th+Pr)	GE-4(Th+Pr),	GE-4 (Th+Pr)	DSE-I (Th+Pr)		PE-5 PE-6	
V		CC-5 (Th+Pr) CC-6 (Th+Pr) CC-7 (Th+Pr) CC-8 (Th+Pr)					CPS2-1 CPS3-1 EPC-2	
VI		CC-9 (Th+Pr) CC-10 (Th+Pr) CC-11(Th+Pr) CC-12(Th+Pr)					CPS2-2, CPS3-2, FE-1	CBC
VII							PE-7, EPC-3 EPC-4, FE-2	
VIII		CC-13 (Th+Pr) CC-14(Th+Pr)			DSE-II (Project)		PE-8, EPC-5, EPC-6, EPC-7, FE-3	

\*GE (Mathematics) is equivalent to CC (Mathematics)

\*GE (Chemistry) is equivalent to CC (Chemistry)

## PHYSICS

### SCHEME OF EXAMINATION

#### Semester I:

**GE/CC 1.1: Mechanics(Terminal-60, Sessional-15) 75 marks**

**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Properties of Matter
- Unit 2: Oscillations
- Unit 3: Elasticity and Fluid Motion
- Unit 4: Special Theory of Relativity-I

**GE/CC 1.2: Practical 25 marks**

#### Semester II:

**GE/CC 2.1: Electricity and Magnetism (Terminal-60, Sessional-15) 75 marks**

**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Vector Differentiation
- Unit 2: Electric Field and Electric Potential
- Unit 3: Dielectric Properties of Materials and Magnetism
- Unit 4: Electrical Circuits and Network theorems

**GE/CC 2.2 : Practical 25 marks**

**SEC 1 : Basic Instrumental Skill (Terminal-40, Sessional-10) 50 marks**

**Credits - 4 : (Theory- 02, Practical- 02)**

- Unit 1 : Basic measuring instruments
- Unit 2 : Analog and Digital instruments

**SEC 2 : Practical 50 marks**

#### Semester III:

**GE/CC 3.1: Waves and Optics(Terminal-60, Sessional-15) 75 marks**

**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Wave Motion
- Unit 2: Wave Optics
- Unit 3: Diffraction
- Unit 4: Polarization

**GE/CC 3.2: Practical 25 marks**

#### Semester IV:

**GE/CC 4.1: Thermal Physics(Terminal-60, Sessional-15) 75 marks**

**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Laws of Thermodynamics and Entropy
- Unit 2: Thermodynamic Potentials and  
Maxwell's Thermodynamic Relations
- Unit 3: Kinetic Theory of Gases
- Unit 4: Radiation and Statistical Mechanics

<b>GE/CC 4.2: Practical</b>	<b>25 marks</b>
<b>(Opt. any one)</b>	
<b>DSE-I (Choice-1) I.1.1 : Computational Physics (Choice-I)</b>	
<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
<b>Credits - 6 : (Theory- 04, Practical- 02)</b>	
Unit 1: Algorithms and Flowcharts	
Unit 2: Scientific Programming	
Unit 3: Control Statements	
Unit 4: Development of FORTRAN Programme	
<b>DSE-I.1.2 Practical</b>	<b>25 marks</b>
<b>DSE-II(Choice-2)I.2.1 : Nano Materials and Applications</b>	
<b>(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
<b>Credits - 6 : (Theory- 04, Practical- 02)</b>	
Unit 1: Nanoscale System	
Unit 2: Nano Materials	
Unit 3: Nano Technology	
Unit 4: Applications	
<b>DSE-I.2.2 Practical</b>	<b>25 marks</b>
<b><u>Semester V:</u></b>	
<b>CC 5.1: Mathematical Physics-I(Terminal-60, Sessional-15)</b>	<b>75 marks</b>
<b>Credits - 6 : (Theory- 04, Practical- 02)</b>	
Unit 1: Calculus and Vector Calculus	
Unit 2: Orthogonal CurvilinearCoordinates	
Unit 3: Dirac Delta functions and its properties and second order differential equations	
Unit 4: Vector Integration	
<b>CC 5.2: Practical</b>	<b>25 marks</b>
<b>CC 6.1: Classical Mechanics (Terminal-60, Sessional-15)</b>	<b>75 marks</b>
<b>Credits - 6 : (Theory- 04, Practical- 02)</b>	
Unit 1: Classical Mechanics - I	
Unit 2: Classical Mechanics - II	
Unit 3: Classical Mechanics - III	
Unit 4: Special Theory of Relativity-II	
<b>CC 6.2: Practical</b>	<b>25 marks</b>
<b>CC 7.1: Quantum Mechanics and Applications (Terminal-60, Sessional-15)</b>	<b>75 marks</b>
<b>Credits - 6 : (Theory- 04, Practical- 02)</b>	

- Unit 1: Introduction to Quantum Mechanics
- Unit 2: Operator Formalism
- Unit 3: One dimensional Schrödinger's Equation
- Unit 4: Atoms in Electric & Magnetic Fields

**CC 7.2: Practical** **25 marks**

**CC 8.1: Digital and Analog Circuits and Oscillators, Rectifiers** **75 marks**  
**(Terminal-60, Sessional-15)**  
**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Digital Circuits
- Unit 2: Semiconductor Devices and Amplifiers
- Unit 3: Operational Amplifiers (Black Box approach)
- Unit 4: Oscillators and Rectifiers

**CC 8.2: Practical** **25 marks**

**Semester VI:**

**CC 9.1: Mathematical Physics-II (Terminal-60, Sessional-15)** **75 marks**  
**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Fourier Series
- Unit 2: Frobenius Method and Special Functions
- Unit 3: Special Integrals and Theory of Errors
- Unit 4: Partial Differential Equations

**CC 9.2: Practical** **25 marks**

**CC 10.1: Maxwell Equations and EMT (Terminal-60, Sessional-15)** **75 marks**  
**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Maxwell's Equations and Optical Fibres
- Unit 2: Electromagnetic Wave Propagation in Unbounded Media
- Unit 3: Electromagnetic Wave in Bounded Media
- Unit 4: Polarization of Electromagnetic Waves

**CC 10.2: Practical** **25 marks**

**CC 11.1: Statistical Mechanics (Terminal-60, Sessional-15)** **75 marks**  
**Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Classical Statistics - I
- Unit 2: Classical Statistics - II
- Unit 3: Radiation
- Unit 4: Quantum Statistics

**CC 11.2: Practical** **25 marks**

**CC 12.1: Solid State Physics (Terminal-60, Sessional-15) 75 marks****Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Crystal Structure
- Unit 2: Elementary Lattice Dynamics and Magnetic Properties of Matter
- Unit 3: Elementary band theory of Solids
- Unit 4: Laser and Superconductivity

**CC 12.2: Practical 25 marks****CBC \*: Renewable Energy And Energy Harvesting 100 marks****(Terminal-80, Sessional – 20)****Credits – 4 \***

- Unit 1 : Fossil fuels and Alternate Sources of Energy
- Unit 2 : Solar Energy
- Unit 3 : Wind Energy harvesting & Ocean Energy
- Unit 4 : Geothermal Energy

**Semester VIII:****CC 13.1: Mathematical Physics-III(Terminal-60, Sessional-15) 75 marks****Credits - 6 : (Theory- 04, Practical- 02)**

- Unit 1: Complex Analysis-I
- Unit 2: Complex Analysis-II
- Unit 3: Fourier Transform
- Unit 4: Laplace Transforms

**CC 13.2: Practical 25 marks****CC 14.1: Nuclear and Particle Physics (Terminal-80, Sessional-20) 100 marks****Credits - 6**

- Unit 1: General Properties of Nuclei and Nuclear Models
- Unit 2: Radioactivity decay and Nuclear Reaction
- Unit 3: Detector for Nuclear Radiations
- Unit 4: Particle Accelerators and Particle Physics

**CC 14.2: Tutorial****DSEII : PROJECT (Cr-4) 100 marks**

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

## General Course Objectives

- Develop independent critical thinking and learning habits.
- Gain comprehensive knowledge and a sound understanding of physics together with the practical, analytical and mathematical skills required for physics teaching and research.
- Acquire appropriate pedagogical content knowledge relevant to teaching learning of physics.
- Develop understanding and broad knowledge of the general theoretical and experimental scientific principles of physics and apply their knowledge to a wide range of physical phenomena.
- Develop transferable skills related to communication, computing, and problem solving.
- Acquire a range of general skills like, ability to evaluate information, identify key issues, solve problems, use computers with confidence, develop team spirit, communicate effectively and learn independently.
- Establish deeper understanding of selected topics in physics by enhancing the capability to work in teams and pursue complex, open-ended investigations through project work, dissertation and seminar presentations.
- Learn to appreciate how simplified approaches / formulations and approximations can explain wide ranging physical phenomena
- Learn to develop microscopic understanding of macroscopic phenomena
- Extend imagination skills or develop abstract thinking in getting a firsthand understanding/explanation of complex physical phenomena
- Appreciate the underlying principles of physics experiments and in particular, get an appreciation that practical work can foster both an understanding of the content and also the process of learning.
- Exercise the use of physical intuition, including the ability to guess an approximate or conceptual answer to a physics problem and recognize whether or not the result of a calculation makes physical sense.
- Access information on a topic from a variety of sources, and develop the habit of learning to learn.
- Apply the basic laws of physics in the areas of classical mechanics, Newtonian gravitation, special relativity, electromagnetism, geometrical and physical optics, quantum mechanics, thermodynamics and statistical mechanics, modern physics, electronics, solid state physics, nuclear and particle physics.
- Recognize how observation, experiment and theory work together to continue to expand the frontiers of knowledge of the physical universe.
- Apply basic mathematical tools commonly used in physics, including elementary probability theory, differential and integral calculus, vector calculus, ordinary differential equations, partial differential equations, and linear algebra.
- Use basic laboratory data analysis techniques, including distinguishing statistical and systematic errors, propagating errors, and representing data graphically.
- Convert a physical situation to a mathematical formulation, and then analyze it quantitatively.
- Apply more advanced mathematical tools, including Fourier series and transforms, abstract linear algebra, and functions of a complex variable.
- Use classic experimental techniques and modern measurement technology, including analog electronics, computer data acquisition, laboratory test equipment, optics, lasers, and detectors.
- Communicate verbally, graphically, and/or in writing the results of theoretical calculations and laboratory experiments in a clear and concise manner.

# PHYSICS

## Semester I

### GE/CC1.1: Mechanics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Properties of Matter:** Moment of Inertia. Calculation of moment of inertia for rectangular, cylindrical and spherical bodies. Kinetic energy of rotation. Motion involving both translation and rotation. Gravitational potential energy. Inertial and gravitational mass. Motion of a particle under a central force field. Two-body problem and its reduction to one-body problem and its solution. The energy equation and energy diagram. Kepler's laws. Satellite in circular orbit and applications. Geosynchronous orbits. Weightlessness. Basic idea of global positioning system (GPS).

**Unit 2: Oscillations:** Free oscillations of simple systems: linear harmonic oscillator, Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential energy, Total energy and their time averages. Oscillatory motion of a free compound pendulum, length of equivalent simple pendulum; damped harmonic oscillator: Solution of differential equations for cases of over/under/critical damping, forced harmonic oscillation of a lightly damped system, Transient and steady state, logarithmic decrement, resonance, Sharpness of resonance, Power dissipation and Q-factor .

**Unit 3: Elasticity & Fluid Motion:** Hooke's law, Stress-strain diagram, Elastic moduli, Relation between elastic constants, Poisson's Ratio, expression for Poisson's ratio in terms of elastic constants, Work done in stretching and work done in twisting a wire, Twisting couple on a cylinder, Determination of rigidity modulus by static torsion, Torsional pendulum, Determination of  $Y$ ,  $\eta$  and  $\sigma$  by Searle's method, by Bending of beams, by Vibration of loaded cantilever, Viscosity of liquids, Stoke's law and its applications, Poiseuille's formula for steady flow of a viscous liquid

**Unit 4: Special Theory of Relativity-I:** Galilean transformation and invariance of Newton's laws of motion, Michelson-Morley experiment and its outcome, inertial frame. Postulates of special theory; Lorentz transformation along one of the axes, Length contraction, Time dilation and Relativistic addition of velocities, Relativistic momentum (linear) and energy, Mass-Energy equation

### Reference Books:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.

3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning.
5. Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
8. Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
9. University Physics. F.W. Sears, M.W. Zemansky, H.D. Young 13/e, 1986, Addison Wesley
10. Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A. Serway, 2010, Cengage Learning
11. Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
12. Mechanics - J. C. Slater and N. H. Frank (McGraw-Hill)

### **GE/CC 1.2:Practicals**

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

1. To study the random error in observations, using measuring instruments.
2. To determine the elastic Constants  $Y$ ,  $n$  and  $\sigma$  of a wire by Searle's method.
3. To determine Young's modulus using vibration of cantilever, one end free.
4. To determine Poisson's ratio of rubber.
5. To determine the acceleration due to gravity 'g' using Bar pendulum.
6. To determine rigidity modulus of a wire using Maxwell's needle.
7. To determine g and velocity for a freely falling body using Digital Timing Technique.
8. To determine Coefficient of viscosity of water by Capillary flow method (Poiseuille's method).
9. To determine the Young's modulus of a wire by Optical lever method.
10. To determine coefficient of viscosity of water using Ostwald Viscometer.

### **Reference Books**

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers
3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11<sup>th</sup> Edn, 2011, Kitab Mahal

**Semester II****GE/CC 2.1: Electricity and Magnetism**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Vector Differentiation:**Scalar and Vector field, Gradient of a scalar field and its geometrical interpretation. Directional derivatives and normal derivatives, Properties of gradient operator, Divergence and Curl of a vector field. The physical significance of divergence and Curl, Laplacian operators. Vector identities (related to gradient, divergence, curl). Curvilinear coordinates, gradient, divergence, curl and laplacian in spherical and cylindrical coordinates.

**Unit 2 :Electric Field and Electric Potential:**Electric field: Electric field lines. Electric flux. Gauss' law with applications to charge distributions with spherical, cylindrical and planar symmetry. Conservative nature of Electrostatic field. Electrostatic potential. Laplace's and Poisson's equations. The Uniqueness theorem. Potential and Electric field of a dipole. Force and torque on a dipole.

Electrostatic energy of system of charges. Electrostatic energy of a charged sphere. Conductors in an electrostatic Field. Surface charge and force on a conductor. Capacitance of a system of charged conductors. Parallel-plate capacitor. Capacitance of an isolated conductor.

**Unit3 :Dielectric Properties of Materials and Magnetism:**Polarization. Local electric field at an Atom. Depolarization field. Electric susceptibility. Polarizability. Clausius Mosotti equation. Classical Theory of electric polarizability.

Ampere's circuital law and its application to (1) Solenoid and (2) Toroid. Properties of magnetic field and magnetic induction and magnetic flux. Torque on a current loop in a uniform magnetic field. Lorentz force and motion of charged particles in electric and magnetic fields. Magnetic properties of Dia-, Para-, and Ferro-magnetic materials, Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Ferromagnetism. B-H curve and hysteresis.

**Unit 4 :Electrical Circuits And Network Theorems:**Growth & decay of currents in RC, RL and LCR Series circuits for DC and AC Circuits: Kirchhoff's laws for AC circuits. Complex reactance and impedance. Series LCR Circuit: (1) Resonance, (2) Power dissipation and (3) Quality factor, and (4) Band width, Parallel LCR circuit.

**Network theorems:** Ideal Constant-voltage and Constant-current sources. Network theorems: Thevenin theorem, Norton theorem, Superposition theorem, Reciprocity theorem, Maximum power transfer theorem.

**Reference Books:**

1. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw
2. Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
3. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn., 1998, Benjamin Cummings.
4. Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
5. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

6. Electricity and Magnetism, J.H.Fewkes&J.Yarwood. Vol. I, 1991, Oxford Univ. Press.

### GE/CC 2.2:Practicals

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, (d) Capacitances, and (e) Checking electrical fuses.
2. To study the characteristics of a series RC Circuit.
3. To determine an unknown Low Resistance using Potentiometer.
4. To determine an unknown Low Resistance using Carey Foster's Bridge.
5. To compare capacitances using De'Sauty's bridge.
6. Measurement of field strength B and its variation in a solenoid (determine dB/dx)
7. To verify the Thevenin and Norton theorems.
8. To verify the Superposition, and Maximum power transfer theorems.
9. To determine self inductance of a coil by Anderson's bridge.
10. To study response curve of a Series LCR circuit and determine its (a) Resonant frequency, (b) Impedance at resonance, (c) Quality factor Q, & (d) Band width.
11. To study the response curve of a parallel LCR circuit and determine its (a) Antiresonant frequency and (b) Quality factor Q.
12. Measurement of charge and current sensitivity and CDR of Ballistic Galvanometer
13. Determine a high resistance by leakage method using Ballistic Galvanometer.
14. To determine self-inductance of a coil by Rayleigh's method.
15. To determine the mutual inductance of two coils by Absolute method.
16. To study the charging & discharging action of a capacitor.

### Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
2. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Complete Course in Degree Practical Physics, B. B. Swain, Kalyani Publishers (2016)
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.

### SEC1:Basic Instrumentation Skills

Contact Hour per Week	:	2
Credits	:	2
Terminal Examination duration	:	2 hours
Maximum Marks	:	50 (Terminal-40, Sessional-10)

This course is to get exposure with various aspects of instruments and their usage through hands-on mode. Experiments listed below are to be done in continuation of the topics.

### Unit 1 :

#### Basic Measuring Instruments :

**Basic of Measurement:** Instruments accuracy, precision, sensitivity, resolution range etc. Errors in measurements and loading effects.

**Multimeter:** Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance. Specifications of a multimeter and their significance.

**Electronic Voltmeter:** Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity. Principles of voltage, measurement (block diagram only). Specifications of an electronic Voltmeter/ Multimeter and their significance.

**Cathode Ray Oscilloscope:** Block diagram of basic CRO. Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only– no mathematical treatment), brief discussion on screen phosphor, visual persistence & chemical composition. Time base operation, synchronization. Front panel controls. Specifications of a CRO and their significance. Use of CRO for the measurement of voltage (dc and ac frequency, time period. Special features of dual trace, introduction to digital oscilloscope, probes

### Unit-2 :

#### Analog and Digital Instruments :

**Analog Instruments:** Analog Instruments, Block diagram, explanation and specifications of low frequency signal generators. pulse generator, and function generator.

**Digital Instruments:** Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter.

**Digital Multimeter:** Block diagram and working of a digital multimeter. Working principle of time interval, frequency and period measurement using universal counter/ frequency counter, time-base stability, accuracy and resolution.

### SEC 2 : Practicals

#### Credit-2

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	50 ( Expt-25, Viva-15, Record-10)

1. Use of an oscilloscope.
2. CRO as a versatile measuring device.
3. Circuit tracing of Laboratory electronic equipment,
4. Use of Digital multimeter/VTVM for measuring voltages
5. Circuit tracing of Laboratory electronic equipment,
6. Winding a coil / transformer.

7. Study the layout of receiver circuit.
8. Trouble shooting a circuit
9. Balancing of bridges
10. To observe the loading effect of a multimeter while measuring voltage across a low resistance and high resistance.
11. To observe the limitations of a multimeter for measuring high frequency voltage and currents.
12. To measure Q of a coil and its dependence on frequency, using a Q- meter.
13. Measurement of voltage, frequency, time period and phase angle using CRO.
14. Measurement of time period, frequency, average period using universal counter/frequency counter.
15. Measurement of rise, fall and delay times using a CRO.
16. Measurement of distortion of a RF signal generator using distortion factor meter.
17. Measurement of R, L and C using a LCR bridge/ universal bridge.
18. Using a Dual Trace Oscilloscope
19. Converting the range of a given measuring instrument (voltmeter, ammeter)

#### Reference Books:

1. A text book in Electrical Technology - B L Theraja - S Chand and Co.
2. Performance and design of AC machines - M G Say ELBS Edn.
3. Digital Circuits and systems, Venugopal, 2011, Tata McGraw Hill.
4. Logic circuit design, Shimon P. Vingron, 2012, Springer.
5. Digital Electronics, Subrata Ghoshal, 2012, Cengage Learning.
6. Electronic Devices and circuits, S. Salivahanan & N.S. Kumar, 3rd Ed., 2012, Tata McGrawHill.
7. Electronic circuits: Handbook of design and applications, U. Tietze, Ch. Schenk, 2008, Springer.
8. Electronic Devices, 7/e Thomas L. Floyd, 2008, Pearson India.
9. Text book of electronics, B.B. Swain, Kitab Mahal (2015).

### Semester III

#### GE/CC 3.1: Waves and Optics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Wave Motion:** Propagation of a disturbance, The traveling wave model, Transverse waves on a string. Speed of waves on strings, Travelling and standing waves on a string. Normal modes of a string. Group velocity, Phase velocity. Plane waves. Spherical waves, Wave intensity, Plucked and Struck Strings. The Linear wave equation; Superposition of two perpendicular harmonic waves: Graphical and Analytical Methods. Lissajous figures (frequency ratio 1:1 and 1:2) and their uses

**Unit 2 :Wave Optics:** Electromagnetic nature of light. Definition and Properties of wave front. Huygen's Principle.

**Interference:** Interference: Division of amplitude and division of wavefront. Fresnel's Biprism. Interference in thin films: parallel and wedge-shaped films. Newton's rings: measurement of wavelength and refractive index.

**Interferometers:** Idea of form of fringes (no theory needed), Determination of wavelength, Wavelength difference, Refractive index and Visibility of fringes. Fabry-Perot Interferometer Determination of wavelength.

**Unit 3 :Diffraction:** Fraunhofer diffraction: Single slit; Double Slit. Multiple slits & Plane Diffraction grating. Rayleigh criterion of resolution, Resolving power of grating, telescope and microscope. Fresnel diffraction: Half-period zones. Zone plate. Fresnel diffraction pattern of a straight edge using half-period zone analysis.

**Unit 4 :Polarization:** Transverse nature of light waves. Polarized & unpolarized light, Polarization by reflection, refraction & scattering, Brewster's law, Malus law, light propagation in uniaxial crystal, double refraction, Nicol prism, Plane polarized light - production and analysis. Circular and elliptical polarization. Half wave & quarter wave plates

#### Reference Books

1. Waves: Berkeley Physics Course, vol. 3, Francis Crawford, 2007, Tata McGraw-Hill.
2. Fundamentals of Optics, F.A. Jenkins and H.E. White, 1981, McGraw-Hill
3. Principles of Optics, Max Born and Emil Wolf, 7<sup>th</sup> Edn., 1999, Pergamon Press.
4. Optics, Ajoy Ghatak, 2008, Tata McGraw Hill
5. The Physics of Vibrations and Waves, H. J. Pain, 2013, John Wiley and Sons.
6. The Physics of Waves and Oscillations, N.K. Bajaj, 1998, Tata McGraw Hill.
7. Optics – Brijlal & Subramaniam- (S. Chand Publication) 2014.
8. Geometrical and Physical Optics –R.S. Longhurst, Orient Blackswan, 01-Jan-1986
9. Vibrations and Waves -- A. P. French, (CBS) Indian print 2003
10. Optics, E. Hecht (PearsonIndia)

#### GE/CC 3.2: Practicals

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. To determine the frequency of an electric tuning fork by Melde's experiment and verify  $\lambda^2 \propto T$  law.
2. To investigate the motion of coupled oscillators.
3. To study Lissajous Figures.
4. Familiarization with: Schuster's focusing; determination of angle of prism.
5. To determine refractive index of the Material of a prism using sodium source.

6. To determine the dispersive power and Cauchy constants of the material of a prism using mercury source.
7. To determine the wavelength of sodium source using Michelson's interferometer.
8. To determine wavelength of sodium light using Fresnel Biprism.
9. To determine wavelength of sodium light using Newton's Rings.
10. To determine the thickness of a thin paper by measuring the width of the interference fringes produced by a wedge-shaped Film.
11. To determine wavelength of (1) Na source and (2) spectral lines of Hg source using plane diffraction grating.
12. To determine dispersive power and resolving power of a plane diffraction grating.

#### Reference Books

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Complete Course in Degree Practical Physics, B. B. Swain, Kalyani Publishers (2016)
5. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani

### Semester IV

#### GE/CC 4.1: Thermal Physics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit 1 :Introduction to Thermodynamics

Recapitulation of Zeroth and First law of thermodynamics:

**Second Laws of Thermodynamics:** Reversible and Irreversible process with examples.

**Second laws& Entropy,** Concept of Entropy, Clausius theorem. Clausius inequality, Second la of thermodynamics in terms of entropy. Entropy of a perfect gas. Principle of increase of entropy. Entropy Changes in reversible and irreversible processes with examples. Temperature–Entropy diagrams for Carnot's cycle. Third law of thermodynamics. Unattainability of absolute zero.

**Unit 2 :Thermodynamic Potentials:** Extensive and intensive thermodynamic variables. Thermodynamic potentials: Internal energy, Enthalpy, Helmholtz free energy, Gibb's free energy. Their definitions, properties and applications. Magnetic work, Cooling due to adiabatic demagnetization, first and second order Phase Transitions with examples, ClausiusClapeyron Equation and Ehrenfest equations.

**Maxwell's Thermodynamic Relations:** Derivations and applications of Maxwell's Relations, Maxwell's relations:(1) Clausius-Clapeyron equation, (2) Values of  $C_p-C_v$ , (3) Tds equations, (4) Change of temperature during adiabatic process.

**Unit 3 :Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean free path (Zeroth Order), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.

**Real Gases:** Behaviour of real gases: Derivations from the Ideal gas equation, Andrew's experiments on  $CO_2$ , Critical constants, Free adiabatic expansion of a perfect Gas, Joule-Thomson cooling.

**Unit 4 :Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of energy density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh- Jeans law, Ultraviolet Catastrophe, Stefan-Boltzmann law and Wien's displacement law from Planck's law.

**Statistical Mechanics:** Maxwell-Boltzmann law - distribution of velocity, Quantum statistics - Fermi-Dirac distribution law - electron gas - Bose-Einstein distribution law - photon gas - comparison of three statistics.

#### Reference Books:

1. Heat & Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal & Ghosh, 2<sup>nd</sup> Ed., 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger.1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell & K.M. Blundell, 2nd Ed., 2012, OxfordUniversity Press
7. Heat and Thermal Physics- Brijlal & Subramaiam (S. Chand Publication) 2014
8. Thermal Physics-- C. Kittel and H. Kroemer (McMillan Education India) 2010

#### GE/CC 4.2: Practicals

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
3. To determine the temperature co-efficient of resistance using meter bridge.
4. To study the variation of thermo emf across two junctions of a thermocouple with temperature.
5. To record and analyze the cooling temperature of an hot object as a function of time using a thermocouple and suitable data acquisition system
6. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge

7. To determine Stefan's Constant.
8. To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.
9. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
10. To determine the Boltzmann constant using PN junction diode.

### Reference Books :

1. Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, AsiaPublishing House
2. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers
4. A Laboratory Manual of Physics for undergraduate classes, D.P.Khandelwal, 1985, Vani Pub.
5. A Complete Course in Degree Practical Physics, B.B. Swain, Kalyani Publishers (2016)

### (Opt. any one)

#### DSE I (Choice-1) I.1.1: Computational Physics (Choice-I)

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

The aim of this course is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- Use of computer language as a tool in solving physics problems (applications)
- Course will consist of hands on training on the Problem solving on Computers.

#### Unit 1 :

**Algorithms and Flowcharts:** Algorithm: Definition, properties and development. Flowchart: Concept of flowchart, symbols, guidelines, types. Examples: Cartesian to Spherical polar coordinates, Roots of quadratic equation, Sum of two matrices, Sum and product of a finite series, calculation of  $\sin(x)$  as a series, algorithm for plotting (1) Lissajous figures and (2) Trajectory of a projectile thrown at an angle with the horizontal.

#### Unit 2 :

**Scientific Programming:** Some fundamental Linux commands (Internal and External commands). Operators: Arithmetic, Relational, Logical and Assignment Operators. Expressions: Arithmetic, Relational, Logical, Character and Assignment Expressions. Fortran Statements: I/O Statements (unformatted/formatted), Executable and Non-Executable Statements.

#### Unit3 :

**Control Statements:** Types of Logic (Sequential, Selection, Repetition), Branching statements (Logical **IF**, Arithmetic IF, Block IF, Nested Block IF, SELECT CASE and ELSE IF Ladder statements), Looping Statements (DO-CONTINUE, DO-ENDDO, DOWHILE, Implied and Nested DO

Loops), Jumping Statements (Unconditional GOTO, Computed GOTO, Assigned GOTO) Subscripted Variables (Arrays: Types of Arrays, DIMENSION Statement, Reading and Writing Arrays), Functions and Subroutines (Arithmetic Statement Function, Function Subprogram and Subroutine), RETURN, CALL, COMMON and EQUIVALENCE Statements), Structure, Disk I/O Statements.

#### Unit 4 :

**Development of FORTRAN Programme :** Basic elements of FORTRAN: Character Set, Constants and their types, Variables and their types, Keywords, Variable Declaration and concept of instruction and program. Layout of Fortran Program, Format of writing Program and concept of coding, Initialization and Replacement Logic. Open a file, writing in a file, reading from a file. Examples from physics problems.

#### DSE I.1.2 Practical/Programming:

1. Exercises on syntax on usage of FORTRAN.
2. To print out all natural even/ odd numbers between given limits.
3. To find maximum, minimum and range of a given set of numbers.
4. To find a set of prime numbers and Fibonacci series.
5. Write programming of differential equation applicable in physical system, Heat-plugs, SHM.
6. Matrix solution (Inverse).

#### Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn., 2012, PHI Learning Pvt. Ltd.
2. Computer Programming in Fortran 77". V. Rajaraman (Publisher: PHI).
3. Schaum's Outline of Theory and Problems of Programming with Fortran, S. Lipsdutz and A. Poe, 1986Mc-Graw Hill Book Co.
4. Computational Physics: An Introduction, R.C. Verma, et al. New Age International Publishers, New Delhi(1999)
5. A first course in Numerical Methods, U.M. Ascher and C. Greif, 2012, PHI Learning
6. Elementary Numerical Analysis, K.E. Atkinson, 3<sup>rd</sup> Edn., 2007, Wiley India Edition.
7. A Complete Course in Degree Practical Physics, B.B. Swain & P.K. Jena, Kalyani Publishers (2017)

#### DSE II (Choice-2) I.2.1 : Nano Materials and Applications (Choice-II)

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Nanoscale Systems:** Length scales in physics, Nanostructures: 1D, 2D and 3D nanostructures (nanodots, thin films, nanowires, nanorods), Band structure and density of states of materials at nanoscale, Size effects in nano-systems.

**Unit 2: Nano Materials:** Structure, properties and importance of the Nanomaterials - Metallic nanoparticles - Semiconductor quantum dots, core-shell nanoparticles - carbon based nanomaterials - fullerenes, carbon nanotubes (single walled and multi walled) and graphene

#### Unit 3: Nano Technology

Fundamentals of Microscopic techniques - Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning probe microscopy (STM and AFM) - Spectroscopy- Characterization of nanomaterials by absorption spectroscopy (UV, Visible, IR) and Raman spectroscopy.

**Unit 4:Applications:** Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron devices (no derivation). CNT based transistors.

### Reference books:

1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
2. Gabor L. Hornyak, Joy Deep Dutta, Harry F. Tibbals and Hail K. Rao, Introduction to Nanoscience, New York, CRC press, 2008
3. Pradeep T, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, New Delhi, Tata McGraw-Hill Publishing Company Limited, 2008
4. Rao, C.N.R, Muller, Cheetham, The Chemistry of Nanomaterials, 1 and 2, Weinheim, Wiley-VCH Verlag GmbH& Co, 2004 Learning Private Limited).
5. Peter M. Martin, Handbook of deposition technologies for films and coatings science, application and technology, USA, Elsevier, 2010
6. W.R. Fahrner (Ed.), Nanotechnology and Nanoelectronics, materials, devices, measurement techniques, Springer- Verlag Berlin Heidelberg, 2005
7. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).
8. Nanotechnology- Rakesh Rathi(S. Chand & Company, New Delhi)

### Semester V

#### CC 5.1: Mathematical Physics-I

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:Calculus:** Calculus of functions of more than one variable: Partial derivatives, exact and inexact differentials, integrating factor, with simple illustration. Constrained maximization using Lagrange multipliers.

**Vector Calculus:** Recapitulation of vectors: Properties of vectors under rotations. Scalar product and its invariance under rotations. Vector product, Scalar triple product and their interpretation in terms of area and volume respectively. Scalar and Vector fields.

**Unit 2 :Orthogonal Curvilinear Coordinates:** Orthogonal curvilinear coordinates, Derivation of Gradient, Divergence, Curl and Laplacian in Cartesian, Spherical and Cylindrical coordinate systems. Comparison of velocity and acceleration in cylindrical and spherical coordinate system.

**Unit 3 :Dirac Delta function and its properties:** Definition of Dirac delta function. Representation as limit of a Gaussian function and rectangular function. Properties of Dirac delta function.

**Second order differential equations :** Second order linear differential equations with constant and variable coefficients. Linear independence of solutions (Wronskian). Series solutions of linear harmonic oscillator.

**Unit 4 :Vector Integration:** Ordinary Integrals of Vectors. Multiple integrals, Jacobians, Notion of infinitesimal line, surface and volume elements. Line, surface and volume integrals of vector fields. Flux of a vector field. Gauss' divergence theorem, Green's and Stoke's theorem, and their applications (no rigorous proofs).

#### Reference Books:

1. Mathematical Methods for Physicists, G.B. Arfken, H.J. Weber, F.E. Harris, 2013, 7<sup>th</sup> Ed., Elsevier.
2. An introduction to ordinary differential equations, E.A. Coddington, 2009, PHI learning.
3. Differential Equations, George F. Simmons, 2007, McGraw Hill.
4. Mathematical Tools for Physics, James Nearing, 2010, Dover Publications.
5. Mathematical methods for Scientists and Engineers, D.A. McQuarrie, 2003, Viva Book
6. Advanced Engineering Mathematics, D.G. Zill and W.S. Wright, 5 Ed., 2012, Jones and Bartlett Learning
7. Advanced Engineering Mathematics, Erwin Kreyszig, 2008, Wiley India.
8. Essential Mathematical Methods, K.F. Riley & M.P. Hobson, 2011, Cambridge Univ. Press
9. Mathematical Physics and Special Relativity --M. Das, P.K. Jena and B.K. Dash (Srikrishna Prakashan) 2<sup>nd</sup> Edition 2009
10. Mathematical Physics-H.K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6<sup>th</sup> Edition 2011.
11. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.
12. Mathematical Physics- Goswami (Cengage Learning) 2014
13. Mathematical Method for Physical Sciences - M. L. Boas (Wiley India) 200

#### CC 5.2:Practicals

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

The aim of this Lab is not just to teach computer programming and numerical analysis but to emphasize its role in solving problems in Physics.

- Highlights the use of computational methods to solve physical problems
- The course will consist of lectures (both theory and practical) in the Lab
- Evaluation done not on the programming but on the basis of formulating the problem

- Aim at teaching students to construct the computational problem to be solved
- Students can use any one operating system Linux or Microsoft Windows

Topics	Description with Applications
Introduction and Overview	Computer architecture and organization, memory and Input/output devices.
Basics of scientific computing	Binary and decimal arithmetic, Floating point numbers, algorithms, Sequence, Selection and Repetition, single and double precision arithmetic, underflow & overflow emphasize the importance of making equations in terms of dimensionless variables, Iterative methods.
Errors and error Analysis	Truncation and round off errors, Absolute and relative errors, Floating point computations.
Review of C & C++ Programming Fundamentals	Introduction to Programming, constants, variables and data types, operators and Expressions, I/O statements, scanf and printf, c in and c out, Manipulators for data formatting, Control statements (decision making and looping statements) ( <i>If.....statement. If....else Statement. Nested if Structure. Else....if Statement. Ternary Operator. Goto Statement. Switch Statement. Unconditional and Conditional Looping. While Loop. Do-While Loop. FOR Loop. Break and Continue Statements. Nested Loops</i> ), Arrays (1D & 2D) and strings, user defined functions, Structures and Unions, Idea of classes and objects
Programs:	Sum & average of a list of numbers, largest of a given list of numbers and its location in the list, sorting of numbers in ascending descending order, Binary search
Random number generation	Area of circle, area of square, volume of sphere, value of $\pi$ .

### Reference Books:

1. Introduction to Numerical Analysis, S.S. Sastry, 5th Edn. , 2012, PHI Learning Pvt. Ltd.
2. Schaum's Outline of Programming with C++. J. Hubbard, 2000, McGraw-Hill Pub.
3. Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al, 3<sup>rd</sup> Edn. 2007, Cambridge University Press.
4. A first course in Numerical Methods, U.M. Ascher & C. Greif, 2012, PHI Learning.
5. Elementary Numerical Analysis, K.E. Atkinson, 3<sup>rd</sup> Edn., 2007, Wiley India Edition.
6. Numerical Methods for Scientists & Engineers, R.W. Hamming, 1973, Courier Dover Pub.
7. An Introduction to computational Physics, T. Pang, 2<sup>nd</sup> Edn., 2006, Cambridge Univ. Press.

### CC 6.1: Classical Mechanics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### Unit1 : Classical Mechanics - I

Rotating frame of reference, Inertial & Coriolis force, Mechanics of a system of particle, Conservation of linear momentum, angular momentum & energy, Constraints: holonomic & non-holonomic, Degrees of freedom, Generalised coordinates & velocities

### **Unit2 : Classical Mechanics - II**

Principle of virtual work, D'Alembert principle, & derivation of Euler-Lagrange equation. Hamilton's principle, Lagrangian, Cyclic coordinate & conservation theorems, Simple applications of Lagrangian formulation (Atwood machine, simple pendulum. Canonical momenta & Hamiltonian. Hamilton's equations of motion. Applications: Hamiltonian for a harmonic oscillator

### **Unit3 :Classical Mechanics - III**

Central force & its characteristics. Lagrangian approach to study two-body central force problem and reduction to equivalent one-body problem, Inverse square law and different forms of orbit. Deduction of Kepler's laws of planetary motion. Rutherford scattering cross section.

### **Unit4 :**

**Special Theory of Relativity-II:** Postulates of special theory of relativity. Lorentz transformations. Minkowski space. The invariant interval, light cone and world lines. Space-time diagrams. Time-dilation, length contraction & twin paradox. Four-vectors: space-like, time-like & light-like. Four-velocity and acceleration. Metric and alternating tensors. Four-momentum and energy-momentum relation. Doppler effect from a four-vector perspective. Concept of four-force. Conservation of four-momentum. Relativistic kinematics.

### **Reference Books:**

1. Classical Mechanics, H. Goldstein, C.P. Poole, J.L. Safko, 3<sup>rd</sup>Edn. 2002, Pearson Education.
2. Mechanics, L. D. Landau and E. M. Lifshitz, 1976, Pergamon.
3. Classical Mechanics: An introduction, Dieter Strauch, 2009, Springer.
4. Solved Problems in classical Mechanics, O.L. Delange and J. Pierrus, 2010, Oxford Press
5. Classical Mechanics-J.C. Upadhyay (Himalaya Publication) 2014
6. Classical Dynamics of Particles and Systems – S.T. Thornton (Cengage Learning) 2012
7. Introduction to Classical Mechanics- R.K. Takwale, S.Puranik(Tata McGraw Hill)
8. Classical Mechanics-M. Das, P.K. Jena, M. Bhuyan, R.N. Mishra (Srikrishna Prakashan)

### **CC 6.2:Practicals**

10. To determine the Moment Of Inertia of a Fly Wheel.
11. To determine the Coefficient of Viscosity of a liquid using Stoke's method (engg. Oil)
12. To determine acceleration due to gravity 'g' using Kater's Pendulum
13. To determine rigidity modulus of a wire using Barton's apparatus
14. To determine Young's modulus 'Y' using cantilever loaded at the middle
15. To investigate the motion of a coupled oscillator
16. Moment of inertia, rigidity modulus, using torsional pendulum.

17. Moment of inertia of a rod using bi-pillar pendulum.

### CC 7.1: Quantum Mechanics and Applications

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit1 :

##### Introduction to quantum mechanics

Inadequacy of classical physics: Brief review of Black body radiation, Photoelectric effect, Compton effect, dual nature of radiation, wave nature of particles. de Broglie hypothesis, Experimental confirmation of matter wave, Davisson-Germer experiment, velocity of de Broglie wave, wave particle duality, phase velocity and group velocity, wave packets ,Uncertainty principle, Illustration of the Principle through thought experiments of electron diffraction through a slit. Time dependent Schrodinger equation and dynamical evolution of a quantum state; Properties of wave function. Interpretation of wave function Probability and probability current densities in three dimensions; Conditions for physical acceptability of wave functions. Normalization of wave function.

#### Unit 2 :

**Operator Formalism:** Observables and Operator, Hermitian operator, Eigen values and Eigen functions. Position, momentum and Energy operators; commutator of position and momentum operators; Expectation values of position and momentum. Hamiltonian, stationary states and energy eigen values; expansion of an arbitrary wave function as a linear combination of energy eigen functions; General solution of the time dependent Schrodinger equation in terms of linear combinations of stationary states; Application to spread of Gaussian wave-packet for a free particle in one dimension; wave packets, Fourier transforms and momentum space wave function; Position-momentum uncertainty principle.

#### Unit3 :

##### One Dimensional Schrödinger's Equation

General discussion of bound states in an arbitrary potential, continuity of wave function, application to one-dimensional problem-square well potential; Quantum mechanics of simple harmonic oscillator-energy levels and energy Eigen functions ground state, zero point energy & uncertainty principle. One dimensional infinitely rigid box- energy Eigen values and Eigen functions, normalization; Quantum dot as example; Quantum mechanical tunnelling in one dimension-across a step potential & rectangular potential barrier.

#### Unit4 :

**Atoms in Electric & Magnetic Fields:** Electron angular momentum. Space quantization. Electron spin and Spin angular momentum. Larmor's theorem. Spin magnetic moment. Stern-Gerlach experiment. Zeeman effect: Electron magnetic moment and magnetic energy, Gyromagnetic ratio and Bohr magneton.

**Reference Books:**

1. A Text book of Quantum Mechanics, P. M. Mathews and K. Venkatesan, 2nd Ed., 2010, McGraw Hill
2. Quantum Mechanics, Robert Eisberg and Robert Resnick, 2nd Edn., 2002, Wiley.
3. Quantum Mechanics, G. Aruldas, 2<sup>nd</sup>Edn. 2002, PHI Learning of India.
4. Quantum Mechanics, Bruce Cameron Reed, 2008, Jones and Bartlett Learning.
5. Quantum Mechanics: Foundations & Applications, Arno Bohm, 3rd Edn., 1993, Springer
6. Quantum Mechanics for Scientists & Engineers, D.A.B. Miller, 2008, Cambridge University Press
7. Quantum Physics-S. Gasiorowicz (Wiley India) 2013
8. Quantum Mechanics -J.L. Powell and B. Craseman (Narosa) 1988
9. Introduction to Quantum Mechanics- M. Das, P.K. Jena, (SriKrishna Prakashan)
10. Basic Quantum Mechanics –A.Ghatak (Mc Millan India) 2012
11. Lectures on Engineering Physics, L Moharana, P.K. Panda, S.K. Dash and B. Ojha, Pearson Publishers, 2017.
12. Introduction to Quantum Mechanics – R. Dicke and J. Wittke
13. Quantum Mechanics- Eugen Merzbacher, 2004, John Wiley and Sons, Inc.
14. Introduction to Quantum Mechanics, D.J. Griffith, 2nd Ed. 2005, Pearson Education
15. Quantum Mechanics, Walter Greiner, 4th Edn., 2001, Springer
16. Quantum Mechanics - F. Mandl (CBS) 2013
17. Cohen-Tannoudji, B Diu and F Laloë, Quantum Mechanics (2 vols) Wiley-VCH 1977

**CC 7.2: Practicals**

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

**Use C/C++/Scilab for solving the following problems based on Quantum Mechanics like**

1. Solve the s-wave Schrodinger equation for the ground state and the first excited state of the hydrogen atom:  
Here,  $m$  is the reduced mass of the electron. Obtain the energy eigenvalues and plot the corresponding wave functions. Remember that the ground state energy of the hydrogen atom is  $\approx -13.6$  eV. Take  $e = 3.795$  (eVÅ)<sup>1/2</sup>,  $\hbar c = 1973$  (eVÅ) and  $m = 0.511 \times 10^6$  eV/c<sup>2</sup>.
2. Solve the s-wave radial Schrodinger equation for an atom: where  $m$  is the reduced mass of the system (which can be chosen to be the mass of an electron), for the screened coulomb potential Find the energy (in eV) of the ground state of the atom to an accuracy of three significant digits. Also, plot the corresponding wave function. Take  $e = 3.795$  (eVÅ)<sup>1/2</sup>,  $m = 0.511 \times 10^6$  eV/c<sup>2</sup>, and  $a = 3$  Å,  $5$  Å,  $7$  Å. In these units  $\hbar c = 1973$  (eVÅ). The ground state energy is expected to be above  $-12$  eV in all three cases.
3. Solve the s-wave radial Schrodinger equation for a particle of mass  $m$ : For the anharmonic oscillator potential for the ground state energy (in MeV) of particle to an accuracy of three significant digits. Also, plot the corresponding wave function. Choose  $m = 940$  MeV/c<sup>2</sup>,  $k = 100$  MeV fm<sup>-2</sup>,  $b = 0, 10, 30$  MeV fm<sup>-3</sup> In these units,  $\hbar c = 197.3$  MeV fm. The ground state energy  $I$  expected to lie between  $90$  and  $110$  MeV for all three cases.

- Solve the s-wave radial Schrodinger equation for the vibrations of hydrogen molecule: Where  $\mu$  is the reduced mass of the two-atom system for the Morse potential Find the lowest vibrational energy (in MeV) of the molecule to an accuracy of three significant digits. Also plot the corresponding wave function.

Take:  $m = 940 \times 106 \text{ eV}/c^2$ ,  $D = 0.755501 \text{ eV}$ ,  $a = 1.44$ ,  $r_0 = 0.131349 \text{ \AA}$

#### Laboratory based experiments:

- Study of Electron spin resonance- determine magnetic field as a function of the resonance frequency
- Study of Zeeman effect: with external magnetic field; Hyperfine splitting
- To show the tunneling effect in tunnel diode using I-V characteristics.
- Quantum efficiency of CCDs

#### Reference Books:

- Schaum's outline of Programming with C++. J.Hubbard, 2000, McGraw-Hill Publication
- Numerical Recipes in C: The Art of Scientific Computing, W.H. Press et al., 3rd Edn., 2007, Cambridge University Press.
- An introduction to computational Physics, T.Pang, 2nd Edn., 2006, Cambridge Univ. Press
- Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific & Engineering Applications: A. VandeWouwer, P. Saucez, C.V. Fernández. 2014 Springer.
- Scilab (A Free Software to Matlab): H. Ramchandran, A.S. Nair. 2011, S. Chand & Co.
- Scilab Image Processing: L.M. Surhone. 2010 Betascript Publishing ISBN: 978-6133459274
- A Complete Course in Degree Practical Physics, B. B. Swain & P.K. Jena, Kalyani Publishers (2017)

#### CC 8.1: Digital and Analog Circuits, Oscillators, Rectifiers

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Digital Circuits:** Difference between Analog and Digital Circuits. Binary Numbers. Decimal to Binary and Binary to Decimal Conversion, AND, OR and NOT Gates (Realization using Diodes and Transistor). NAND and NOR Gates as Universal Gates. XOR and XNOR Gates. De Morgan's theorems. Boolean laws. Simplification of logic circuit using Boolean algebra. fundamental products. Conversion of a truth table into an equivalent logic circuit by (1) Sum of products method and (2) Karnaugh map.

**Unit 2: Semiconductor Devices and Amplifiers:** Zener diode and its characteristics, LED, Photodiode (Characteristics). Bipolar junction transistors: n-p-n and p-n-p transistors. Characteristics of CB, CE and CC Configurations. Current gains  $\alpha$  and  $\beta$ . Relation between  $\alpha$  and  $\beta$ . Load line analysis of Transistors. DC load line and Q-point. Active, Cutoff, and Saturation regions. Voltage divider bias circuit for CE Amplifier. h-parameters, Equivalent circuit. Analysis of a single-stage CE amplifier

using Hybrid model. Input and Output Impedance. Current, Voltage and Power Gains. Class A, B, C and AB Amplifiers. JFET: n-channel and p-channel

**Unit 3: Operational Amplifiers (Black Box approach)** :Characteristics of an Ideal and Practical Op-Amp (IC 741), Differential amplifier (Dual input balanced and unbalanced output, single input balanced and unbalanced output) and its gain, input/output resistance, Open-loop & Closed-loop Gain. CMRR, concept of Virtual ground. Applications of Op-Amps: (1) Inverting and Non-inverting Amplifiers, (2) Adder, (3) Subtractor, (4) Differentiator, (5) Integrator, (6) Zero crossing detector.

#### **Unit 4 :Oscillators and Rectifiers**

Oscillators, criteria for sustained oscillation, tank circuit, Hartley, Colpitt and Weinbridge oscillators, Multivibrators. Power supply: Half-wave rectifiers. Centre-tapped and Bridge full-wave rectifiers Calculation of ripple factor and rectification efficiency, Basic idea about series inductor, L-section and  $\Pi$ -section filters, Zener diode and Voltage regulation, Radio transmission, Modulation and demodulation (Amplitude and Frequency)

#### **Reference Books:**

1. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill.
2. Electronic Circuits and Systems: Analog and Digital, Y N Bapat, 1992, Tata Mc-Graw Hill
3. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill.
4. Microelectronic Circuits, M.H. Rashid, 2<sup>nd</sup> Edn., 2011, Cengage Learning.
5. Modern Electronic Instrumentation & Measurement Tech., Helfrick & Cooper, 1990, PHI Learning
6. Digital Principles & Applications, A.P. Malvino, D.P. Leach & Saha, 7th Ed.,2011, Tata McGraw Hill
7. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.
8. OP-AMP and Linear Digital Circuits, R.A. Gayakwad, 2000, PHI Learning Pvt. Ltd.
9. Textbook on Electronics, B. B. Swain, Kitab Mahal, Cuttack (2015)

#### **CC 8.2: Practicals**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. To measure (a) Voltage, and (b) Frequency of a periodic waveform using a CRO
2. To verify and design AND, OR, NOT and XOR gates using NAND gates.
3. To minimize a given logic circuit.
4. Half adder, Full adder and 4-bit Binary Adder.
5. Adder-Subtractor using Full Adder I.C.
6. To design an astable multivibrator of given specifications using 555 Timer.
7. To design a monostable multivibrator of given specifications using 555 Timer.
8. To study IV characteristics of PN diode, Zener and Light emitting diode

9. To study the characteristics of a Transistor in CE configuration.
10. To design a CE amplifier of a given gain (mid-gain) using voltage divider bias.
11. To design an inverting amplifier of given gain using Op-amp 741 and study its frequency response.
12. To design a non-inverting amplifier of given gain using Op-amp 741 and study its Frequency Response.
13. To study a precision Differential Amplifier of given I/O specification using Opamp.
14. To investigate the use of an op-amp as a Differentiator
15. To design a Wien Bridge Oscillator using an op-amp.

**Reference Books:**

1. Basic Electronics: A text lab manual, P.B. Zbar, A.P. Malvino, M.A. Miller, 1994, Mc-Graw Hill.
2. Electronics: Fundamentals and Applications, J.D. Ryder, 2004, Prentice Hall.
3. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall.
4. Electronic Principle, Albert Malvino, 2008, Tata Mc-Graw Hill.
5. A Complete Course in Degree Practical Physics, B. B. Swain, Kalyani Publishers (2017)

**Semester VI****CC 9.1: Mathematical Physics-II**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Fourier series:** Periodic functions. Orthogonality of sine and cosine functions, Dirichlet conditions (Statement only). Expansion of periodic functions in a series of sine and cosine functions and determination of Fourier coefficients. Complex representation of Fourier series. Expansion of functions with arbitrary period. Expansion of non-periodic functions over an interval. Even and odd functions and their Fourier expansions. Application. Summing of infinite Series. Term-by-Term differentiation and integration of fourier series. Parseval identity.

**Unit 2 :Frobenius Method and Special Functions:** Singular Points of Second Order linear differential equations and their importance, Frobenius method and its applications to differential equations: Legendre & Hermite Differential Equations. Properties of Legendre & Hermite Polynomials: Rodrigues Formula, Generating Function, Orthogonality. Simple recurrence relations. Expansion of function in a series of Legendre polynomials. Associated Legendre polynomials and spherical harmonics.

**Unit 3 :Special Integrals:** Beta and Gamma functions and relation between them. Expression of Integrals in terms of Gamma functions. Error function (Probability Integral).

**Theory of Errors:** Systematic and Random errors. Propagation of errors. Normal Law of errors. Standard and Probable error.

**Unit 4 :Partial Differential Equations:** Solutions to partial differential equations using separation of variables: Laplace's equation in problems of rectangular, cylindrical and spherical symmetry. Conducting and dielectric sphere in an external uniform electric field. Wave equation and its solution for vibrational modes of a stretched string.

**Reference Books:**

1. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
2. Fourier Analysis by M.R. Spiegel, 2004, Tata McGraw-Hill.
3. Mathematics for Physicists, Susan M. Lea, 2004, Thomson Brooks/Cole.
4. Differential Equations, George F. Simmons, 2006, Tata McGraw-Hill.
5. Partial Differential Equations for Scientists & Engineers, S.J. Farlow, 1993, Dover Pub.
6. Mathematical methods for Scientists & Engineers, D.A. McQuarrie, 2003, Viva Books
7. Mathematical Physics and Special Relativity --M. Das, P.K. Jena and B.K. Dash(Srikrishna Prakashan) 2<sup>nd</sup> Edition 2009
8. Mathematical Physics-H.K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6<sup>th</sup> Edition 2011.
9. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.
10. Mathematical Physics-Goswami (CENGAGE Learning) 2014
11. Mathematical Method for Physical Sciences - M. L. Boas (Wiley India) 2006

12. Mathematics for Physicists, P. Dennerly and A. Krzywicki (Dover)
13. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.

### CC 9.2: Practicals

Contact Hours Per Week : 2

Examination Duration : 3 Hours

Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

The aim of this Lab is to use the computational methods to solve physical problems. Course will consist of lectures (both theory and practical) in the Lab. Evaluation done not on the programming but on the basis of formulating the problem.

Topics	Description with Applications
Introduction to Numerical computation software Scilab	Introduction to Scilab, Advantages and disadvantages, Scilab environment, Command window, Figure window, Edit window, Variables and arrays, Initialising variables in Scilab, Multidimensional arrays, Subarray, Special values, Displaying output data, data file, Scalar and array operations, Hierarchy of operations, Built in Scilab functions, Introduction to plotting, 2D and 3D plotting (2), Branching Statements and program design, Relational & logical operators, the while loop, for loop, details of loop operations, break & continue statements, nested loops, logical arrays and vectorization (2) User defined functions, Introduction to Scilab functions, Variable passing in Scilab, optional arguments, preserving data between calls to a function, Complex and Character data, string function, Multidimensional arrays (2) an introduction to Scilab file processing, file opening and closing, Binary I/o functions, comparing binary and formatted functions, Numerical methods and developing the skills of writing a program (2).
Curve fitting, Least square fit, Goodness of fit, standard deviation	Ohms law to calculate R, Hooke's law to calculate spring constant
Solution of Linear system of equations by Gauss elimination method and Gauss Seidal method. Diagonalization of matrices, Inverse of a matrix, Eigen vectors, eigen values problems	Solution of mesh equations of electric circuits (3 meshes) Solution of coupled spring mass systems (3 masses)
Solution of ODE <ul style="list-style-type: none"> <li>• First order Differential equation Euler, modified Euler and Runge-Kutta second order methods</li> <li>• Second order differential equation.</li> </ul>	First order differential equation <ul style="list-style-type: none"> <li>• Radioactive decay</li> <li>• Current in RC, LC circuits with DC source</li> <li>• Newton's law of cooling</li> <li>• Classical equations of motion</li> </ul>

Fixed difference method	Second order Differential Equation <ul style="list-style-type: none"> <li>• Harmonic oscillator (no friction)</li> <li>• Damped Harmonic oscillator</li> <li>• Over damped</li> <li>• Critical damped</li> <li>• Oscillatory</li> <li>• Forced Harmonic oscillator</li> <li>• Transient and</li> <li>• Steady state solution</li> <li>• Apply above to LCR circuits also</li> </ul>
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### Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J.20 Bence, 3rd Ed., 2006, Cambridge University Press
2. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8th Ed., 2011, Cambridge Univ. Press
3. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett
4. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A.V. Wouwer, P. Saucez, C.V. Fernández. 2014 Springer
5. Scilab by example: M. Affouf 2012, ISBN: 978-1479203444
6. Scilab (A free software to Matlab): H. Ramchandran, A.S.Nair. 2011 S.Chand& Company
7. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
8. A Complete Course in Degree Practical Physics, B.B. Swain & P.K. Jena, Kalyani Publishers (2017)

### CC 10.1: Maxwells Equations and EMT

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Maxwell's Equations:** Maxwell's equations. Displacement current. Vector and Scalar potentials. Gauge transformations: Lorentz and Coulomb gauge. Poynting theorem and Poynting vector. Electromagnetic (em) Energy density. Physical concept of electromagnetic field energy density.

**Optical Fibres :** Propagation of em-wave through optical fibre, Acceptance angle and acceptance cone, numerical aperture, skip distance, fractional index change, mono-mode and multi-mode optical fibre, raypath in STIN and GRIN optical fibre, dispersion (inter/intra modal), Delay time, losses in optical fibres and attenuation, applications of optical fibres.

**Unit 2 :EM Wave Propagation in Unbounded Media:** Plane em waves through vacuum and isotropic dielectric medium, transverse nature of plane em waves, refractive index and dielectric constant, wave impedance.

Propagation through conducting media, relaxation time, skin depth. Electrical conductivity of ionized gases, plasma frequency, refractive index, skin depth, application to propagation through ionosphere.

**Unit 3 :EM Wave in Bounded Media:** Boundary conditions at a plane interface between two media. Reflection & Refraction of plane waves at plane interface between two dielectric media, Laws of reflection & refraction. Fresnel's formulae for perpendicular & parallel polarization cases, Brewster's law. Reflection & Transmission coefficients. Total internal reflection, evanescent waves. Metallic reflection (normal Incidence)

**Unit 4 :Polarization of Electromagnetic Waves:** Description of Linear, Circular and Elliptical Polarization. Propagation of em waves in anisotropic media. Light propagation in Uniaxial crystal. Double refraction. Polarization by double refraction. Nicol prism. Ordinary & extraordinary refractive indices. Production & detection of Plane, Circularly and Elliptically polarized light. Phase retardation plates: Babinet compensator and its uses.

Rotatory Polarization: Optical Rotation. Fresnel's Theory of optical rotation. Calculation of angle of rotation. Specific rotation. Laurent's half-shade polarimeter.

#### Reference Books:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Ed., 1998, Benjamin Cummings.
2. Elements of Electromagnetics, M.N.O. Sadiku, 2001, Oxford University Press.
3. Introduction to Electromagnetic Theory, T.L. Chow, 2006, Jones & Bartlett Learning
4. Fundamentals of Electromagnetics, M.A.W. Miah, 1982, Tata McGraw Hill.
5. Electromagnetic field Theory, R.S. Kshetrimayun, 2012, Cengage Learning
6. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer
7. Electricity and Magnetism – D.C. Tayal (Himalaya Publication) 2014
8. Introduction to Electrodynamics-A.Z.Capri & P.V.Panat (Alpha Science) 2002
9. Optics E. Hecht, (Pearson India)
10. Electromagnetic Fields & Waves, P. Lorrain & D. Corson, 1970, W.H. Freeman & Co.
11. Electromagnetics, J.A. Edminster, Schaum Series, 2006, Tata McGraw Hill.
12. Electromagnetic field theory fundamentals, B. Guru and H. Hiziroglu, 2004, Cambridge University Press
13. Electromagnetic Theory-A. Murthy (S. Chand Publication) 2014
14. Classical Electrodynamics, J.D. Jackson (Wiley India)
15. Lectures on Engineering Physics, L. Moharana, P.K. Panda, S.K. Dash and B. Ojha, Pearson Publishers (2017)

#### CC 10.2: Practicals

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. To verify the law of Malus for plane polarized light.

2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by multi frequency interferometer.
6. To study the reflection, refraction of microwaves
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan's law of radiation and to determine Stefan's constant.
12. To determine the Boltzmann constant using V-I characteristics of PN junction diode.
13. To study the reflection and total internal reflection by optical fibres.

#### Reference Books :

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash & Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
4. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, 2010, Springer

#### CC 11.1: Statistical Mechanics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Classical Statistics-I:** Macrostate & Microstate, Elementary concept of Ensemble, Microcanonical, Canonical and Grand canonical ensemble. Phase space, Entropy and thermodynamic probability, Maxwell-Boltzmann distribution law, Partition Function, Thermodynamic functions of an ideal Gas, Classical entropy expression.

**Unit 2 :Classical Statistics-II:** Gibb's Paradox, Sackur-Tetrode equation, Law of equipartition of energy (with proof) – Applications to specific heat and its limitations, Thermodynamic functions of a Two-Energy levels system, Negative temperature.

**Unit 3 :Radiation:** Properties of Thermal Radiation. Blackbody Radiation. Pure temperature dependence. Kirchhoff's law. Stefan-Boltzmann law: Thermodynamic proof. Radiation Pressure. Wien's Displacement law. Wien's Distribution law. Saha's ionization formula. Rayleigh-Jean's law. Ultraviolet Catastrophe. Planck's law of Blackbody radiation: Experimental verification.

**Unit 4 :Quantum Statistics:** Identical particles, macrostates and micro states. Fermions and Bosons, Bose Einstein distribution function and Fermi-Dirac distribution function. Bose-Einstein condensation, Bose deviation from Planck's law, Effect of temperature on F-D distribution function, degenerate Fermigas, Density of states, Fermi energy.

**Reference Books:**

1. Statistical Mechanics-R.K.Pathria& Paul D. Beale (Academic Press) 3<sup>rd</sup> Edition (2011)
2. Statistical Physics, Berkeley Physics Course, F. Reif, 2008, Tata McGraw-Hill
3. Statistical and Thermal Physics, S. Lokanathan and R.S. Gambhir. 1991, Prentice Hall
4. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.
5. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
6. An Introduction to Statistical Mechanics & Thermodynamics, R.H. Swendsen, 2012, Oxford Univ. Press.
7. An introduction to Equilibrium Statistical Mechanics: Palash Das (I.K. International Publication) 2012
8. Statistical Physics - F. Mandl (CBS) 2012
9. Statistical Physics of Particles-M. Kardar (CUP 2007)

**CC 11.2: Practicals**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

**Use C/C++/Scilab for solving the problems based on Statistical Mechanics like**

1. Plot Planck's law for Black Body radiation and compare it with Wein's Law and Raleigh-Jeans Law at high temperature (room temperature) and low temperature.
2. Plot Specific Heat of Solids by comparing (a) Dulong-Petit law, (b) Einstein distribution function, (c) Debye distribution function for high temperature (room temperature) and low temperature and compare them for these two cases
3. Plot Maxwell-Boltzmann distribution function versus temperature.
4. Plot Fermi-Dirac distribution function versus temperature.
5. Plot Bose-Einstein distribution function versus temperature.

**Reference Books:**

1. Elementary Numerical Analysis, K.E. Atkinson, 3<sup>rd</sup> Edn. 2007, Wiley India Edition
2. Statistical Mechanics, R.K. Pathria, Butterworth Heinemann: 2<sup>nd</sup> Ed., 1996, Oxford University Press.
3. Thermodynamics, Kinetic Theory and Statistical Thermodynamics, Francis W. Sears and Gerhard L. Salinger, 1986, Narosa.

4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer
5. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB: Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C.V. Fernández. 2014 Springer ISBN: 978-3319067896.
6. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444.
7. Scilab Image Processing: L.M. Surhone. 2010, Betascript Pub., ISBN: 978- 6133459274.
8. A Complete Course in Degree Practical Physics, B. B. Swain & P.K. Jena, Kalyani Publishers (2017)

### CC 12.1: Solid State Physics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit 1 :

**Crystal Structure:** Solids: Amorphous and Crystalline Materials. Lattice Translation Vectors. Lattice with a Basis – Central and Non-Central Elements. Unit Cell. Miller Indices. Types of Lattices, Reciprocal Lattice. Brillouin Zones. Diffraction of X-rays by Crystals. Bragg’s Law. Atomic and Geometrical Factor.

#### Unit 2 :

**Elementary Lattice Dynamics:** Lattice Vibrations and Phonons: Linear Monoatomic and Diatomic Chains. Acoustical and Optical Phonons. Qualitative Description of the Phonon Spectrum in Solids. Dulong and Petit’s Law, Einstein and Debye theories of specific heat of solids.

**Magnetic Properties of Matter:** Dia-, Para-, Ferri- and Ferromagnetic Materials. Classical Langevin Theory of dia- and Paramagnetism. Curie’s law, Weiss’s Theory of Ferromagnetism and Ferromagnetic Domains.

#### Unit 3 :

**Elementary band theory:** Bloch function, Bloch theorem, Kronig Penny model. Band Gap. Conductor, Semiconductor (P and N type) and insulator. Charge carrier concentration of both P-type and n-type semiconductor. Intrinsic carrier concentration, Law of mass action. Conductivity of Semiconductor, mobility, Hall Effect. Measurement of conductivity (Four probe method) & Hall coefficient

#### Unit 4 :

**Lasers :** Principle of LASER emission and Einstein Equation, Einstein’s A and B coefficients. Metastable states. Spontaneous and Stimulated emissions. Optical Pumping and Population Inversion. Three-Level and Four-Level Lasers. Ruby Laser, He-Ne Laser and Semiconductor Laser.

**Superconductivity:** Critical Temperature. Critical magnetic field. Meissner effect. Type I and type II Superconductors, London’s Equation and Penetration Depth. Isotope effect. Cooper pair and Idea of BCS theory (No derivation), Entropy, specific heat, energy gap of super conductor, High temperature superconductivity. Application of superconductor, Josephson effect, Superconducting quantum interference device (SQUID).

**Reference Books:**

1. Introduction to Solid State Physics, Charles Kittel, 8th Edition, 2004, Wiley India Pvt. Ltd.
2. Elements of Solid State Physics, J.P. Srivastava, 2nd Edition, 2006, Prentice-Hall of India
3. Introduction to Solids, Leonid V. Azaroff, 2004, Tata Mc-Graw Hill
4. Solid State Physics, N.W. Ashcroft and N.D. Mermin, 1976, Cengage Learning
5. Solid-state Physics, H. Ibach and H. Luth, 2009, Springer
6. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
7. Solid State Physics, M.A. Wahab, 2011, Narosa Publications
8. Solid State Physics – S. O. Pillai (New Age Publication)
9. Solid State Physics- R.K.Puri & V.K. Babbar (S. Chand Publication)2013
10. Lasers and Non linear Optics – B.B. Laud-Wiley Eastern.
11. LASERS: Fundamentals and Applications – Thyagarajan and Ghatak (McMillanIndia) 2012
12. Lectures on Engineering Physics, L. Moharana, P.K. Panda, S.K. Dash and B. Ojha, Pearson Publishers (2017)

**CC 12.2: Practicals**

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

1. Measurement of susceptibility of paramagnetic solution (Quinck`s Tube Method)
2. To measure the Magnetic susceptibility of Solids.
3. To determine the Coupling Coefficient of a Piezoelectric crystal.
4. To measure the Dielectric Constant of a dielectric Materials with frequency
5. To determine the complex dielectric constant and plasma frequency of metal using Surface Plasmon Resonance (SPR)
6. To determine the refractive index of a dielectric layer using SPR
7. To study the PE Hysteresis loop of a Ferroelectric Crystal.
8. To draw the BH curve of Fe using Solenoid & determine energy loss from Hysteresis.
9. To measure the resistivity of a semiconductor (Ge) with temperature by four-probe method (room temperature to 150<sup>o</sup>C) and to determine its band gap.
10. To determine the Hall coefficient of a semiconductor sample.
11. To study the band gap energy of a semiconductor.

**Reference Books**

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4<sup>th</sup> Edition, reprinted 1985, Heinemann Educational Publishers.
3. A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11<sup>th</sup> Ed., 2011, Kitab Mahal
4. Elements of Solid State Physics, J.P. Srivastava, 2nd Ed., 2006, Prentice-Hall of India.
5. A Complete Course in Degree Practical Physics, B.B. Swain, Kalyani Publishers (2017)

**Semester VIII****CC 13.1: Mathematical Physics-III**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :Complex Analysis – I** : Brief revision of Complex Numbers and their Graphical representation. Euler's formula, De Moivre's theorem, Roots of complex numbers. Functions of complex variables. Analyticity and Cauchy-Riemann Conditions. Examples of analytic functions. Singular functions: poles and branch points, order of singularity, branch cuts. Integration of a function of a complex variable. Cauchy's Inequality. Cauchy's theorem, Cauchy's integral formula

**Unit 2 :Complex Analysis-II:** Laurent and Taylor's expansion. Residues and Residue theorem. Application in solving definite integrals. Fourier transforms: Fourier integral theorem. Fourier transform. examples. Fourier transform of trigonometric, Gaussian, finite wave train & other functions. Representation of Dirac delta function as a Fourier integral.

**Unit 3 :Fourier Transform:** Fourier transform of derivatives, Inverse Fourier transform, Convolution theorem. Properties of Fourier transform (translation, change of scale, complex conjugation, etc.). Three dimensional Fourier transforms with examples. Application of Fourier Transforms to differential equations: One dimensional Wave and Diffusion/Heat flow equations.

**Unit 4 :Laplace Transforms:** Laplace Transform (LT) of Elementary functions. Properties of LTs: Change of scale theorem, Shifting theorem. LTs of Derivatives and Integrals of functions, Derivatives and Integrals of LTs. LT of Unit Step function, Dirac Delta function, Periodic functions. Convolution theorem. Inverse LT. Application of Laplace transforms to differential equations: Damped Harmonic Oscillator, Simple electrical circuits.

**Reference Books:**

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J. Bence, 3<sup>rd</sup> ed., 2006, Cambridge University Press
2. Mathematical Methods for Physicists: Arfken, Weber, 2005, Harris, Elsevier.
3. Advanced Engineering Mathematics, E. Kreyszig (New Age Publication) 2011.
4. Mathematics for Physicists, P. Dennery & A. Krzywicki, 1967, Dover Publications
5. Complex Variables, A.S. Fokas & M.J. Ablowitz, 8<sup>th</sup> Ed., 2011, Cambridge Univ. Press
6. Complex Variables and Applications, J.W. Brown & R.V. Churchill, 7<sup>th</sup> Ed. 2003, Tata McGraw-Hill
7. First course in complex analysis with applications, D.G. Zill and P.D. Shanahan, 1940, Jones & Bartlett.
8. Mathematical Physics- H.K. Dass, Dr. Rama Verma (S. Chand Higher Academics) 6<sup>th</sup> Edition 2011.
9. Mathematical Physics –C. Harper, (Prentice Hall India) 2006.

10. Mathematical Physics-Goswami (Cengage Learning) 2014
11. Mathematical Method for Physical Sciences - M. L. Boas (Wiley India) 2006
12. Introduction to the theory of functions of a complex variable- E.T. Copson (Oxford) Univ. Press, 1970

### CC 13.2: Practicals

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

#### **Scilab based simulations experiments based on Mathematical Physics problems like**

1. Solve differential equations:  
 $dy/dx = e^{-x}$  with  $y = 0$  for  $x = 0$   
 $dy/dx + e^{-x}y = x^2$   
 $d^2y/dt^2 + 2 dy/dt = -y$   
 $d^2y/dt^2 + e^{-t}dy/dt = -y$
2. Dirac Delta Function:  
 Evaluate  $\frac{1}{\sqrt{2\pi\sigma^2}} \int e^{-\frac{(x-2)^2}{2\sigma^2}} (x+3)dx$  for  $\sigma=1, 0.1, 0.01$  and show it tends to 5
3. Fourier Series:  
 Program to sum  $\sum_{n=1}^{\infty} (0.2)^n$   
 Evaluate the Fourier coefficients of a given periodic function (square wave)
4. Frobenius method and Special functions:  

$$\int_{-1}^1 P_n(\mu) P_m(\mu) d\mu = \delta_{n,m}$$
 Plot  $P_n(x)$ ,  $J_\nu(x)$   
 Show recursion relation
5. Calculation of error for each data point of observations recorded in experiments done in previous semesters (choose any two).
6. Calculation of least square fitting manually without giving weightage to error. Confirmation of least square fitting of data through computer program.
7. Evaluation of trigonometric functions e.g.  $\sin \theta$ , Given Bessel's function at Npoints find its value at an intermediate point. Complex analysis: Integrate  $1/(x^2+2)$  numerically and check with computer integration.
8. Integral transform: FFT of  $e^{-x^2}$

#### Reference Books:

1. Mathematical Methods for Physics and Engineers, K.F Riley, M.P. Hobson and S. J.Bence, 3rd ed., 2006, Cambridge University Press
2. Mathematics for Physicists, P. Dennery and A. Krzywicki, 1967, Dover Publications
3. Simulation of ODE/PDE Models with MATLAB®, OCTAVE and SCILAB:Scientific and Engineering Applications: A. Vande Wouwer, P. Saucez, C.V.Fernández. 2014 Springer ISBN: 978-3319067896
4. Scilab by example: M. Affouf, 2012. ISBN: 978-1479203444
5. Scilab (A free software to Matlab): H. Ramchandran, A.S.Nair. 2011 S. Chand & Company
6. Scilab Image Processing: Lambert M. Surhone. 2010 Betascript Publishing
7. A Complete Course in Degree Practical Physics, B.B. Swain & P.K. Jena, Kalyani Publishers (2017)

**CC 14.1: Nuclear and Particle Physics**

Contact Hours per Week	: 4
Credit	: 6
Examination Duration	: 3 Hours
Maximum Marks	: 100(Terminal-80, Sessional-20)

**Unit 1 :General Properties of Nuclei:** Constituents of nucleus and their Intrinsic properties, quantitative facts about mass, radii, charge density (matter density), binding energy, average binding energy and its variation with mass number, main features of binding energy versus mass number curve, N/A plot, angular momentum, parity, magnetic moment, electric moments, nuclear excite states.

**Nuclear Models:** Liquid drop model approach, semi empirical mass formula and significance of its various terms, condition of nuclear stability, two nucleon separation energies, evidence for nuclear shell structure, nuclear magic numbers, basic assumption of shell model,

**Unit 2 :Radioactivity decay:**(a) Alpha decay: basics of  $\alpha$ -decay processes, theory of  $\alpha$ - emission, Gamow factor, Geiger Nuttall law. (b)  $\beta$ -decay: energy kinematics for  $\beta$ -decay, positron emission, electron capture, neutrino hypothesis. (c) Elementary idea of Gamma decay.

**Nuclear Reactions:** Types of Reactions, Conservation Laws, kinematics of reactions, Q-value,

**Unit 3 :Detector for Nuclear Radiations:** Gas detectors: estimation of electric field, mobility of particle, for ionization chamber and GM Counter. Basic principle of Scintillation Detectors and construction of photo-multiplier tube (PMT). Semiconductor Detectors (Si and Ge) for charge particle and photon detection (concept of charge carrier and mobility), neutron detector.

**Unit 4 :Particle Accelerators:** Van-de Graaff generator (Tandem accelerator), Linear accelerator, Cyclotron, Synchrotrons.

**Particle physics:** Four basic interactions in nature and their relative strengths, examples of different types of interactions.Symmetries and Conservation Laws: energy and momentum, angular momentum, parity, baryon number, Lepton number, Isospin, Strangeness and charm. Elementary ideas of quarks and gluons.

**Reference Books:**

1. Introductory nuclear Physics by Kenneth S. Krane (Wiley India Pvt. Ltd., 2008).
2. Concepts of nuclear physics by Bernard L. Cohen. (Tata Mcgraw Hill, 1998).
3. Introduction to High Energy Physics, D.H. Perkins, Cambridge Univ. Press
4. Introduction to Elementary Particles, D. Griffith, John Wiley & Sons
5. Basic ideas and concepts in Nuclear Physics - An Introductory Approach by K. Heyde (IOP-Institute of Physics Publishing, 2004).
6. Theoretical Nuclear Physics, J.M. Blatt & V.F. Weisskopf (Dover Pub. Inc., 1991)
7. Atomic and Nuclear Physics -A.B. Gupta, Dipak Ghosh. (Books and Allied Publishers)
8. Physics of Atoms and Molecules – Bransden (Pearson India) 2003
9. Subatomic Physics - Henley and Gracia (World Scientific) 2012
10. Introduction to Nuclear and Particle Physics- A. Das and T. Ferbel (World Scientific)

11. Radiation detection and measurement, G.F. Knoll (John Wiley & Sons, 2000).
12. A Complete Course in Degree Practical Physics, B.B. Swain, Kalyani Publishers (2017)

**DSE II: Project-cum-Seminar**

Contact Hours per Week : 4

Credit : 4

Maximum Marks : 100 (Internal)

The students will complete the project work under the guidance of members of faculty. Regular monitoring as per the steps/processes indicated below is essential. Weightage as indicated against each step is to be assigned through seminar/workshop mode.

<b>Identification of problem</b>	<b>Review of literature</b>	<b>Methodology</b>	<b>Analysis</b>	<b>Findings</b>	<b>Viva-voice</b>	<b>Total</b>
10	10	15	15	20	30	100
Internal				Internal and External		

## PROGRAM STRUCTURE: MATHEMATICS (HONS.)

Sem-ester	AECC	CC (Hons) Mathematics	GE-I* Chemistry	GE-II* Physics	DSE	SEC	Education	CBC*
I	AECC-1 Communicative English	CC-1 (Th+Pr)	GE-1 (Th+Pr)	GE-1 (Th+Pr)			PE-1 EPC-1	
II		CC-2 (Th+Pr)	GE-2(Th+Pr),	GE-2 (Th+Pr)		SEC- (Th+Pr)	PE-2 CPS-1	
III	AECC-2 (Environmental Studies)	CC-3 (Th+Pr)	GE-3(Th+Pr),	GE-3 (Th+Pr)			PE-3 PE-4	
IV		CC-4 (Th+Pr)	GE-4(Th+Pr),	GE-4 (Th+Pr)	DSE-I (Th+Pr)		PE-5 PE-6	
V		CC-5 (Th+Pr) CC-6 (Th+Pr) CC-7 (Th+Pr) CC-8 (Th+Pr)					CPS2-1 CPS3-1 EPC-2	
VI		CC-9 (Th+Pr) CC-10 (Th+Pr) CC-11(Th+Pr) CC-12(Th+Pr)					CPS2-2, CPS3-2, FE-1	CBC
VII							PE-7, EPC-3 EPC-4, FE-2	
VIII		CC-13 (Th+Pr) CC-14(Th+Pr)			DSE-II (Project)		PE-8, EPC-5, EPC-6, EPC-7, FE-3	

\*GE (Chemistry) is equivalent to CC (Chemistry)

\*GE (Physics) is equivalent to CC (Physics),

## MATHEMATICS

### SCHEME OF EXAMINATION

**Semester I:**

**GE/CC 1.1 (Elementary Algebra & Calculus) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

- Unit 1: Complex Number : Properties & Application
- Unit 2: Matrices
- Unit 3: Differential Calculus
- Unit 4: Integral Calculus

**GE/CC 1.2: Practical 25 marks**

**Semester II:**

**GE/CC 2.1 (Solid Geometry and Differential Equation-I) 75 marks**  
**(Terminal-60, Sessional-15)**  
**Credits-6 (Theory-04, Practical-02)**

- Unit 1: Solid Geometry Introduction
- Unit 2: Solid Geometry: Cone and Cylinder
- Unit 3: Introduction & First Order Differential Equation
- Unit 4: Second Differential Equation

**GE/CC 2.2: Practical 25 marks**

**SEC 1: (Discrete Mathematics)**

**(Terminal-40, Sessional-10) 50 marks**  
**Credits-4 (Theory-02, Practical-02)**

- Unit 1: Introduction and Properties of Discrete Mathematics
- Unit 2: Application of Discrete Mathematics

**SEC 2 :Practical 50 marks**

**Semester III:**

**CC 3.1 (Real Analysis-I) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 (Theory-04, Practical-02)**

- Unit 1: Basic Concept of Real Analysis
- Unit 2: Application of Real Analysis
- Unit 3: Sequence & Its Convergence
- Unit 4: Infinite series

**CC 3.2: Practical 25 marks**

**Semester IV:**

**GE/CC 4.1 (Real Analysis-II) (Terminal-60, Sessional-15) 75 marks**  
**Credits-6 : (Theory-04, Practical-02)**

- Unit 1: Limit and Continuity
- Unit 2: Differentiability
- Unit 3: Application of Differentiability
- Unit 4: Maxima and Minima, Taylor theorem

**GE/CC 4.2: Practical 25 marks**

**(Opt. any one)**

**DSE-I (Choice-1) I.1.1: (Number Theory)(Terminal-60, Sessional-15) 75 marks**  
**Credits-6: (Theory-04, Practical-02)**

- Unit 1: Introduction
- Unit 2: Theorems on Number Theory

Unit 3: Theorems on Number Theory Contd...

Unit 4: Application of Number Theory

**DSE-I.1.2: Practical**

**25 marks**

**DSE-II (Choice-2) I.2.1: (Mathematical Modeling)**

**(Terminal-60, Sessional-15)**

**Credits-6: (Theory-04, Practical-02)**

**75 marks**

Unit 1: Simple Situations Requiring Mathematical Modeling

Unit 2: Mathematical modeling in population dynamics

Unit 3: Mathematical modeling of Planetary Motions

Unit 4: Situations that can be modeled through graphs

**DSE-I.2.2: Practical**

**25 marks**

**DSE-III (Choice-3) I.3.1: (CLASSICAL GEOMETRY)**

**(Terminal-60, Sessional-15)**

**Credits-6: (Theory-04, Practical-02)**

**75 marks**

Unit 1: Euclid's Geometry

Unit 2: Hilbert's axioms for geometry

Unit 3: Geometry over fields

Unit 4: Segment Arithmetic

**DSE-I.3.2: Practical**

**25 marks**

**Semester V:**

**CC 5.1 (Advanced Calculus and Differential equation-II)**

**(Terminal-60, Sessional-15)**

**Credits-6 (Theory-04, Practical-02)**

**75 marks**

Unit 1: Limits and continuity of function of several variables

Unit 2: Maxima & Minima of Several variable & Vector Calculus

Unit 3: Power Series solution of differential Equation

Unit 4: Laplace transforms & its Application

**CC 5.2: Practical**

**25 marks**

**CC 6.1: (Abstract Algebra)**

**(Terminal-60, Sessional-15)**

**Credits-6 (Theory-04, Practical-02)**

**75 marks**

Unit 1: Fundamental of Abstract Algebra

Unit 2: Cyclic Group and Properties

Unit 3: Normal Group and Homomorphism

Unit 4: Rings: Introduction and Theorem

**CC 6.2: Practical**

**25 marks**

**CC 7.1: (Partial Differential Equation & Systems of Ordinary Differential Equation)**

**(Terminal-60, Sessional-15)  
Credits-6 (Theory-04, Practical-02)**

75 marks

- Unit 1: System of Linear Ordinary Differential Equation
- Unit 2: Introduction of Partial Differential Equation
- Unit 3: Solution of Partial Differential Equation
- Unit 4: Application of Partial Differential Equation

**CC 7.2:Practical**

25 marks

**CC 8.1: (Object Oriented Programme C++) (Terminal-60, Sessional-15)75 marks  
Credits-6 (Theory-04, Practical-02)**

- Unit 1: C++ Basics
- Unit 2: Arrays
- Unit 3: Basic Concepts of OOP
- Unit 4: Classes & Function of Classes

**CC 8.2: Practical**

25 marks

**Semester VI:**

**CC 9.1 (Riemann Integration & Series of Functions (Analysis-III))  
(Terminal-60, Sessional-15)  
Credits-6 (Theory-04, Practical-02)**

75 marks

- Unit 1: Riemann integration and Properties
- Unit 2: Improper integral
- Unit 3: Sequence and series of functions
- Unit 4: Power series

**CC 9.2: Practical**

25 marks

**CC 10.1 (Linear Programming) (Terminal-60, Sessional-17)  
Credits-6 (Theory-04, Practical-02)**

75 marks

- Unit 1: Introduction to linear programming problems (LPP)
- Unit 2: Duality in LPP
- Unit 3: Transportation Problem (TP)
- Unit 4: Games and Strategies

**CC 10.2: Practical**

25 marks

**CC 11.1 (Numerical Analysis) (Terminal-60, Sessional-15)  
Credits-6 (Theory-04, Practical-02)**

75 marks

- Unit 1: Basic and Introduction of Numerical Analysis
- Unit 2: System of linear algebraic equations
- Unit 3: Polynomial interpolation
- Unit 4: Numerical Integration

**CC 11.2 : Practical**

25 marks

**CC 12.1 (Probability & Statistics) (Terminal-60, Sessional-15)  
Credits-6 (Theory-04, Practical-02)**

75 marks

- Unit 1: Introduction of Probability
- Unit 2: Random variables
- Unit 3: Theory of Distributions
- Unit 4: statistics

**CC 12.2: Practical** **25 marks**  
**CBC: (General Mathematics)(Terminal-80, Sessional-20)** **100 marks**  
 Unit 1: Introduction & Basic of Mathematics

Unit 2: Real life problem in Mathematics

Unit 3: Logical Mathematics

Unit 4: Data analysis in Mathematics

**Semester VIII:**

**CC 13.1 (Metric Spaces & Complex Analysis)** **75 marks**  
**(Terminal-60, Sessional-15)**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1: Metric spaces

Unit 2: Basic of Complex Analysis

Unit 3: Complex integration

Unit 4: Series, Singularities & Residue

**CC 13.2 : Practical** **25 marks**

**CC 14.1 (Linear Algebra)** **75 marks**  
**(Terminal-60, Sessional-15)**  
**Credits-6 (Theory-04, Practical-02)**

Unit 1: Vector spaces

Unit 2: Linear transformations

Unit 3: Eigenvalues & Eigenvectors

Unit 4: Inner Product spaces

**CC 14.2 : Practical** **25 marks**

**DSE-II: Project cum seminar(Cr-6)** **100 marks**

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

## Objectives (Mathematics)

### The Theory course in Mathematics will enable the students to

1. develop proper knowledge in different content areas (Algebra, Analysis, Calculus, Geometry, Optimization and Numerical Computation) of Mathematics;
2. understand the basic rules of logic, including the role of axioms or assumptions;
3. appreciate the role of mathematical proof in formal deductive reasoning;
4. be able to distinguish a coherent argument from a fallacious one, both in mathematical reasoning and in everyday life;
5. understand and be able to articulate the differences between inductive and deductive reasoning;
6. proficiently construct logical arguments and rigorous proofs;
7. formulate conjectures by abstracting general principles from examples;
8. formulate and solve abstract mathematical problems;
9. recognize real-world problems that are amenable to mathematical analysis, and formulate mathematical models of such problems;
10. apply mathematical methodologies to open-ended real-world problems;
11. recognize connections between different branches of mathematics;
12. recognize and appreciate the connections between theory and applications;
13. present mathematics clearly and precisely to an audience of peers and faculty;
14. appreciate the role of mathematical proof as a means of conveying mathematical knowledge;
15. understand the differences between proofs and other less formal arguments;
16. make vague ideas precise by formulating them in mathematical language;
17. describe mathematical ideas from multiple perspectives;
18. define different mathematical terms and notations;
19. explain fundamental mathematical concepts or analyses of real-world problems to non-mathematicians;
20. to solve the numerical problems by using computer;
21. recognize and appreciate the connections between theory and applications;
22. make significant progress on typical mathematical problems previously unfamiliar to them, using appropriate techniques and tools;
23. formulate precise and relevant conjectures based on examples and counterexamples, prove or disprove conjectures, and translate between intuitive understandings and formal definitions and proofs;
24. construct, modify and analyze mathematical models of systems encountered in disciplines such as physics, economics or biology, assess the models' accuracy and usefulness, and draw contextual conclusions from them;
25. clearly communicate mathematical ideas in appropriate contexts both orally and in writing to a range of audience, including the educated general public;
26. explore applications of mathematics in other fields and gain experience in mathematical modeling of real-world phenomena using ordinary and partial differential equations, approximation and optimization techniques, linear programming, or game theory;
27. identify different kinds of functions and explore their properties;
28. explore the use of mathematics in daily-life by people of different occupations;
29. define different mathematical terms and notations with correct usage rules;
30. develop suitable algorithms for different kinds of problem;
31. solve various numerical problems using programming language C++;
32. explore alternative solutions to a problem;
33. expand mathematics as a language of other sciences.

## MATHEMATICS

### Semester – I

#### GE/CC 1.1: Elementary Algebra & Calculus

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Elementary Algebra

**Unit1** :Polar representation of complex numbers, nth roots of Unity, De Moivre’s theorem, Binomial Theorem for complex quantities, Expansions of  $\sin n\theta$ ,  $\cos n\theta$  and  $\tan n\theta$ , Expansions of  $\sin a$  and  $\cos a$  in a series of ascending powers of  $a$ , Sines and Cosines of small angles, Approximation to the root of an equation, Evaluation of indeterminate quantities, Expansions of  $\cos^n\theta$  and  $\sin^n\theta$  in cosines or sines of multiples of  $\theta$ , Expansions of  $\sin n\theta$  and  $\cos n\theta$  in series of descending and ascending powers of  $\sin \theta$  and  $\cos \theta$ .

**Unit2** :Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation  $Ax=b$ , solution sets of linear systems, applications of linear systems, linear independence. Matrices of real and complex numbers : Algebra of matrices. Symmetric and skew-symmetric matrices, Hermitian and skew-Hermitian matrices, Orthogonal matrices. Elementary operations on matrices. Echelon matrix. Rank of a matrix. Determination of rank of a matrix (relevant results are to be stated only).

#### Calculus

**Unit3** :Higher order derivatives, L-Hospitals,Leibnitz rule and its applications to problems of the type  $e^{(ax+b)} \sin x$ ,  $e^{(ax+b)} \cos x$ ,  $(ax + b)^n \sin x$ ,  $(ax + b)^n \cos x$ , Concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L-Hospitals rule.

**Unit-4**:Reduction formulae, derivations and illustrations of reduction formulae of the type  $\int \sin^n x dx$ ,  $\int \cos^n x dx$ ,  $\int \tan^n x dx$ ,  $\int \sec^n x dx$ ,  $\int \sin^n x \cos^n x dx$ , Rectification length of plane curves, volume and surfaces of revolutions, Beta and Gamma functions.

#### GE/CC 1.2 : PRACTICAL

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

- Plotting the graphs of the functions  $e^{(ax+b)}$ ,  $\log(ax + b)$ ,  $\frac{1}{ax+b}$ ,  $\sin(ax + b)$ ,  $\cos(ax + b)$  and to illustrate the effect of  $a$  and  $b$  on the graph.
- Plotting the graphs of the polynomial of degree 4 and 5.

3. Sketching parametric curves (Eg. Trochoid, cycloid, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Applications of L-Hospital rule in business, economics and life sciences.
6. Matrix operation (addition, multiplication, inverse, transpose)

**Reference books:**

1. S.L. Loney, Trigonometry Part-II, Macmillan and Co., London. Chapter[II, III, IV]
2. S.K. Mapa, Higher Algebra (Classical), Sarat Book Distributors.
3. PK. Mittal & Shanti Narayan , Differential Calculus , S. Chand and Co. Chapters [5(5.1, 5.2,5.3, 5.4, 5.5), 13(13.1, 13.2), 15, 17]
4. P.K. Mittal & Shanti Narayan, Integral Calculus, S.Chand and Co. Chapters[2(2.8), 4(4.1 to 4.6), 9, 10]
5. S. Ponnusamy, Foundations of complex analysis.
6. Burnside and Panton, The Theory of Equations (Vol. I).
7. Chandrika Prasad, Theory of Algebra, (Pothisala).
8. Thomas Calculus & Analytic Geometry, Dorling Kindersley Pvt. Ltd.
9. Anton B.Davis, Calculus, Wiley Publication house.
10. Schaum's Outline of Calculus, 6th Edition.
11. Robert A. Wredge and Murray Spiegel, Advanced Calculus.

**Semester – II**

**GE/CC2.1 : Solid Geometry and Differential Equation-I**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Solid Geometry**

**Unit1** :Introduction to three dimensional geometry, Cartesian plane, Co-ordinate planes and straight lines. Sphere: Plane section of a sphere, intersection of two spheres, sphere with a given diameter, Equation of a sphere through a given circle.

**Unit2** :Cones and Cylinders: Definition, Equation of a cone with a conic as guiding curve, the right circular cone, its definition and equation. Definition and equation of cylinder, Definition and equation of right circular cylinder. Conicoid: General equation of conicoid, shapes of some surfaces.

**Differential Equation-I**

**Unit3** :Basic concepts of Differential equations (Origin and classification of differential equations, Solution of a differential equation Initial and boundary value problem, existence and uniqueness of solutions.) First order and first degree Ordinary differential equations(variables separable,

homogeneous, exact, non-exact, linear and reducible to linear). Applications of first order differential equations (Growth, Decay and Chemical Reactions, Heat flow, Oxygen debt, Economics). Equations of first order but of higher degree.

**Unit4** : Second order linear equations with constant coefficients (Homogeneous and Non Homogeneous), solution by method of undetermined coefficient and by method of variation of parameters. Equations reducible to linear equations with constant coefficients. Euler-Cauchy differential equation, Linear differential equation with variable coefficient.

#### **GE/CC 2.2 : PRACTICAL**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

Activity oriented problem solving/ experiments based on the content studied in theory.

#### **Reference books:**

1. Shanti Narayan and P. K. Mittal, Analytical Solid geometry, S. Chand and Co. [Chapters 1, 2, 3(6(6.3, 6.3.1, 6.3.2, 6.3.3, 6.4,6.4.1, 6.5, 6.6, 6.6.1, 6.7, 6.7.1), 7(7.1, 7.1.1, 7.1.2, 7.2, 7.4, 7.4.1, 7.4.2, 7.6, 7.6.1, 7.7, 7.7.1, 7.6, 7.8.1, 7.8.2), 8(8.1, 8.2, 8.3, 8.3.1, 8.3.2, 8.3.3)]
2. M. D. Raisinghania, Ordinary and Partial differential equation, S. Chand & Co. Ltd., Revised Edition 2014. [Chapters 1 (1.1, 1.2, 1.4, 1.5, 1.6), 2 (2.1 to 2.8), 4 (4.1 to 4.10), 5 (5.1 to 5.27), 6 (6.1 to 6.11), 7 (7.1 to 7.7, 10 (10.1 to 10.16), 11 (11.1 to 11.13)].
3. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi.
4. Robert J. T. Bell Co-ordinate Geometry of Three Dimensions.
5. Smith, Solid Analytic Geometry.
6. P K Mittal & Shanti Narayan, Differential Calculus, S.Chand and Co.
7. Calculus & Analytic Geometry by Thomas, Dorling Kindersley Pvt. Ltd.
8. Schaum's Outline of Calculus, 6th Edition.
9. Arup Mukherjee and Naba Kumar Bej, Analytical Geometry of 2 and 3 Dimensions.

#### **SEC 1 : DISCRETE MATHEMATICS**

Contact Hour per Week : 4(2 T,2 P)  
 Credits : 4(2T,2 P)  
 Terminal Examination duration : 2 hours  
 Maximum Marks : 50 (Terminal-40, Sessional-10)

**Unit 1** : Proportional equivalence, predicates and quantifiers, Nested quantifiers, methods of proof. Relations and their properties, n-array relations and their applications, Boolean functions and their representation.

**Unit 2 :** The basic counting, The Pigeon-hole principle, Generalized permutations and combinations. Recurrence relations and their solutions, Inclusion-exclusion and applications.

**Reference Books :**

1. K. H. Rosen, Discrete Mathematics and its Applications(5<sup>th</sup> edition, TMH).

**SEC 2 : PRACTICAL**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 50( Expt-25, Viva-15, Record-10)

1. Truth table of distinguish relations.
2. Representation of Boolean function and n-array relations.
3. Generalized permutations and combinations with counter examples.
4. Graph and its representations.

**Semester - III**

**GE/CC3.1 : Real Analysis-I**

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

**Analysis-I**

**Unit1 :**

Algebra of Real numbers, Order, Upper and Lower bounds, Least upper bound (LUB) and Greatest lower bound (GLB), Order-completeness, Density, Decimal representations of real numbers, Cardinality of sets, Countability, Higher order cardinals and cardinality of power sets.

**Unit2 :** Analytical properties of  $\mathbb{R}$ , Open sets, Closed sets, Limit points(Accumulation points), Closure, interior and boundary of sets, Compactness, Bolzano-Weierstrass theorem, Cantor's theorem, Heine-Borel theorem.

**Unit3 :** Sequences, Convergence of sequences, Subsequences and Bolzano-Weierstrass theorem for sequences, monotonic sequence, Weierstrass completeness principle, Cauchy's general principle of convergence, Limit superior and Limit inferior.

**Unit4 :** Infinite series: Convergence series, Series of positive terms, Tests for convergence of series (comparison test, condensation test, Cauchy's root test, D'Alembert's ratio test), Absolute convergence, Rearrangement of terms of a series, Conditionally convergent series, Power series.

**GE/CC 3.2 : PRACTICAL**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. Computations of upper bounds and lower bounds, LUB, GLB of sets.
2. Computing the value of  $n$ ,  $e$ .
3. Read Fibonacci series, binomial series.
4. Computing limit superior, limit inferior of a given sequence.

**Reference Books :**

1. G. Das and S. Pattanayak, Fundamentals of Mathematical Analysis, TMH Publishing Co. [Chapters:2(2.1,2.2,2.3,2.4,2.6,2.7),3(3.2,3.3,3.4,3.5),4(4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.10,4.11,4.12,4.13,4.14), 5(5.1,5.2,5.3,5.4,5.5)]
2. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons(Asia) Pvt. Ltd., Singapore, 2002.
3. Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
4. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
5. S.L. Gupta and Nisha Rani-Real Analysis, Vikas Publishing House Pvt. Ltd., New Delhi.
6. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications. [Chapters : 1 (1 to 5), 2 (1 to 4)]
7. Dipak Chatterjee, Real Analysis.
8. A. N. Kolmogorov and S. V. Fomin, Introduction to Real Analysis.

**Semester – IV****GE/CC 4.1: REAL ANALYSIS-II**

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

**Unit 1 :**

Limits of functions ( $\epsilon$ - $\delta$  approach), Left and right limit, Continuity, Sequential criterion for continuity, Algebra of continuous functions and theorems related to continuity of functions, Discontinuity, kinds of discontinuity, Uniform continuity,

**Unit 2 :**

Differentiability, Left and right derivative, Algebra of differentiable functions, Caratheodory's theorem(without proof).

**Unit 3 :**

Rolle's theorem, Generalized mean value theorem, Lagrange's Mean Value Theorem and applications, Darboux's theorem, Indeterminate forms, Higher order derivatives, Taylor's theorem.

**Unit 4 :**

Maxima and Minima, Taylor's theorem with different forms of remainder, Maclaurin's theorem, Deduction of Taylor's theorem from Mean Value Theorem, Taylor's and Maclaurin's infinite series, Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions,  $\ln(1 + x)$ ,  $1/(ax + b)$  and  $(1 + x)^n$ .

**GE/CC 4.2 : PRACTICAL:**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. Computing  $\delta$  for given  $\varepsilon$  for given functions, for example, polynomials of 1<sup>st</sup> degree, 2<sup>nd</sup> degree, 3<sup>rd</sup> degree and so on.
2. Problems related to Mean Value Theorem.

**Reference books:**

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Publishing Co.[Chapters: 6(6.1, 6.2, 6.3, 6.4, 6.5, 6.6, 6.9), 7(7.2, 7.3, 7.4, 7.5, 7.6, 7.7)]
2. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
3. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.
4. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
5. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
6. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.
7. S. L. Gupta and Nisha Rani, Fundamentals of Real Analysis.
8. Richard L Goldberg, Methods of Real Analysis.
9. Dipak Chatterjee, Real Analysis.
10. A. N. Kolmogorov and S. V. Fomin, Introduction to Real Analysis.

**(Opt. any one)**

**DSE-I (Choice-1) I.1.1 : Number Theory**

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

**Unit 1 :** Divisibility, Primes and their distribution, the binomial theorem.

**Unit 2 :** Congruences. Definition and properties, Euler's phi function, Fermat's Theorem, Euler's Theorem, Wilson's Theorem, Solutions of Congruences, The Chinese Remainder Theorem.

**Unit 3 :** Quadratic reciprocity and quadratic forms-Quadratic residues, quadratic reciprocity, The Jacobi symbol, The Fermat conjecture-The famous "Last Theorem".

**Unit 4 :** Some functions of number theory-Greatest integer function, Arithmetic functions, The Mobius inversion formula, Recurrence functions, Some Diophantine equations.

**Reference Books :**

1. Niven Ivan, Number Theory.[Chapters 2(2.1,2.2,2.3,2.5), 3(3.1 to 3.3), 4(4.1 to 4.4), 5.1].
2. David M. Burton, Elementary Number Theory
3. Neville Robinns, Beginning to Number Theory.
4. Gareth A Jones and J. Mary Jones, Elementary Number Theory.

**DSE I.1.2 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25

1. Application of divisibility and prime numbers.
2. Application of Euler's phi function, Fermat's, Euler's, Wilson's and The Chinese Remainder Theorem.
3. Quadratic reciprocity.
4. Application of Greatest integer function, Arithmetic functions

**DSE II (Choice-2)I.2.1Mathematical Modeling**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1** :Simple Situations Requiring Mathematical Modeling. The Technique of Mathematical Modeling, Mathematical Modeling through differential equations. Linear growth and Decay Models, Non-linear growth and decay models, compartment models, mathematical modeling of geometrical problems through ordinary differential equations of first order.

**Unit 2** :Mathematical modeling in population dynamics, mathematical modeling of epidemics through systems of ordinary differential equations of first order, compartment models through systems of ordinary differential equations, Mathematical modeling in economics through systems of ordinary differential equations of first order. Mathematical models in Medicine, Arms Race, Battles and International Trade in terms of systems of ordinary differential equations

**Unit 3** :Mathematical modeling of Planetary Motions, Mathematical modeling of circular motion and motion of satellites. Mathematical modeling through linear differential equations of second order.

**Unit 4** :Situations that can be modeled through graphs. Mathematical models in terms of directed graphs, Optimization principles and techniques. Mathematical modeling through calculus of variations.

**Reference Books :**

1. Mathematical Modeling—J.N. Kapur  
Chapters: 1(1.1, 1.2), 2(2.1 to 2.6), 3(3.1 to 3.5), 4(4.1 to 4.3),7(7.1, 7.2), 9(9.1, 9.2).

**DSE I.2.2 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 (Expt-15, Viva-5, Record-5)

1. Development of the model for the Linear and Non-linear growth and decay models

2. Development of the model for the population dynamics and epidemics.
3. Development of the model for the Planetary and Circular Motions.
4. Mathematical modeling of variational problems and graph.

### **DSE III (Choice-3) I.3.1: CLASSICAL GEOMETRY**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1** :Euclid's Geometry: Introduction, Ruler and compass constructions, Euclid's Axiomatic Method, Construction of the regular pentagon.

**Unit 2** :Hilbert's axioms for geometry: Axioms of Incidence, Betweenness, Congruence for line segments, Congruence for angles, Hilbert Planes, Intersections of lines and circles, Euclidean planes.

**Unit 3** :Geometry over fields: The real Cartesian plane, Abstract fields and incidence, Ordered fields and betweenness, Congruences of segments and angles, Rigid motions and SAS.

**Unit 4** :Segment Arithmetic: Addition and multiplication of line segments, Similar triangles, Introduction to coordinates.

#### **Reference Books:**

1. R. Hartshorne, Geometry, Euclid and Beyond, Springer, UTM.
2. R. J. T Bell, Coordinate Geometry of Three Dimensions, Macmillan and Co.
3. H. S. M. Coxeter, S. L. Greitzer, Geometry Revisited, Random House, New York, 1967/ Dover.

### **DSE I.3.2 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 (Expt-15, Viva-5, Record-5)

1. Ruler and compass constructions.
2. Congruence for line segments and angles.
3. Ordered fields, Rigid motions and SAS.
4. Hands on Addition and multiplication of line segments

### **Semester – V**

#### **CC 5.1: Advanced Calculus and Differential equation-II**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Advanced calculus**

**Unit1** :Limits and continuity of function of several variables, partial derivatives, homogeneous functions, change of variables, Mean value theorem, Maclaurin's theorem.

**Unit2** :Maxima and minima of functions of two and three variables, Lagrange's multiplier, Multiple integral, Change of variables. Vector definition, Gradient, Curl, Line integral, Surface and volume integrals, Statements of Gauss, Stoke's and Green's theorems( without proof).

**Differential Equations-II**

**Unit3** :Power series solutions of second order differential equations. Legendre Equation and Legendre Polynomial, Power series solution about regular singular points by Frobenius method, Bessel's equation and Bessel function. Properties of Bessel function.

**Unit4** :Laplace transforms, Inverse Laplace transform, Convolution theorem. Its applications to the solutions of ordinary differential equations.

**CC 5.2 : PRACTICAL**

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. Plotting of second order solution of family of differential equations.
2. Plotting of third order solution of family of differential equations.
3. Growth model (exponential case only).
4. Decay model (exponential case only).
5. Oxygen debt model.
6. Economic model.
7. Vibration /Oscillation problems (undamped, damped, forced vibration).

**Reference books:**

1. S.C.Malik and S.Arora (New Age International), [Chapters 15(15.1 to 15.10), 17, 18]
2. M. D. Raisinghania, Advanced differential equation, S. Chand & Co. Ltd., Revised Edition 2013. [Chapters 7 (7.1 to 7.8), 8 (8.1 to 8.17), 11 (11.1, 11.2, 11.4, 11.7, 11.8)]
3. J. K. Goyal & K.P. Gupta, Integrated Transform, Pragati Publication, 10<sup>th</sup> Edition 2002. [Chapter 1, Part-I (1.0 to 1.6), Part-II (1.0 to 1.5), Part-III (1.0 to 1.1)]
4. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. (Chapters:7(7.1 to 7.3,7.3.1, 7.4 ,7.4.1,7.4.2)
5. R.G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.
7. 2.Gerald G. Bilodeau , Paul R. Thie, G.E. Keough, An Introduction to Analysis, 2nd Ed., Jones & Bartlett, 2010.
8. Brian S. Thomson, Andrew. M. Bruckner and Judith B. Bruckner, Elementary Real Analysis, Prentice Hall, 2001.
9. S.K. Berberian, A First Course in Real Analysis, Springer Verlag, New York, 1994.
10. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Publications.
11. Dipak Chatterjee, Real Analysis.
12. A. N. Kolmogorov and S. V. Fomin, Introduction to Real Analysis.
- 13.

**CC 6.1 : ABSTRACT ALGEBRA**

Contact Hour per Week : 4  
 Credits : 4

Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1** : Binary operation on set, Algebraic Structure, Introduction to groups, Abelian group, Definition and general properties of with some example, Additive and multiplicative modulo  $m$ , Finite groups, Complex and subgroups- terminology and notation, Lagrange's theorem and its application.

**Unit2** : Cyclic groups- Properties of cyclic groups, classification of subgroups of cyclic groups; Permutation group- Definition and notation, Cycle notation, Properties of permutations, even and odd permutations; Isomorphism of groups.

**Unit3** : Normal Subgroup, Cosets, Quotient or Factor groups; Group homomorphisms- Definition and examples, Properties of homomorphisms; Fundamental theorem on Group homomorphisms, Cayley's theorem,

**Unit4** : Rings- Definition and examples of rings, Elementary properties of rings, subrings; Integral domains- Definition and examples, Fields, Characteristic of a ring; Ideals and Quotient rings- Definitions and examples, Homomorphisms

### CC 6.2 : PRACTICAL

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Read permutation group, rotation group, dihedral group in details.
2. Study of group in details.
3. Ring, Field, Integral domain relation
4. Ideals and application
5. Homomorphisms and its application in group and ring

### Reference books:

1. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, 2<sup>nd</sup> Edition, Chapter[ 2.1, 2.2, 2.3, 2.4, 2.5, 2.5, 2.7, 2.9, 2.10, 3.1, 3.2, 3.3, 3.4, 3.5]
2. Joseph A. Gallian, Contemporary Abstract Algebra(7th Edn.), Narosa Publishing House, New Delhi
2. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
3. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
4. A Course in Abstract Algebra, Bhambri & Khanna, Vikas Publishing House PVT LTD.

### CC 7.1 : PARTIAL DIFFERENTIAL EQUATIONS & SYSTEMS OF ORDINARY DIFFERENTIAL EQUATIONS

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1** :Systems of Linear Differential Equations: Basic theory of linear systems, Trial solution method for linear system with constant co-efficients, Simultaneous linear first order equations in three variables, methods of solution, Pfaffian differential equations, methods of solutions of Pfaffian differential equations in three variables.

**Unit2** :Formation of first order partial differential equations, Linear partial differential equations of first order, non linear partial differential equation of first order by charpits method, special types of first order nonlinear PDE's , Solutions of partial differential equations of first order satisfying given conditions.

**Unit3** :Linear partial differential equations with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients, Non linear second order PDE of the form  $R_r + S_s + T_t = V$  by Monges method.

**Unit4** :One dimensional wave equation, Solution of the wave equation (method of separation of variables), Diffusion equation, Solution of one-dimensional diffusion equation, Laplace equation, Solution of Laplace equation by separation of variables

### CC 7.2 : PRACTICAL

Contact Hours Per Week	: 2
Examination Duration	: 3 Hours
Maximum Marks	: 25 ( Expt-15, Viva-5, Record-5)

1. To find the general solution of the non-homogeneous system of the form:

$$\frac{dx}{dt} = a_1x + b_1y + f_1(t), \frac{dy}{dt} = a_2x + b_2y + f_2(t)$$

with given condition.

2. Plotting the integral surfaces of a given first order PDE with initial data.
3. Solution of wave equation

$$\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial x^2} = 0$$

for the following associated conditions:

$$u(x,0) = \varphi(x), u_t(x,0) = \Psi(x), x \in \mathbb{R}, t > 0.$$

$$u(x,0) = \varphi(x), u_t(x,0) = \Psi(x), u_x(0,t) = 0, x \in (0, \infty), t > 0.$$

$$u(x,0) = \varphi(x), u_t(x,0) = \Psi(x), u(0,t) = 0, x \in (0, \infty), t > 0.$$

$$u(x,0) = \varphi(x), u_t(x,0) = \Psi(x), u(0,t) = 0, u(1,t) = 0, 0 < x < 1, t > 0.$$

4. Solution of diffusion equation  $\frac{\partial u}{\partial t} - k^2 \frac{\partial^2 u}{\partial x^2} = 0$  for the following associated conditions:

(a)  $u(x, 0) = \varphi(x), u(0, t) = a, u(l, t) = b, 0 < x < l, t > 0.$

(b)  $u(x, 0) = \varphi(x), x \in \mathbb{R}, 0 < t < T .$

(c)  $u(x, 0) = \varphi(x), u(0, t) = a, x \in (0, \infty), t \geq 0.$

### Reference books:

1. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi, Ludhiana, 2012. Chapters:8(8.1 to 8.4),11,12,13(13.1 to 13.3,13.7), 15(15.1, 15.5),16(16.1 only),17(17.1 to 17.3)
2. Tyn Myint-U and Lokenath Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006.
3. S.L. Ross, Differential equations, 3rd Ed., John Wiley and Sons, India, 2004.
4. B.V.Ramana, Higher Engineering Mathematics, TMH publication Co.
5. P.P.Gupta and G.S.Malik, Partial Differential Equation.
6. Sankara Rao, Introduction to Differential Equation.
7. T. Amarnath, An Elementary Course on Partial Differential Equation.

### CC 8.1: Object Oriented Programme C++

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: C++ Basics:** Flow chart and Algorithm, C++ Character Set, Tokens; **Data Handling:** C++ Data Types, Variables, Formatting Output; **Operators and Expressions:** I/o Operators, Arithmetic Operators, Increment/Decrement Operators, Relational Operators, Logical Operators, Conditional Operator, Some Other Operators; **Flow of Control:** Statements, Selection Statements, Iteration Statements, Jump Statements.

**Unit 2: Arrays:** Single dimensional Arrays , Two- Dimensional Arrays; **Functions :** Function Definition, Default Arguments, Constant Arguments, Call By Value , Call By Reference, Calling Function With Arrays, Recursion, Returning From a Function, Scope Rules.

**Unit 3: Basic Concepts of OOP:**Data Abstraction, Encapsulation, Modularity, Inheritance, Polymorphism; **Advantages and Disadvantages of OOP. Function Overloading:** Need for Function Overloading, Declaration and Definition, Restriction on Overloaded Functions, Calling Overloaded function.

**Unit 4:Classes:**Need for classes, Declaration of classes, Referencing Class Members, Array within a Class, Scope of Class and its Members, Types of Class Functions; **Data Hiding and Encapsulation;** **Functions in a Class:** Inline Functions, Constant Member Functions, The Scope resolution Operator :: ; **Using Objects:** Memory Allocation of Objects, Array of Objects, Objects as Function Arguments, Functions Returning Objects.

### CC 8.2 : Practical to be performed in Lab.

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

### Reference books:

1. A.R. Venugopal, Rajkumar, and T. Ravishanker, *Mastering C++*, TMH, 1997.
2. S.B. Lippman and J. Lajoie, *C++ Primer*, 3rd Ed., Addison Wesley, 2000.
3. Bruce Eckel, *Thinking in C++*, 2nd Ed., President, Mindview Inc., Prentice Hall.

4. D. Parsons, *Object Oriented Programming with C++*, BPB Publication.
5. Bjarne Stroustrup, *The C++ Programming Language*, 3rd Ed., Addison Welsley.
6. E. Balagurusamy, *Object Oriented Programming in C++*, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

### Semester VI:

#### **CC 9.1: RIEMANN INTEGRATION & SERIES OF FUNCTIONS (ANALYSIS-III)**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1 :Riemann integration:** Partition of a closed and bounded interval, Upper and lower Darboux sum of a bounded function with respect to a partition of an interval, Definition of Riemann integrability of a bounded function, Characterization of Reimann integrability, Continuity and Integrability, Properties of the Riemann integral, Fundamental Theorem of Calculus.

**Unit2 :Improper integral:** Definition and examples, Different Kind of improper integral and their convergence, Absolute convergent integral.

**Unit3 :Sequence and series of functions:** Point-wise and Uniform convergence of sequence of functions, Cauchy's criterion for uniform convergence of sequence of functions, Weierstrass M-test for absolute and uniform convergence of series of functions, Dedekind test for uniform convergence of series of functions, Uniform convergence and Continuity, Term-by- term integration of series, Term-by-term differentiation of series.

**Unit4 :**Power series (Cauchy Hadamard Theorem), Radius of convergence, Differentiation and integration of power series, Abel's Limit Theorem, Stirling's formula, More about Taylor's series, Weierstrass Approximation Theorem( without proof).

#### **CC 9.2 :PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Computations of Beta and Gamma functions.
2. Convergence of improper integrals for different functions.
3. Testing of uniform convergence of sequence and series of functions/ Power series.

#### **Reference books:**

1. S.C. Mallik and S. Arora-Mathematical Analysis, New Age International Ltd., New Delhi [Chapters: 9(1to9), 11 (1 to 4), 12 (1 to 5), 13 (1 to 4)].
2. K.A. Ross, *Elementary Analysis, The Theory of Calculus*, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.
3. W. Rudin, *Principles of Mathematical Analysis*.
4. R.G. Bartle D.R. Sherbert, *Introduction to Real Analysis*, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002.

5. Richard R Goldberg, Methods of Real Analysis.
6. Dipak Chatterjee, Real Analysis.
7. A. N. Kolmogorov and S. V. Fomin, Introduction to Real Analysis.
8. G. Das and S. Pattanayak-Fundamentals of Mathematics Analysis, TMH Publishing Co.

### CC 10.1: LINEAR PROGRAMMING

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1** :Introduction to linear programming problems(LPP), Mathematical formulation of the LPP with illustrations, Graphical method, General Linear programming problems, Canonical & standard form of LPP. Theory of Simplex method, Optimality and unboundedness, the Simplex algorithm, Simplex method in tableau format, Introduction to artificial variables, Two-phase method, Big-M method and their comparisons.

**Unit2 :Duality in LPP:** Introduction, General Primal-Dual pair, Formulation of the Dual problem, Primal-Dual relationships, Duality theorems, Complementary slackness theorem, Duality & Simplex method, Economic interpretation of the Duality.

**Unit3 :Transportation Problem(TP):** LP formulation of TP, Existence of solution and Duality in TP, Solution of Transportation problems, North-West corner method, Least-Cost method and Vogel approximation method for determination of starting basic solution, Algorithm for solving transportation problem, Assignment problem and its mathematical formulation, Solution methods of Assignment problem, Special cases in Assignment problems.

**Unit4 :**

**Games and Strategies:** Introduction, Formulation of two person zero sum games, solving two person zero sum games, Maximin-Minimax principle, Games without saddle points, Games with mixed strategies, Graphical solution procedure to  $(2 \times n)$  and  $(m \times 2)$  games.

### CC 10.2 : PRACTICAL

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

Activity oriented problem solving/ experiments based on the content studied in theory.

### Reference books:

1. Kanti Swarup, P.K. Gupta and Man Mohan: Operations Research, S. Chand and Co. Pvt. Ltd.
2. P.K. Gupta and D.S. Hira-Operations Research, S. Chand and Company Pvt. Ltd., New Delhi. [Chapters : 2, 3, 4]
3. G. Hadley, Linear Programming, Narosa Publishing House, New Delhi, 2002.
4. N.V.R. Naidu, G. Rajendra and T. Krishna Rao-Operations Research, I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
5. R. Veerachamy and V. Ravi Kumar-Operations Research- I.K. International Publishing House Pvt. Ltd., New Delhi, Bangalore.
6. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004.

7. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009

### CC 11.1: NUMERICAL ANALYSIS

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1** :Rate of convergence, Algorithms, Errors: Relative, Absolute, Round off, Truncation. Numerical solution of non-linear equations: Bisection method, Regular-Falsi method, Secant method, Newton-Raphson method, Fixed-point Iteration method, Rate of convergence of these methods.

**Unit2** :System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

**Unit3** :Polynomial interpolation: Existence uniqueness of interpolating polynomials, Lagrange and Newtons divided difference interpolation, Error in interpolation, Forward and back ward difference operator Central difference & averaging operators, Gauss-forward and backward difference interpolation.

**Unit4** :Numerical Integration: Some simple quadrature rules, Newton-Cotes rules, Trapezoidal rule, Simpsons  $\frac{1}{3}$  -rd rule, Simpsons  $\frac{3}{8}$  -th rule, compound trapezoidal rule, compound Simpsons rule, Gauss-Legendre 2-point and 3-point rules. Numerical solutions of Differential Equations: Euler's Method, Modified Euler's method. Runge-Kutta Method

### CC 11.2 : PRACTICAL

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

1. Bisection Method.
2. Newton Raphson Method.
3. Secant Method.
4. Regula Falsi Method.
5. Lagrange Interpolation
6. Newton Interpolation method.
7. Compound Trapezoidal rule
8. Compound Simpson's rules.
9. Euler's Method
10. Runge-Kutta Method

### Reference books:

1. B.P. Acharya and R.N. Das, A Course on Numerical Analysis, Kalyani Publishers, New Delhi, Ludhiana. Chapters:1,3(3.1-3.4, 3.6-3.8), 8(8.1-8.4), 2 (2.1-2.9),6(6.1-6.5,6.10-6.12),7(7.1-7.7)

2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 6th Ed., New age International Publisher, India, 2007.
3. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
4. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
5. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
6. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.
7. E. Kendali Athinson, An Introduction to Numerical Analysis.
8. S. A. Mollah, An Introduction to Numerical Analysis.
9. D.C. Sanyal and K. Das, Introduction to Numerical Analysis.
10. S.S Sastry, Introductory Methods of Numerical Analysis.

### CC 12.1: PROBABILITY & STATISTICS

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1** :Events and Sample space, Probability axioms, additive theorem of probability, Independent events, Conditional probability, Multiplication theorem of probability, Bayes' theorem and its application.

**Unit 2** :Random variables, probability mass function, probability density function, distribution function(discrete and continuous) Joint probability distribution function, Marginal & conditional distributions, definition and examples of mathematical expectation, variance and covariance.

**Unit 3** :Generating function and law of large number, Some probability distributions (Discrete and Continuous case), Binomial, Poisson, Uniform, Gamma, Exponential, Beta distributions, Normal distributions, Normal approximation to the Binomial distribution, Bivariate normal distribution.

**Unit 4** :Random sampling, Estimation of Parameters, Confidence Intervals, Significance Level, Testing of hypothesis, Acceptance sampling, Regression Analysis, Fitting Straight Lines, Correlation analysis.

### CC 12.2 : PRACTICAL

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 ( Expt-15, Viva-5, Record-5)

Activity oriented problem solving/ experiments based on the content studied in theory.

### Reference Books:

1. S. Ross-A First Course in Probability, Pearson Education.Chapters:2,3,4,5 ,6(6.1 to 6.5,6.7), 7 (7.1-7.4,7.6)
2. P.C.Biswal , Probability and Statistics,PHI publication
3. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7<sup>th</sup> Ed., Pearson Education, Asia, 2006.
4. Sheldon Ross, Introduction to Probability Models, 11th Ed., Academic Press, Indian Reprint, 2007.
5. Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007.
6. S.C. Gupta and V.K. Kapoor-Fundamentals of Mathematical Statistics, S. Chand and Company Pvt. Ltd., New Delhi. [ Chapters : 3 (3.1 to 3.15), 4 (4.1 to 4.2)]
7. Kai Lai Chung, Elementary Probability Theory with Stochastic Processes, 3rd Ed., Springer International Student Edition.
8. Robert V. Hogg, Joseph W. McKean and Allen T. Craig: Introduction to Mathematical Statistics, Pearson Education, Asia, 2102.
9. J. N. Kapur and H.C. Saxena, Mathematical Statistics.
10. Prem S. Mann, Introductory Statistics.
11. D. W. Elhance, Fundamentals of Statistics.
12. Murray R Spigel, Probability and Statistics.

### Semester VIII:

#### **CC 13.1: METRIC SPACES & COMPLEX ANALYSIS (ANALYSIS-IV)**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit1 :Metric spaces:** Definition and examples, Open & Closed spheres, Neighborhoods, Interior points, Open set, Closed set, Boundary points, Limit points & isolated points, Closure of a set, Sequences in metric spaces, Convergent sequences, Cauchy sequences, Complete metric spaces, Continuity & Uniform continuity in metric space.

**Unit2 :**Limits & Continuity of complex functions, Derivatives, Differentiation formulas, Cauchy-Riemann equations, Sufficient conditions for differentiability, Analytic functions, Examples of analytic functions Cauchy Riemann equation.

**Unit3 :Complex integration:** Complex line integral,Cauchy- theorem, Cauchy- Goursat theorem (statement only), Definite integrals of functions, Cauchy integral formula, Cauchy integral formula for higher order derivative (without prof). Extension of Cauchy's integral formula to multiply connected region (statement only) to solve integral problems.

**Unit4** :Taylor series (with Proof), Laurent series (without proof) with examples, Singularities, Different types of singularity, Zeros of complex functions., Residue and its application for solving  $\int_0^{2\pi} f(\sin \theta, \cos \theta) d\theta$ .

### CC 13.2 : PRACTICAL

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

Activity oriented problem solving/ experiments based on the content studied in theory.

### Reference Books :

1. P.K. Jain and K. Ahmad: Metric Spaces, Narosa Publishing House, New Delhi.
2. James Ward Brown and Ruel V. Churchill: Complex Variables and Applications, 8th Ed., McGraw Hill International Edition, 2009.
3. John H. Mathews & Russel W. Howell, Complex Analysis for Mathematics and Engineering, 5<sup>th</sup> Edition, Jones & Batlett Publications. [Chapter 2 (2.3), 3 (3.1 to 3.31), 6 (6.1 to 6.4), 7 (7.1 to 7.4), 8 (8.1 to 8.2)].
4. G. F. Simmons, Introduction to topology and modern analysis, Robert E. Krieger Publishing Company, Malabar, Florida. [Chapter 2 (9 to 14)]
5. S.Arumugam, A.T.Isaac, A.Somasundaram-Complex Analysis, Scitech Pub.(INDIA) pvt.ltd.
6. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
7. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011.
8. S. Ponnusamy-Foundations of Complex Analysis, Alpha Science International Ltd.
9. J.B. Conway-Functions of one complex variable, Springer.
10. N. Das- Complex Function Theory, Allied Publishers Pvt. Ltd., Mumbai.
11. Merk, J. Ablowitz and Athanassias S. Fokas, Introduction and Applications of Complex Analysis.
12. A. R. Vasishta, Complex Analysis.

### CC 14.1: LINEAR ALGEBRA (ALGEBRA-III)

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

**Unit1** :Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces.

**Unit2** :Linear transformations, null space, range, rank and nullity of a linear transformation, the algebra of linear transformations, Isomorphism, Representation of a linear transformation by matrices, algebra of linear transformations. Isomorphisms.

**Unit3** :Eigenvalues, eigenvectors of a linear transformation, linear independence of eigenvectors corresponding to different eigenvalues, characteristic polynomials. Caley-Hamilton theorem, minimum polynomial, Jordan canonical form.

**Unit4** :Introduction to Inner Product spaces, Definitions and examples of Inner Product Spaces, Parallelogram law, Schwarz's inequality, triangular inequality.

### Reference Books:

1. K. Hoffman, R. Kunze, Linear Algebra, Chapter[ 2(2.1 to 2.3), 3(3.1, 3.2, 3.3, 3.4), 6(6.1, 6.2, 6.3), 7(7.3), 8(8.1 to 8.5)]
2. David C. Lay, Linear Algebra and its Applications, 3rd Ed.

3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2004.
4. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
5. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999.
6. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.
7. A. R. Vashistha and J. N. Sharma, Linear Algebra.
8. Surjit Singh, Linear Algebra.

#### CC 14.2 : Practical

Contact Hours Per Week : 2  
 Examination Duration : 3 Hours  
 Maximum Marks : 25 ( Expt-15, Viva-5, Record-5)

1. Vector space and sub space, basic and dimension counter examples.
2. Linear transformation, identification of rank and nullity of a linear transformation.
3. Eigenvalues, eigenvectors of a linear transformation.
4. Application of Caley-Hamilton theorem, minimum polynomial.
5. Inner product spaces.

#### Mathematics-DSE-II: Project cum Seminar

Contact Hours per Week : 4  
 Credit : 4  
 Maximum Marks : 100

The students will complete the project work under the guidance of members of faculty. Regular monitoring as per the steps/processes indicated below is essential. Weightage as indicated against each step is to be assigned through seminar/workshop mode.

Identification of problem	Review of literature	Methodology	Analysis	Findings	Viva-voice	Total
10	10	15	15	20	30	100
Internal				Internal and External		

## **PROGRAM STRUCTURE: ZOOLOGY (HONS.)**

<b>Sem-ester</b>	<b>AECC</b>	<b>CC (Hons) Zoology</b>	<b>GE-I* Chemistry</b>	<b>GE-II* Botany</b>	<b>DSE</b>	<b>SEC</b>	<b>Education</b>	<b>CBC*</b>
I	AECC-1 Communicative English	CC-1 (Th+Pr)	GE-1 (Th+Pr)	GE-1 (Th+Pr)			PE-1 EPC-1	
II		CC-2 (Th+Pr)	GE-2(Th+Pr),	GE-2 (Th+Pr)		SEC- (Th+Pr)	PE-2 CPS-1	
III	AECC-2 (Environmental Studies)	CC-3 (Th+Pr)	GE-3(Th+Pr),	GE-3 (Th+Pr)			PE-3 PE-4	
IV		CC-4 (Th+Pr)	GE-4(Th+Pr),	GE-4 (Th+Pr)	DSE-I (Th+Pr)		PE-5 PE-6	
V		CC-5 (Th+Pr) CC-6 (Th+Pr) CC-7 (Th+Pr) CC-8 (Th+Pr)					CPS2-1 CPS3-1 EPC-2	
VI		CC-9 (Th+Pr) CC-10 (Th+Pr) CC-11(Th+Pr) CC-12(Th+Pr)					CPS2-2, CPS3-2, FE-1	CBC
VII							PE-7, EPC-3 EPC-4, FE-2	
VIII		CC-13 (Th+Pr) CC-14(Th+Pr)			DSE-II (Project)		PE-8, EPC-5, EPC-6, EPC-7, FE-3	

\*GE (Chemistry) is equivalent to CC (Chemistry)

\*GE (Botany) is equivalent to CC (Botany)

## ZOOLOGY

### SCHEME OF EXAMINATION

#### Semester-I

<b>GE/CC1.1 :</b>	<b>(Animal diversity, Non-chordates) (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>	<b>75marks</b>
	Unit 1 : Systematics and Classification	
	Unit 2 : Protozoa to Helminths	
	Unit 3 : Annelida and Arthropoda	
	Unit 4 : Mollusca and Echinodermata	
<b>GE/CC1.2 :</b>	<b>Practical</b>	<b>25marks</b>

#### Semester-II

<b>GE/CC2.1 :</b>	<b>(Animal diversity (Chordates) (Terminal-60, Sessional - 15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>	<b>75marks</b>
	Unit 1 : Chordate ancestry and Protochordate	
	Unit 2 : Cyclostomata and Pisces	
	Unit 3 : Amphibia and Reptilia	
	Unit 4 : Aves and Mammalia	
<b>SEC 1 :</b>	<b>Aquaculture(Terminal –40, Sessional – 10)</b> <b>Credit – 4 : (Theory – 02, Practical – 02)</b>	<b>50marks</b>
	Unit 1 : Aquaculture- Concept and Diversity	
	Unit 2 : Fresh water aquaculture	
<b>SEC 2 :</b>	<b>Practical</b>	<b>50marks</b>
<b>GE/CC2.2 :</b>	<b>Practical</b>	<b>25marks</b>

#### Semester-III

<b>GE/CC 3.1 :</b>	<b>(Histology, Embryology &amp; Ethology ) (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>	<b>75marks</b>
	Unit 1 : Histology	
	Unit 2 : Embryology – 1	
	Unit 3 : Embryology – 2	
	Unit 4 : Ethology	
<b>GE/CC3.2 :</b>	<b>Practical</b>	<b>25marks</b>

#### Semester-IV

<b>GE/CC4.1 :</b>	<b>(Human physiology &amp; Comparative Anatomy)</b> <b>(Terminal- 60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>	<b>75marks</b>
	Unit 1 : Digestion and Excretion	
	Unit 2 : Respiration and Circulation	
	Unit 3 : Nervous System and Endocrinology	
	Unit 4 : Comparative Anatomy	
<b>GE/CC4.2 :</b>	<b>Practical</b>	<b>25marks</b>

**(Opt. any one)**

<b>DSE I (Choice-1)</b>	<b>I.1.1: Economic And Applied Zoology</b> <b>(Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>	<b>75marks</b>
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	Unit 1 :	Human Diseases	
	Unit 2 :	Economically Important Insects	
	Unit 3 :	Fish and Fisheries	
	Unit 4 :	Animal Husbandry	
<b>DSE I.1.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>DSE II (Choice-2)</b>	<b>I.2.1: Animal Behaviour</b>		
		<b>(Terminal-60, Sessional-15)</b>	<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Introduction and Mechanisms of Behaviour	
	Unit 2 :	Patterns of Behaviour	
	Unit 3 :	Social Behaviour	
	Unit 4 :	Sexual Behaviour and Biological Clocks	
<b>DSE I.2.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b><u>Semester-V</u></b>			
<b>CC 5.1 :</b>	<b>Cytology (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Cell: Types and Membrane Transport	
	Unit 2 :	Cell Organelles	
	Unit 3 :	Cytoskeleton and Chromosomes	
	Unit 4 :	Cell Division	
<b>CC 5.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 6.1 :</b>	<b>Genetics</b>		<b>75marks</b>
		<b>(Terminal-60,Sessional-15)</b>	
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Mendelian and Non-Mendelian Concepts	
	Unit 2 :	Multiple alleles and Chromosomal Mutation	
	Unit 3 :	Linkage and Crossingover	
	Unit 4 :	Sex Determination and Sex linked inheritance	
<b>CC 6.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 7.1 :</b>	<b>Comparative anatomy &amp; evolution(Terminal-60,Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Integument and Circulatory System	
	Unit 2 :	Respiratory, Nervous and Urinogenital Systems	
	Unit 3 :	Evolution – 1	
	Unit 4 :	Evolution – 2	
<b>CC 7.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 8.1</b>	<b>Biochemistry</b>		<b>75marks</b>
		<b>(Terminal-60, Sessional-15)</b>	
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Structural Biochemistry	
	Unit 2 :	Metabolism – 1	
	Unit 3 :	Metabolism – 2	
	Unit 4 :	Enzymology	
<b>CC 8.2 :</b>	<b>Practical</b>		<b>25mark</b>
<b><u>Semester-VI</u></b>			
<b>CC 9.1</b>	<b>Molecular Biology &amp; Instrumentation (Terminal-60, Sessional-15)</b>		<b>75marks</b>
		<b>Credit – 6 : (Theory – 04, Practical – 02)</b>	
	Unit 1 :	Nucleic acids	
	Unit 2 :	Gene Expression - 1	
	Unit 3 :	Gene Expression - 2	

<b>CC 9.2 :</b>	Unit 4 : <b>Practical</b>	Instrumentation	<b>25marks</b>
<b>CC 10.1</b>	<b>Animal physiology (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>		<b>75marks</b>
	Unit 1 :	pH, Buffers and Principles of Homoestasis	
	Unit 2 :	Physiology of Circulation and Excretion	
	Unit 3 :	Nerve and Muscle physiology	
	Unit 4 :	Physiology of Respiration and Sense Organs	
<b>CC 10.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 11.1</b>	<b>Endocrinology &amp; Immunology (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>		<b>75marks</b>
	Unit 1 :	Endocrinology - 1	
	Unit 2 :	Endocrinology - 2	
	Unit 3 :	Immunology - 1	
	Unit 4 :	Immunology - 2	
<b>CC 11.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 12.1</b>	<b>Developmental Biology (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>		<b>75marks</b>
	Unit 1 :	Principle of development and Gametogenesis	
	Unit 2 :	Developments of Frog and Chick	
	Unit 3 :	Regeneration and Parthenogenesis	
	Unit 4 :	Reproductive biology	
<b>CC 12.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CBC* :</b>	<b>Food Nutrition and Public Health (Terminal-80, Sessional-20)</b>		<b>100 marks</b>
	Unit 1 :	Food and Nutrients	
	Unit 2 :	Nutritional Disorders	
	Unit 3 :	Health and Communicable Diseases	
	Unit 4 :	Non Communicable Diseases	
<b><u>Semester-VIII</u></b>			
<b>CC 13.1</b>	<b>Biotechnology &amp; Microbiology (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>		<b>75marks</b>
	Unit 1 :	Genetic engineering	
	Unit 2 :	Recombinant DNA technology	
	Unit 3 :	Animal Biotechnology	
	Unit 4 :	Microbiology	
<b>CC 13.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>CC 14.1</b>	<b>Ecology &amp; Biostatistics (Terminal-60, Sessional-15)</b> <b>Credit – 6 : (Theory – 04, Practical – 02)</b>		<b>75marks</b>
	Unit 1 :	Introduction to Ecology and Ecosystem	
	Unit 2 :	Population ecology	
	Unit 3 :	Community Ecology	
	Unit 4 :	Biostatistics	
<b>CC 14.2 :</b>	<b>Practical</b>		<b>25marks</b>
<b>DSE II :</b>	<b>Project</b>		<b>100marks</b>

**Project(Credit-4)**

<b>Identification of problem</b>	<b>Review of literature</b>	<b>Methodology</b>	<b>Analysis</b>	<b>Findings</b>	<b>Viva-voice</b>	<b>Total</b>
10	10	15	15	20	30	100
Internal				Internal and External		

**Objectives:****The prospective teachers' trainee would be able to –**

- Appreciate and understand the diversity of form, structure and function of the animal kingdom.
- Acquire knowledge about habits, habitats and life history of different animals.
- State the classification of various phyla up to class and order level with suitable examples.
- Understand affinities and phylogenetic position of the organisms.
- Acquire knowledge and understanding on the vital life processes that sustain the organisms.
- Understand concept of prokaryote, eukaryote cell types and their structure and function of sub cellular components.
- State the structure and chemical composition of chromosomes and their behaviour during division.
- Understand principle of inheritance of characters from one generation to another.
- Have knowledge and understanding on the importance of the endocrine system and the structure and functional significance of the endocrine glands.
- Have knowledge on definite chromosomes that determine sex of the individual and certain diseases are sex linked.
- Appreciate physiological mechanism of different system present in animals.
- Understand structure, function and importance of the tissues like muscles and nerves.
- Appreciate the natural diversity and learn principle and scope of ecology, ecosystem and biosphere.
- Understand principle of physical and chemical organisation of protoplasm.
- Acquire knowledge related to metabolism of the life supporting bio molecules.
- Appreciate internal anatomical diversity of various systems of animals and their adaptive modification.
- State the composition and function of blood, cardiacycle, blood factor and its regulation.
- Appreciate the inter and intra specific biotic relationship vis-à-vis the abiotic environmental components.

- Appreciate need for protection of the environment, animals and plants and their conservation.
- Conversant with the modern areas of biology.
- Have in-depth understanding on vertebrate developmental biology and principles of gametogenesis, fertilization, cleavage, gastrulation and placentation.
- Conversant with various bio statistical techniques to logically interpret the biological phenomenon as to their consistency and feasibility for stimulation and modelling of the life.
- Identify the diverse animals (invertebrate and vertebrates) and be conversant with their habitat and adaptations.
- Develop competency to make microscopy preparation for detail cellular and sub cellular studies.
- Acquire skill of making permanent slides and learn the Microtomy techniques.
- Estimate and find out the physicochemical characteristics of different water samples.
- Develop skill of collecting, fixing and preserving the plankton, nekton and benthos.
- Develop experimental abilities in qualitative and quantitative testing of biochemical samples.
- Convergent with principles of chromatography, pH measurement and buffering action of blood plasma.
- Develop skills and abilities in the preparation of models of different chemical bonds of micro molecules.
- Solving biostatistical problems with regards to mean and SD and preparation of frequency tables, frequency Polygon and frequency histogram.
- To identify and differentiate different types of eggs and cleavage patterns and developmental stages of chick and frog.
- Determination of some components of blood and preparing slides of blood cells.
- Identify and recognise the different poisonous and non-poisonous snake in India.
- Have hands on experience and demonstrative abilities in action of enzymes and the effect of some factors on them.
- Develop abilities to prepare records/ illustrations of the various activities carried out in laboratory and prepare filled note on biodiversity.
- Develop ability to confidently communicate the principle behind the practical exercises carried out by him or her.
- Learn skills of identification of different types of animal cultured.
- Develop skill of identification of fish.
- Analyse various parameter of fish ponds.
- Determine physio- chemical parameter of pond water.

## **ZOOLOGY**

### **Semester I**

#### **GE/CC1.1: Animal Diversity (Non-Chordata)**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### **Unit 1 : Systematic and Classification :**

- Study of systematics and classification, Taxonomic Hierarchy
- Principles and types of classification: classification of Animal kingdom
- General characteristics, classification of different non-chordate (Protozoa, Porifera, Coelenterata, Annelida, Helminthes, Mollusca, Arthropoda, Echinodermata) upto classes with examples

#### **Unit 2 : Protozoa to Helminthes**

- Locomotion, nutrition and reproduction in protozoa
- Canal system in porifera
- Polymorphism in coelenterates/cnidaria
- Corals & coral reefs
- Parasitism and parasitic adaptation in Helminthes

#### **Unit 3: Annelida and Arthropoda**

- Metamerism and excretion in Annelids
- Respiration and Excretion in Arthropods
- Mouth parts in Insects
- Larval forms in crustacea
- Onychophora- structural organization & affinity

#### **Unit 4 : Mollusca and Echinidermata**

- Digestion, respiration & excretion in( Pila & unio)
- Torsion and detorsion in Gastropods
- Water vascular system in Echinodermata
- Larval forms of Echinodermata

#### **GE/CC1.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Study of permanent slides : Amoeba, Paramecium, Paramecium conjugation, Paramecium binary fission, Plasmodium, Vorticella, Sponge spicules, Sponge gemmules obelia medusa, Taenia solium, Fasciola, Larval stages of Fasciola, Crustaceans Larva( Mysis, Megalopa, Nauplius, Zoa), Larval forms Echinoderm, Glochidium larva

2. Study of Museum Specimen : Sycon, Obelia Colony, Hydra with Bud, Aurelia, Metridium, Male and female Ascaris, Fasciola hepatica, Taenia solium, Nereis, Aphrodite, Heteronereis, Centipede, Limulus, Peripatus.
3. Study of Museum Specimen : Chiton, Sepia, Loligo, Pila, Dentalium, Octopus, Nautilus, Astropecten, Clypeaster, Cucumaria, Antedon, Echinus
4. Temporary Slide Preparation: Sponge spicules, Sponge Gemmules, Spermatheca of Earthworm, Parapodia of Nereis, Mouth parts and salivary gland of Cockroach, Appendages and exoskeleton of Prawn.
5. Culture of Euglena and Paramecium.
6. Any other suitable activities/experiment
7. Submission of sessional preparations

#### Reference Books :

1. Barnes, R.D. Invertebrate Zoology (2006) VI Edition. Holt Saunders International Edition.
2. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. & J.I., Spicer (2002) The Invertebrates: A New Synthesis. III Edition. Blackwell Science.
3. Barrington, E.J.W. (1979) Invertebrate Structure and Functions. II Edition. E.L.B.S. and Nelson.
4. Boradale, L.A. and Potts, E.A. (1961) Invertebrates: A Manual for the use of Students. Asia Publishing Home.
5. Bushbaum, R. (1964) Animals without Backbones. University of Chicago Press.
6. Kotpal, R.L. (2014) Modern text book of Zoology, Invertebrates, 11<sup>th</sup> Education, Rostogi Publications, Meerut.
7. Ruppert and Barnes, R.D. (2006), Invertebrates Zoology, VII Edition, Hault Saunders International Edition.

### Semester – II

#### GE/CC 2.1: Animal Diversity (Chordata)

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit 1: Chordata Ancestry and Protochordata

- General characters and classification of chordate upto classes with examples, chordate ancestry.
- General characters and classification of protochordata
- Protochordata: Balanoglossus, Herdmania, Amphioxus - morphology, digestion, respiration and reproduction. Interrelationship among protochordates

#### Unit 2: Cyclostomata and Pisces

- General characters and classification of cyclostomata and pisces upto orders with examples
- Petromyzon and Myxine- external morphology, affinity and phylogenetic position, Amocoete larva
- Circulation and respiration in scoliodon
- Accessory respiratory organ in fishes

#### Unit 3: Amphibia and Reptilia

- General characters and classification of Amphibia and Reptilia upto orders with suitable examples
- Origin of tetrapods. Parental care and neoteny in Amphibia
- Poisonous and Non- poisonous snakes. Poisonous apparatus and biting mechanism

- Structural, peculiarities and Affinities of sphenodon
- Adaptive radiation in reptiles

#### **Unit 4:Aves and Mammalia**

- General character and classification of aves upto subclass and mammalian upto orders with examples
- Respiration and flight adaptation in Birds
- Migration in birds
- Archaeopteryx : structure and affinities
- Peculiarities and affinities of prototheria and metatheria
- Adaptation in cetacean and chiroptera

#### **GE/CC 2.2:Practical**

Contact Hour Per Week : 2

Examination duration : 3 Hours

Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Study of permanent slides and museum specimens (Protochordata and cyclostomata): Herdmania, Amphioxus, Petromyzon, Myxine, and Balanoglossus. T.S through pharynx, oral hood, Gizzard and intestine of Amphioxus. T.S through proboscis, collar and trunk region of Balanoglossus .
2. Pisces and Amphibia: Pristis, Torpedo, Ophiocephalus, Hippocampus, Chimaera, Lepidosiren, Exocoetus, Hyla, Rachophorus, Salamander, Axoltol larva, Alytes, Triton, Urotyphlus, T.S through pancreas, liver, intestine, ovary and testis of frog, placoid, ctenoid and cycloid scales of Fish.
3. Reptilia, Aves and Mammalia: Calotes, Uromatrix, Chamaleon, Draco, Cobra, Kingfisher, Parrot, Owl, Duck, Koel, Bat, Rat and Rabbit, T.S through Skin, Stomach and Spinal cord of Mammal.
4. Osteology: Study of skull, vertebrae, Limbs and girdle bones of mammal
5. Temporary slide preparation of placoid, ctenoid and cycloid scales
6. Collection of feathers and photograph of beaks and legs
7. Collection and preparation of album of chordate diversity
8. Any other suitable activities/experiment
9. Submission of sessional preparations

#### **Reference Books :**

1. Darlington P.J. (1980), The Geographical distribution of animals, R.E., Kriger Publication Co.
2. Hall B.K. and Hallgrimsson B. (2008). Strickberger's Evolution. IV Edition. Jones and Bartlett Publishers, Inc.
3. Hilderbrand, M. and Gaslow G.E. (2002), Analysis of Vertebrate Structure, John Wiley and Sons.
4. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
5. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
6. Kotpal, R.L. (2014) Modern text book of Zoology, Vertebrates, 11<sup>th</sup> Edition, Rostogi Publications, Meerut.
7. Pough H. (2012), Vertebrate life, VIII Edition, Pearson Internation.
8. Young, J.Z. (2004). The life of vertebrates. III Edition. Oxford university press.

**SEC 1 : Aquaculture**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	2 hours
Maximum Marks	:	50 (Terminal-40, Sessional-10)

**Unit 1: Aquaculture; concept and diversity**

- Basic concept of aquaculture, Aquaculture resources and production potential in india
- Types of aquaculture in practice ( inlandwater, cage culture , pen culture)
- Diversity in aquaculture : Food fishes , ornamental fish ,Pearls, see weed
- Types of nets and hapa commonly used in aquaculture ( drag net, bottom net, cast net, gill net, scope net, breeding hapa, outer hatching hapa, inner hatching hapa , fry conditioning hapa)
- Design ,construction and management of fish farm
- Physico-chemical parameters of pond water and soil
- Plankton and productivity of ponds, fertilizers and manuring

**Unit 2: Freshwater aquaculture**

- Morphology and reproduction of common cultivable species ( major carps, magur , Tilapia)
- Grow out culture of magur ( clariasbatracus): seed stocking, feeding, predation control water management
- Grow out freshwater prawn (*Macrobrachium rosenburgii*) culture: pond preparation, stocking of juveniles, food and feed management and harvest
- Principles of induced breeding and seed production in Indian major carps and magur
- Breeding and culture of selected ornamental fishes ( Gold fish, rosibarb, moli, gopi)
- Common diseases of carps ( Gills and fin rot, epizooticulcerative syndrome, argulosis)
- Conventional fish feed ingredients and its availability
- Methods and formulation of fish feed ( mash, dough, hand pellets, extuded or floating pellet) for carps, catfishes, prawns, shrimps

**SEC 2 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	50(Expt 25,Viva-voce 15,Record 10)

1. Learning skill of identification of Fresh water and brackish water fishes.
2. Analysis of physico chemical parameter of fish ponds, estimation of nutrients(nitrite,silicon-silicate)
3. Demonstration ,dissection and extraction of Pituitary preparation for induced breeding
4. Formulation and preparation of Fish feed
5. Collection and Identification of different type of plankton
6. Prepatation and identification of scales of fishes
7. Preparation of album related to acquaculture
8. Visit to Fresh water aquaculture centres to have hands on experiences.
9. Any others suitable experiments/ activities.
10. Submission of sessional preparations

**Reference Books :**

1. Jhingran, V.G. (1975), Fish and Fisheries in India Vol- 1, Hindustan Publishing Corporation, New Delhi

2. Jhingran, V.G. (1975), Fish and Fisheries in India Vol- 2, Hindustan Publishing Corporation, New Delhi
3. Khanna, S.S. and Singh, H.R., A text book of Fish biology and fisheries, 3<sup>rd</sup> Edition, Narendra Publishing House.
4. Norman, J.R. (1963), A History of fishes, Hill and Wang Publishers.
5. Srivastava, C.B.L. (2008), Fish Biology, Narendra Publishing House.
6. Sukla and G.S. and Upadhyaya, V.B. (2014), Economic Zoology, 5<sup>th</sup> Edition, Rastogi Publication, Meerut, New Delhi.

### **Semester – III**

#### **GE/CC 3.1: Histology, Embryology and Ethology**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### **Unit 1: Histology**

- Tissues : Types, structure and function
- Epithelial tissues : Simple epithelium and compound epithelium
- Connective tissue : Structure and functions of connective tissue, skeletal tissue and fluid connective tissue
- Muscular tissue: Skeletal, cardiac & smooth muscles
- Nervous tissue : Structure and types of neuron and neuroglia

#### **Unit 2 : Embryology - 1**

- Gametes: structure and types; spermatogenesis and oogenesis, control and significance
- Fertilization: Mechanism and significance
- Cleavage: types and patterns, Influence of yolk on nature of cleavage

#### **Unit 3 : Embryology - 2**

- Gastrulation: Morphogenetic movement,
- Early development of amphioxus & frog upto 3 germ layers,
- Fate of germ layers, Fate map,
- Placenta in mammals : structure , types and function

#### **Unit 4 :Origin & history of Ethology**

- Innate behavior, Instinct, stimulus filtering pattern of behavior: Reflexes, Orientation and learning, foraging behavior, Territorial behavior,
- Altruism and Group leaving,
- Biological clock and its advantages,
- Social behavior in honey bee

#### **GE/CC 3.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Study of permanent embryological slides of frog
2. Study of developmental stages of toad/frog.
3. Study of Permanent slides of different tissues

4. Preparation of slide of blood smear.
5. Preparation of slide of bucal epithelial cells
6. Study of T.S of Ovary of frog and T.S of testis of frog
7. Collection of Honeybee types, termites, ants, bee hives
8. Identification of some vertebrate tissue sections.
9. Study of animal adaptations in different habitat : Morphological, physiological with specific reference to excretion
10. Any other suitable activities/experiment
11. Submission of sessional preparations

### Reference Books :

1. Agarwal, V.K. and Gupta Usha (2002) Ecology and Ethology, S. Chand and Co. Ltd., New Delhi.
2. Balinsky, B.I. and Fabian, B.C. (2012), An Introduction to Embryology, V<sup>th</sup> Edition, International Thompson Computer Press.
3. Biological Rhythms, Vinod Kumar (2002), Narosa Publishing House, Delhi / Springer, Germany.
4. Devid, McFarland (1999), Animal Behaviour, Pitman Publishing Limited, London, U.K.
5. Gilbert, S.F. (2010) Developmental Biology, IXth Edition, Sinauer Associates, Inc. Publisher, Sunderland, Massachusetts, USA.
6. Kardong, K.V. (2005) Vertebrates Comparative Anatomy, Function and evolution. IV Edition. McGraw-Hill Higher Education.
7. Kent, G.C. and Carr R.K. (2000). Comparative Anatomy of the Vertebrates. IX Edition. The McGraw-Hill Companies.
8. Mathur, R. (2014) Animal Behaviour, Rastogi Publications.
9. Weichert, C.K. (1970). Anatomy of Chordate. McGraw Hill.
10. Young, J.Z. (2004). The life of Vertebrates. III Edition. Oxford University Press.

### Semester - IV

#### **GE/CC 4.1: Human physiology and Comparative anatomy**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### **Unit 1:**

##### **Digestion & Excretion**

- Gastrointestinal tract & associated glands , Role of enzymes & hormone in digestion
- Digestion , absorption & assimilation ( carbohydrates, proteins & fats)
- Minerals, vitamins
- Nutritional Deficiency disorders
- Structure of Nephron, mechanism of urine formation & regulation

#### **Unit 2:**

##### **Respiration & circulation**

- Human respiratory system, mechanism of breathing & regulation
- Pulmonary volumes, transport of O<sub>2</sub> & CO<sub>2</sub> , CO poisoning
- Composition of blood & lymph
- Blood coagulation

- Structure & function of heart of human, blood pressure

### Unit 3:

#### **Nervous system & Endocrinology**

- Nerve cells , glial cells, autonomic nervous system.
- Reflex action & types
- Location of endocrine glands, Hormones: chemical nature, and structure and function of endocrine glands ( elementary idea)
- Mode of hormone action feed back control

### Unit 4:

#### **Comparative Anatomy**

- Comparative studies in Fishes, Amphibians, Reptiles, Birds, Mammals of the following systems
- Integumentary system
- Urinogenital system: evolution of vertebrate kidney and urinogenital system
- Circulatory system- Heart: structure

#### **GE/CC 4.2:Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Study of sections of mammalian oesophagus , stomach, duodenum, ileum, large intestine, liver, trachea, lungs & kidney
2. Counting RBC's by haemocytometer
3. Total count of WBC by haemocytometer
4. Determination of Haemoglobin percentage
5. Demonstration of unconditioned reflex ( knee jerk)
6. Preparation of haemin & haemochromagen crystals
7. Study of skull of Reptiles , Birds & Mammals
8. Any other suitable activities/experiment
9. Submission of sessional preparations

#### **Books for reference**

1. Arey LB ( 1974) Human histology, IV edition, WB Saunders
2. Chatterjee CC ( 2008) Human Physiology. Vol I and II Medical allied agency, Kolkata
3. Eroschenkon VP ( 2008) di Fiore's Atlas of histology with functional correlations, XII edition, Lipinocot W & wilkins.
4. Gyton AC, Hall JE ( 2006) Text book of medical physiology XI edition, Hercourt Asia PTE Ltd.
5. Hleichert CK & William Presch (1970) elements of chordate anatomy, Tata Mc Graw- Hill, New York.
6. Kent GC, Carr RK (2000) Comparative anatomy of vertebrate, 9<sup>th</sup> edition, McGraw- Hill Companies New york.
7. Tortora GJ, Grabowski S (2006) , Principles of anatomy & physiology, XI edition, John wiley & sons

**(Opt. any one)**

**DSE-I (Choice-1) I.1.1 : Economic And Applied Zoology**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:**

**Human Diseases**

- Protozoan parasites and human diseases (plasmodium and trypanosome)
- Nematode parasites and human diseases (Round worm, Hook worm and filarial worm),
- Non communicable diseases (CVD, Cancer),
- Communicable diseases (AIDS, Dengue, Flu),
- Drug misuse

**Unit 2:**

**Economically Important insects**

- Economically Important insects; Apiculture, Sericulture, Lac culture, vermi culture and vermicomposting,
- Insect – pest management (chemical and biological)

**Unit 3:**

**Pisciculture**

- Construction and management of fish farms.
- Induced breeding
- Fish diseases
- fish nutrition
- value added fishery by products
- Preparation and maintenance of fish aquarium

**Unit 4:**

**Animal Husbandry**

- Dairy farming, Cattle management ,Exotic cattle breed, dairy products,
- Poultry farming; definition, historical background,advantages, differene breeds of fowl and their origin
- Goattery ; feeding and breeding of goats and goat products
- Piggery; different breeds and their products, advantage of pig farming
- Pharmaceuticals from animals

**DSE I.2 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 (Expt-15, Viva-5, Record-5)

1. Study of different types of bees( Queen , Drones, Workers)
2. Study of different types of silk moths , cocoons
3. Study of different types of pearl
4. Identification of localy available fishes

5. Formulation and preparation of fish feeds
6. Identification of various types of Natural Silk fibres
7. Study of diseases of silkworms
8. Submission of Report on visit to any one of following: Apiculture unit, dairy farm and poultry farm, prawn and fish farm.
9. Collection of photographs of various diseased persons
10. Preparation of edible and ornamental fish album

### Reference Books :

1. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributers.
2. Atwal, A. S. (1993) Agricultural Pests of India and South East Asia. Kalyani Publishers, New Delhi.
3. Chaudhury, S.K. (1996) Practice of fertility Control, A Comprehensive Textbook. B.I.ChurchillLivingston Pvt Ltd, India.
4. Dunham R.A. (2004) Aquaculture and Fisheries Biotechnology Genetic Approaches. CABI publication
5. Hafez, E. S. E. (1962). Reproduction in Farm Animals. Lea & Fabiger Publisher.
6. Hafez, E. S. E. and Evans, T. N. (1973). Human Reproduction: Contraception and Conception. Harperand Row, New York.
7. Knobil, E. & Neill, J.D. (2006) The Physiology of Reproduction, Vol. 2, Elsevier Pub.
8. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.
9. Pradhan, S (1983) Insect Pests of Crops. National Book Trust, India.
10. Prost, P.J. (1962) Apiculture. Oxford and IBH, New Delhi.
11. Srivastava, C.B.L. (1999) Fishery Science and Indian Fisheries. Kitab Mahal publications, India.

### DSE II(Choice-2)I.2.1 : Animal Behaviour

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### Unit 1 :

##### Introduction and Mechanisms of Behaviour :

Origin and History of Ethology; Brief profiles of Karl von Frisch, Ivan Pavlov, Konrad Lorenz, Niko Tinbergen; Proximate and ultimate behavior; Objective of behavior, Behaviour as a basis of evolution; Behaviour as a discipline of science; Innate behaviour, Instinct, Stimulus filtering, Sign stimuli and Code breakers as a discipline of science.

#### Unit 2 :

##### Patterns of Behaviour

**Reflexes:** Types of reflexes, reflex path, characteristics of reflexes (latency, after discharge, summation, fatigue, inhibition) and its comparison with complex behavior.

**Orientation :** Primary and secondary orientation; kinesis-orthokinesis, klinokinesis; taxis tropotaxis and klinotaxis and menotaxis (light compass orientation) and mnemotaxis.

**Learning :** Associative learning, classical and operant conditioning, Habituation and Imprinting.

#### Unit 3 :

##### Social Behaviour

Insects' society: Honey bee: Society organization, polytheism, foraging, round dance, waggle dance, Experiments to prove distance and direction component of dance, learning ability in honey bee, formation of new hive / queen; Reciprocal altruism. Hamilton's rule.

**Unit 4 :****Sexual Behaviour**

Asymmetry of sex, Sexual dimorphism, Mate choice, Intra-sexual selection (male rivalry), Inter-sexual selection (female choice), Infanticide, Consequences of mate choice for female fitness, Sexual conflict for male versus female parental care and Courtship behaviour in three spine stickleback.

**Biological Clocks**

Circadian rhythm, Tidal rhythm, Lunar rhythm, Advantages of biological clocks, Photic & non-photic Zeitgebers.

**Reference Books :**

1. Agarwal V K (2002) Animal Behaviour, S. Chand, New Delhi.
2. David McF (2001), Animal Behaviour. Pitman Publishing Limited, London, U.K.
3. John A (2001) Animal Behaviour, 7<sup>th</sup> Edition. Sinauer Associate iNc., USA.
4. Manning A and Dawkins MS. (1998) An introduction of Animal Behaviour. Cambridge University Press, USA.
5. Mathur R (2014), Animal Behaviour, Rastogi Publications, Meerut.
6. Mohanty PK (2000) Illustrated Dictionary of Biology, Kalyani Publishers, Ludhiana,
7. Paul WS and John A (2013) Exploring Animal Behaviour, 6<sup>th</sup> Edition. Sinauer Associate Inc. Massachusetts, USA.

**DSE I.2.1 : PRACTICAL**

Contact Hours Per Week	:	2
Examination Duration	:	3 Hours
Maximum Marks	:	25 (Expt-15, Viva-5, Record-5)

1. To study different types of animal behavior such as habituation, social life, courtship behavior in insects, and parental care from short videos/movies and prepare a short report.
2. To study nests and nesting habits of the birds and social insects.
3. To study the behavioural responses of wood lice to dry condition.
4. To study behavioural responses of wood lice in response to humid condition.
5. To study geotaxis behavior in earthworm.
6. To study the phototaxis behavior in insect larvae.
7. Visit to Forest / Wild life Sanctuary / Biodiversity Park / Zoological Park to study behavioural activities of animals and prepare a short report.

**Semester - V****CC 5.1: Cytology**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:****Cell, Types and membrane transport**

- Prokaryotic & Eukaryotic cells, cell size & shape, phages, viroids, mycoplasma & E.coli,
- Plasma membrane: ultrastructure & various models, chemical compositions.
- Transport across membranes (Passive transport, Active transport, Bulk transport (Endocytosis & Exocytosis))
- Cell junction & plasmodesmata.

**Unit 2:****Cell Organelles**

- The endoplasmic reticulum
- Golgi apparatus, mechanism of vesicular transport
- Lysosomes, Ribosomes
- Structure & function of mitochondria: chemiosmotic hypothesis, Peroxisomes

**Unit 3:****Cytoskeleton and chromosomes**

- Cytoskeleton :microtubules and microfillaments
- Nucleus: Nuclear envelope, Nucleus Matrix, Nucleolus,
- Chromosome: structure , types, Chemical composition,
- Euchromatin and Heterochromatin

**Unit 4:****Cell Division**

- Cell cycle and regulation,
- Cell division – Mitosis and Meiosis,
- Apoptosis
- Biology of Cancer

**CC 5.2:Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Study of various stages of mitosis by permanent slide
2. Study of various stages of meiosis by permanent slides
3. Study of Prokaryotic and Eukaryotic cells
4. Temporary squash preparation of grasshopper testis, onion root tip and Onion bud
5. Study of Drumstick chromosomes
6. Study of Barr bodies in human epithelia buccal cells
7. Separation of nucleic acid bases by paper chromatography
8. Gram staining technique for visualization of prokaryotic cells
9. Any other suitable activities/experiment
10. Submission of sessional preparations

**Reference Books :**

1. Becker, w.m. Kleinsmith, L.J. Hardin.J and Bertoni G.P (2009), The world of cell, 7<sup>th</sup> edition
2. Cooper, G.M and Hausman, R.E. (2009). The cell: A molecular approach 5<sup>th</sup> edition
3. De Robertis, EDP & De Robertis, EMF. (2006), cell & molecular biology, 8<sup>th</sup> edition
4. Karp. G. (2010) cell & molecular biology: concepts & Experiment 6<sup>th</sup> edition
5. R.H. Tamarin (2001) Principles of genetics, Tata MaGraw- Hill 7<sup>th</sup> Edition.
6. Rastogi V.B. Introduction to cytology, Rastogi KNRN Publication.

**CC 6.1: Genetics**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 :****Mendelian and Non Mendelian concepts**

- Mendelian principles of Inheritance: Mendel's material and crossing techniques;
- monohybrid and dihybrid crosses; back cross and test cross;
- phenomenon of dominance;
- Law of segregation and independent assortment.
- Deviation of Mendelism: Incomplete dominance and codominance.
- Gene interactions: Epistasis, complementary genes, supplementary genes, duplicate genes , collaborator genes, lethal genes, pleiotropy

**Unit 2 :****Multiple Allelism and Chromosomal Mutation**

- Multiple alleles: Characterstics,
- ABO blood groups,
- Rh factor inheritance,
- Eye colour in Drosophila.
- Inheritance of multiple genes: Character, skin colour in man
- Chromosomal mutation:
  - Structural changes in chromosomes- deletion, duplication, inversion and translocation
  - Changes in chromosomes number – euploidy and aneuploidy

**Unit 3:****Linkage and Crossing over**

- Linkage: Characters , hypotheses,
- chromosomal theory of linkage, kinds and significance.
- Crossing over: Characters, types, mechanism, theories, kinds and significance, cytological basis of crossing over.
- Mapping of chromosome: Construction of a linkage map or genetic mapping; interference & coincidence, somatic hybridization

**Unit 4 :****Sex determination and Sex linked inheritance**

- Sex determination: Genetic ; environmental; and hormonal control
- Barr body
- Sex linked inheritance
- Sex influenced genes; sex limited genes
- Pedigree analysis

- Human genetic disorders

### CC 6.2: Practical

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Culture of *Drosophila* – study of life cycle of *Drosophila*
2. Sorting out and study of the mutants of *Drosophila* with reference to their various contrasting characters comparison to normal flies
3. Temporary preparation of polytene chromosome of *Drosophila* larvae.
4. Study of human karyotype and idiogram
5. Study of linkage, recombination, gene mapping using data
6. Temporary squash preparation to study different stages of meiosis.
7. Problems related to monohybrid, dihybrid, genetic interactions, hemophilia, colour blindness and pedigree analysis.
8. Any other suitable experiments/ activities
9. Submission of sessional preparations

### Reference Books :

1. Gardener, E.J, Simmons, M.J, Snustad, D.P (2008), Principle of Genetics, VIII th Edition, Wiley India.
2. Griffiths, A.J.F, Wessler, S.R, Lewontin, R.C & Carroll, S.B, Introduction Genetic Analysis, IXth Edition, W.H. Freeman and Co.
3. Klung, W.S, Cumming, M.R., Spenser, C.A (2012), Concept of Genetics, Xth Edition.
4. R.H. Tamarin (2001) Principles of genetics, Tata McGraw- Hill 7<sup>th</sup> Edition.
5. Russel, P.J (2009), Genetics – A molecular Approach, IIIrd Edition, Benjamin Cumming.

### CC 7.1: Comparative anatomy and evolution

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

#### Unit 1: Integument and Circulatory System

- Integument: Structure, functions and derivatives, development of scales, feathers and hairs.
- General plan of circulation, heart, aortic arches( development and evolution)

#### Unit 2:

##### Respiratory, nervous and Urinogenital System

- Respiratory system: Gills, lungs, air sacs and accessory respiratory organs in fishes
- Nervous system: Comparative account of brain.
- Urinogenital system: Evolution of kidney and urinogenital ducts.

#### Unit 3: Evolution - 1

- Evolution- I, Origin of life, Biological Evolution, Lamarkism, Darwinism, Neo Darwinism, Extinction, Mass Extinction
- Evidences: Paleontological (Fossils, Fossil records, types), Anatomical, Embryological, Molecular evidences, Convergent and Divergent evolution.
- Dating of fossils

#### Unit 4: Evolution - 2

- Evolution- II, Organic variation, Isolation and isolating mechanism, Modes of speciation, Natural selection, Darwin finches, Genetic drift, Industrial melanism, Types of Natural selection, sexual and artificial selection, Evolution of man.

**CC7.2:Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Comparative study of Skull, Limb, Vertebrae and Girdle bones of Varanus, Fowl and Mammal
2. Study of placoid, cycloid, & ctenoid scales through permanent slides
3. Study of Reptilian and Avian Scales
4. Study of carapace & plastron of turtles
5. Study of fossil evidences from plaster cast models & pictures
6. Study of homology & analogy from specimen/ pictures
7. Bioinformatics construction of phylogenetic tree
8. Construction of cladogram based on Morphological characters
9. Microtomy: Preparation of permanent histological slides(Block preparation ,cutting, stretching and staining)
10. Study of teeth and skull of Horse, Elephant and Man showing evolutionary significance ( Album preparation)
11. Field visit to Regional Museum of Natural History, Bhubaneswar
12. Any other suitable experiments/ activities
13. Submission of sessional preparations

**Reference Books :**

1. Douglas, T. Futuyma (1997), *Evolutionary Biology*, Sinauer Associates.
2. Hall, B.K and Hallgrimson, B (2008), *Evolution*, 4<sup>th</sup> Edition, John and Barlett Publishers.
3. Hiderbrand, M. and Gaslow, G.E, *Analysis of Vertebrate structure*, John Wiley and Sons.
4. Kardong, K.V (2005), *Vertebreates' comparative anatomy, function and evolution*, IV<sup>th</sup> Edition, McGraw, Hill Higher Education.
5. Kent, G.C and Carr, R.K (2000), *Comparative anatomy of the vertebrates*, IX<sup>th</sup> Edition, The McGraw Hill Companies.
6. Ridley, M (2004) *Evolution*, III Edition, Blackwell Publishing.
7. Watter H.E and Sayles, L.P., *Biology of Vertebrates*, Khosla Publishing House.
8. Yong J.Z (1981), *Life of Vertebrates*, Oxford University Press.

**CC 8.1: Biochemistry**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:****Structural Biochemistry**

- Structure and properties of carbohydrates ( mono-,di-, and polysaccharides)
- Structure and properties of amino acid and proteins (primary, secondary, tertiary and quaternary, motifs and protein folding)
- Structure & properties of lipids (steroids, FA, and triglycerides), storage and conjugated lipids, steroids, prostaglandins, and terpenoids

**Unit 2: Metabolism - 1**

- Carbohydrates: Glycolysis, TCA Cycle, Pentose phosphate pathway, glycogen metabolism, gluconeogenesis
- Protein: protein degradation, AA catabolism (General reaction of amino acid: transamination & deamination and decarboxylation), urea cycle

**Unit 3: Metabolism - 2**

- Lipids :  $\beta$ - oxidation of FAs (saturated; even & odd, Unsaturated), Biosynthesis of palmitic acid, ketogenesis
- Interrelationship between carbohydrates, proteins, & lipid metabolism
- Oxidative phosphorylation, respiratory chain in mitochondria
- ATP Synthesis

**Unit 4: Enzymology**

- Nomenclature and classification of enzymes, activation energy, factor affecting enzyme catalyzed reactions
- Enzyme kinetics: Michaelis & Menten equation
- Mechanism of enzyme action (chymotrypsin)
- Enzyme regulation
- Enzyme inhibition

**CC 8.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Identification of Carbohydrates ( monosaccharide, disaccharides, polysaccharides)
2. Preparation of Osazone Crystal
3. Identification of proteins ( Albumin, Gelatin and Caesin)
4. Identification of lipids ( saturated and unsaturated fats)
5. Study of amylase activity
6. Study of effect of pH and substrate concentration on the action of Urease.
7. Study the effect of temperature on enzyme activity
8. Detection of Urea, Uric acid , Ammonia and Creatinine in the test sample provided
9. Preparation of models of bio-molecules
10. Any other suitable experiments/ activities
11. Submission of sessional preparations

**Reference Books :**

1. Berg, J. M., Tymoczko, J. L. and Stryer, L. (2006). Biochemistry. VI Edition. W.H Freeman and Co.
2. Devsena T (2014) Enzymology, 2<sup>nd</sup> edition, Oxford University Press, U.K.
3. Hames BD, Harper NM (2009) Instant notes in biochemistry 2<sup>nd</sup> edition, BIOS Scientific Publioshers Ltd. UK.
4. Murray, R. K., Granner, D. K., Mayes, P. A. and Rodwell, V. W. (2009). Harper's Illustrated Biochemistry. XXVIII Edition. Lange Medical Books/McGraw-Hill
5. Nelson, D. L., Cox, M. M. and Lehninger, A.L. (2009). Principles of Biochemistry. IV Edition. W.H Freeman and Co.

### Semester - VI

#### **CC 9.1: Molecular Biology And Instrumentation**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

#### **Unit 1:**

##### **Nucleic Acid**

- Nucleic acids:
  - (1) DNA – salient features, Watson - Crick model, forms, Organization in eukaryotes, denaturation and renaturation.
  - (2) RNA- structure, genetic RNA, non- genetic RNA (m RNA, t RNA, r RNA).
- Replication of DNA in Prokaryotes

#### **Unit 2:**

##### **Gene Expression - 1**

- Gene mutation: Types and causes.
- DNA repair: Types and mechanism
- Gene Expression: Transcription in Prokaryotes
- Post transcriptional modification & processing of eukaryotic RNA

#### **Unit 3:**

##### **Gene Expression - 2**

- Genetic code: Features, triplet codon, Wobble hypothesis
- Gene expression: Translation in Prokaryotes
- Regulation of gene expression in prokaryotes ( Lac operon and Trp operon)
- Gene silencing, mi RNA, si RNA

#### **Unit 4:**

##### **Instrumentation**

- Instrumentation: Principles and uses of analytical instruments-
  - Microscopes ( light microscopy, electron microscopy),
  - pH meter,
  - spectrophotometer,
  - centrifuge,
  - colorimeter
  - paper chromatography

**CC 9.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Quantitative estimation of Protein and DNA using spectrophotometer.
2. Quantitative analysis of Carbohydrates( Benedict's Quantitative method)
3. Quantitative estimation of RNA
4. Separations of Amino Acids by Paper Chromatography
5. Study of DNA by Fuelgen reaction
6. Preparation of models of DNA , RNA and nucleotides
7. Study and interpretation of photograph showing DNA replication, transcription, translation
8. Measurement of pH of biological samples
9. Separation of serum
10. Any other suitable experiments/ activities
11. Submission of sessional preparations

**Reference Books :**

1. Brown, T.A. (1998). Molecular biology Labfax II: Gene analysis. II Edition. Academic Press, California, USA.
2. Butler, M. (2004). Animal cell culture and technology: The basics. II Edition. Bios scientific publishers.
3. Glick, B.R. and Pasternak, J.J. (2009). Molecular biotechnology- Principles and applications of recombinant DNA. IV Edition. ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An introduction to genetic analysis. IX Edition. Freeman & Co., N.Y., USA.
5. Watson, J.D., Gilman, M., Witkowski, J. and Zoller, M., (1983) Recombinant DNA. II Edition. Freeman and Co., N.Y., USA.
6. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA- genes and genomes- A short course. III Edition. Freeman and Co., N.Y., USA.

**CC10.1: ANIMAL PHYSIOLOGY**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1 : pH, Buffers and Principles of Homeostasis**

- pH, buffers, buffering action of blood, hydrogen ion concentrations,
- vitamins and minerals, homeostasis,
- Control of blood sugar level & blood calcium level
- thermoregulation, physiology of aging

**Unit 2 : Physiology, Circulation and Excretion**

- Composition of blood and their functions. Haematopoiesis, Coagulation of blood.
- Structure of heart, coronary circulation, origin and conduction of cardiac impulses, cardiac cycle, cardiac output and its regulation.

- Blood group
- Kidney: Structure, Renal blood supply, Ultra- structure of nephrons, mechanism of urine formation and its regulation.

### **Unit 3 : Nerve and Muscle Physiology**

- Structure of neurons, resting membrane potential, generation and conduction of action potential through the myelinated and non- myelinated nerve fibres,
- Synapse: structure and types, transmission of signal through synapse, EPSP and IPSP.
- Neuroglia cells
- Types of muscles, ultra-structure of skeletal muscles, molecular and chemical basis of muscle contraction, muscle twitch, fatigue, energetics of muscle contraction and rigor mortis.

### **Unit 4 :**

#### **Physiology of Respiration and Sense Organ**

- Lungs; structure and histology, mechanism of breathing, pulmonary volumes and capacity, transport of O<sub>2</sub> and CO<sub>2</sub>, Oxygen dissociation curve, Control of respiration, Carbon monoxide poisoning.
- Physiology of hearing, internal ear vestibule and cochlea, organ corti, auditory pathway.
- Human eye; structure
- Retinal components, photoreceptors, photo-pigments, visual pathway

### **CC10.2:Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Estimation of haemoglobin of goat/ human
2. Enumeration of RBC and WBC in given blood sample
3. Measurement of blood pressure, heartbeat and pulse rate
4. Differential count of WBC
5. Effect of different concentration of NaCl on RBC
6. Demonstration of unconditioned reflex action of knee jerk
7. Determination of bleeding time & clotting time
8. Analysis of ECG report collected from medical diagnostic lab.
9. Estimation of erythrocyte sedimentation rate in Human
10. Testing of Blood Glucose using Glucometer kit.
11. Any other suitable experiments/ activities
12. Submission of sessional preparations

### **Reference Books:**

1. Hoar, W.S (1983) General and Comparative Physiology, Prentice Hall of India, New Delhi
2. Prossor, C.L and Brown, F.A (1965) Comparative Animal Physiology, Prentice Hall of India, New Delhi.
3. Chatterjee, C.C. (1986) Human Physiology, Vol. I and II, Medical Allied Agency, Kolkata.
4. Guyton, A.C (2016), Text book of Medical Physiology, 13<sup>th</sup> Edition, W.B. Saunders Co.
5. Raven, P.H, Johnson, G.B. Jonathan, B.L and S.R Singer (2014), Biology, Tata McGraw Hill Publishing Co. Ltd
6. Nielson, S (1962), Animal Physiology, Prentice Hall Publication.

**CC11.1: Endocrinology & Immunology**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1:****Endocrinology - 1**

- General idea of mammalian Endocrine systems,
- Hormones and its chemical nature, Classification , mechanism of hormone actions,
- Hypothalamus ,
- Pituitary : Anatomy, hormones and its functions and disorders
- Thyroid : Anatomy, Synthesis of T<sub>3</sub> and T<sub>4</sub> , function and disordering

**Unit 2: Endocrinology - 2**

- Endocrine glands : Anatomy, hormones & functions of Adrenal, Pancreas, Thyroid, Parathyroid, Gonads, and its disorders
- Hormonal regulation of Reproductive cycle,

**Unit 3: Immunology - I**

- Innate and Adaptive Immunity : Anatomical barriers, Inflammation, cells and molecules involved in innate immunity, adaptive immunity (cell mediated and humoral).
  - Passive: Artificial and Natural Immunity,
  - Active: Artificial and Natural Immunity.
- Primary and Secondary lymphoid organs,
- Antigenicity and immunogenicity, Immunogens, Adjuvants and Haptens, Factors influencing immunogenicity, B and T-cell epitopes.

**Unit 4: Immunology - II**

- Structure and functions of different classes of immunoglobulins, Antigen-antibody interactions, Immunoassays (ELISA), Polyclonal sera, Hybridoma technology.
- Monoclonal antibodies in therapeutics and diagnosis.
- Structure and function of MHC molecules. Endogenous and Exogenous pathway of antigen processing and presentation.
- Complement system: components and pathways of complement activation.

**CC11.2: Practical**

Contact Hour Per Week	:	2
Examination duration	:	3 Hours
Maximum marks	:	25 (Expt-15, Viva-5, Record-5)

1. Tissue fixation, microtomy, block preparation, staining and mounting of endocrine tissues ( pancreas, thyroid, Adrenal, ovary and testis)
2. Study of permanent slides of Endocrine glands
3. Dissection and display of Pituitary gland of fish
4. Ouchterlony's double immunodiffusion method.
5. Determination ABO blood group & RH factor
6. Preparation of single cell suspension.
7. Study of endocrine disorders and collection of photographs, pictures.
8. Any other suitable experiments/ activities

## 9. Submission of sessional preparations

**Reference Books :**

1. Bolandar, M. (2001). Molecular Endocrinology. Elsevier Science.
2. Greenspan, F. S. & Gardener, F. G. (2003). Basic and Clinical Endocrinology. 7th Ed. McGraw Hill.
3. Hadley, M. E. (2000). Endocrinology 5th Ed. Pearson Education.
4. Kindt, T. J., Goldsby, R. A., Osborne, B. A., Kuby, J. (2006). VI Edition. Immunology. W.H. Freeman and Company.
5. Negi (2010). Introduction to Endocrinology. PHI Learning Private Ltd.
6. Norris, D. O., (2006). Williams Textbook of Endocrinology: Vertebrate Endocrinology. 3rd Ed. Academic Press.
7. Turner, C.D., Bagnara, J.T. (1976) : General Endocrinology, 6th Edition, Saunders.

**CC12.1: Developmental Biology**

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

**Unit 1: Principles of Development and Gametogenesis**

- Principles of development-Epigenesis, Preformation,
- Developmental patterns and differentiation, Discovery of induction cell interaction cytoplasmic determinants and asymmetric cell division,
- Stem cell culture and Amniocentesis.
- Gametogenesis:- Spermatogenesis and oogenesis,
- Types of eggs, Fertilization- changes in gametes, mono- and polyspermy,

**Unit 2:Development of Frog and Chick**

- Development of Frog up to three germ layers.
- Fate map, Neurulation, Notogenesis and Enterogenesis.
- Development of chick upto three germ layers.
- Embryology of chick (different hours),
- Extra embryonic membrane in chick- development and functions.

**Unit 3: Regeneration and Parthenogenesis**

- Regeneration- in Hydra, Planaria and Amphibia .
- Metamorphosis – changes and hormonal regulation of metamorphosis in insects and amphibians.
- Parthenogenesis: natural and artificial.
- Embryonic Induction and Organiser.
- Medical implications: Infertility- Diagnosing infertility, IVF, Teratogenesis- teratogenic agents and effect of teratogens on embryonic development.

**Unit 4: Reproductive Biology**

- Hormonal control of male and female reproduction.
- Reproductive cycles and its hormonal regulation.
- Implantation.
- Placentation- structure, types and physiology of placenta,
- Hormonal regulation of pregnancy, parturition and lactation.

**CC12.2:Practical**

Contact Hour Per Week : 2  
 Examination duration : 3 Hours  
 Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Study of development stages of chick- primitive streak, 24h, 33h, 48h, 72h, 96h through permanent slides.
2. Study of early developmental stages of chick through photographs
3. Study of permanent embryological slides of frog.
4. Study of various developmental stages of frog / toad (tadpole larva metamorphosis )
5. Temporary slide preparation of chick embryo of different hours
6. Study of Chick embryo in vivo by making a window preparation
7. Drosophila- study of development stages and life cycle from fruit fly stock culture.
8. Any other suitable experiments/ activities
9. Submission of sessional preparations

#### Reference Books :

1. Balinsky, B.I. (2008). An introduction to Embryology, International Thomson Computer Press.
2. Browder, L. W. (1984). Developmental Biology. 2nd Ed., CBS College Publishing.
3. Carlson, B. M. (1999). Patten's Foundations in Embryology. 6th Ed. McGraw Hill.
4. Gilbert S. F. (1999). Embryology. Sinauer Associates, Sunderland, Massachusetts.
5. Gilbert, S. F. (2006). Developmental Biology, VIII Edition, Sinauer Associates, Inc., Publishers, Sunderland, Massachusetts, USA.
6. Gillbert, S.F. (2006). Developmental Biology. 8th Ed. Sinauer Associates.
7. Kalthoff, (2000). Analysis of Biological Development, II Edition, McGraw-Hill Professional
8. Kalthoff, K., (2001). Analysis of Biological Development. 2nd Ed. McGraw Hill.
9. Moody, S.A. (Ed.) (2007). Principles of Developmental Genetics. Academic Press.

### Semester – VIII

#### CC13.1: Biotechnology and Microbiology

Contact Hour per Week : 4  
 Credits : 4  
 Terminal Examination duration : 3 hours  
 Maximum marks : 75 (Terminal- 60, Sessional- 15)

#### Unit 1:

##### Genetic Engineering

- Basic concepts in genetic engineering
- Cloning Vectors: Plasmids, Lambda bacteriophage, cosmid, phasmid, BAC, YAC, Expression vector.
- Restriction endonuclease: source, restriction sequence, types of cut, nomenclature, types
- Transformation techniques: Calcium chloride, Gene gun, Electroporation, microinjection.

#### Unit 2:

**Recombinant DNA technology**

- Recombinant DNA technology: cloning by using vectors (plasmid and lambda bacterio phage).
- Gene amplification: DNA library, genomic library, PCR
- DNA fingerprinting, Southern, northern, and western blotting techniques.
- DNA sequencing- Sanger method, Human genome project.

**Unit 3:****Animal Biotechnology**

- Animal cell culture, expressing cloned genes in mammalian cells, molecular diagnosis of genetic disease (sickle cell anaemia, cystic fibrosis.)
- Recombinant DNA medicines- recombinant insulin and hGH.
- Gene therapy
- Production of cloned and transgenic animals, nuclear transplantation, retroviral method, DNA microinjection.

**Unit 4:****Microbiology**

- Virus, Viroids, virions, mycoplasma: structure and general characters of viruses, classification, structure & Life cycle of Bacteriophage,
- Bacteria: structure, classification and reproduction ( transformation, transduction and conjugation)

**CC13.2:Practical**

Contact Hour Per Week : 2

Examination duration : 3 Hours

Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Genomic DNA isolation
2. Plasmid DNA isolation
3. Restriction digestion of plasmid DNA
4. Study of following techniques through photographs.
  - a) Southern blotting
  - b) Northern blotting
  - c) Western blotting
  - d) DNA fingerprinting
  - e) PCR
5. Report on animal cell culture/ report on institute visited.
6. Preparation and use of culture media for microbes and animal tissues, sterilization, inoculation and growth monitoring, use of fermentors.

7. Counting of bacterial population through Haemocytometer
8. Any others suitable experiments/ activities.
9. Submission of sessional preparations

### Reference Books :

1. Beauchamp, T.I and Childress, J.F. (2008). Principles of Biomedical Ethics. VI Edition, Oxford University Press.
2. Brown, T.A. (1998). Molecular Biology Labfax II: Gene cloning and DNA analysis. II Edition, Academic Press, California, USA.
3. Glick, B.R. and Pasternak, J.J.( 2009). Molecular Biotechnology- Principles, and applications of recombinant DNA. IV Edition, ASM press, Washington, USA.
4. Griffiths, A.J.F., J.H. Miller, Suzuki, D.T., Lewontin, R.C. and Gelbart, W.M. (2009). An Introduction to Genetic Analysis. IX Edition. Freeman and Co., N.Y., USA.
5. Prescott, L.M (2004), Microbiology, McGraw – Hill Higher Education.
6. Singh, B.D (2003), Biotechnology Expanding Horizons, Kalyani Publishers.
7. Snustad, D.P. and Simmons, M.J (2009). Principles of genetics. V Edition, Jhon wiley and Sons Inc.
8. Watson, J.D., Myers, R.M., Caudy, A. and Witkowski, J.K. (2007). Recombinant DNA Genes and Genomes- A Short course. III Edition, Freeman and Co., N.Y., USA.

### CC14.1: Ecology and Biostatistics

Contact Hour per Week	:	4
Credits	:	4
Terminal Examination duration	:	3 hours
Maximum marks	:	75 (Terminal- 60, Sessional- 15)

### Unit1:Introduction to Ecology and Ecosystem

- Relevance of studying ecology; History of ecology; Laws of limiting factors;
- Detailed study of temperature and light as physical factors;
- Types of ecosystem;
- Food chain; Detritus and grazing food chains;
- Food web;
- Energy flow through the ecosystem;
- Ecological pyramids

### Unit 2:Population Ecology

- Unitary and modular populations; Unique and group attributes of population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, dispersal and dispersion; Exponential and logistic growth, equation and patterns, r and k strategies, population regulation- density- dependent and independent factors; population interactions,
- Gause's Principle with laboratory and field examples; Lotka – voltera equation for competition and predation, functional and numerical responses

**Unit 3: Community Ecology**

- Community characteristics: dominance, diversity, species richness, abundance, stratification; Ecotone and edge effect;
- General idea about zoogeographical realms of the world;
- Types of biodiversity; its significance, loss of biodiversity; conservation strategies (in situ and Ex situ);
- Endangered species concept;
- Role of ZSI, WWF, IUCN

**Unit 4: Biostatistics**

- Concept, definition and scope of biostatistics, biological data, sampling techniques,
- Measures of central tendency (mean, median and mode),
- Measures of dispersion, hypothesis and testing of hypothesis (chi square test, student t test and Z test), correlation,
- Data analysis using EXCEL programme.

**CC1.2: Practical**

Contact Hour Per Week : 2

Examination duration : 3 Hours

Maximum marks : 25 (Expt-15, Viva-5, Record-5)

1. Estimation of the following of different water samples:
  - a) Dissolved oxygen and carbon dioxide
  - b) Total alkalinity and chloride
  - c) Salinity
  - d) pH
2. Measurement of transparency of water using Secchi Disc
3. Estimation of the water holding capacity and pH of the soil sample
4. Study of Zooplankton ( Cyclops, zoea larva, naupilus, megalopa, Lucifer, mysis, medusa), nekton ( pristis, Torpedo, Hippocampus, Exocetus, Hemiramphus), and Benthos (chiton, pennatula, Murex, Metridium, Asteris)
5. Analysis of producers and consumers from the grassland.
6. Study of biodiversity of the five faunal groups
7. Visit to Nandan Kanan zoological park to study the wild animals and endangered species and submission of report.
8. Calculation of Airthmetic mean and standard deviation of length of supplied bone
9. Problems based on Biostatistics Unit
10. Any others suitable experiments/ activities.
11. Submission of sessional preparations

**Reference Books :**

1. Chainy, G.B.N; Mishra G and Mohanty P.K (2004), Basic Biostatistics, Kalyani Publishers, Ludhiana.
2. Colinvau, P. A. (1993). Ecology. II Edition. Wiley, John and Sons, Inc.
3. Krebs, C. J. (2001). Ecology. VI Edition. Benjamin Cummings.
4. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D (2005), Ecology and Environment, Rastogi Publications.
7. Taylor, C; Gibbon; F; Moris, W.L (1987), How to Analyse Data, SAGE Publication, The International Professional Publishers, Newbury Park Lodon, New Delhi.

**DSE-II: Seminar and Project**

Contact Hours per Week : 4  
 Credit : 4  
 Maximum Marks : 100

The students will complete the project work under the guidance of members of faculty. Regular monitoring as per the steps/processes indicated below is essential. Weightage as indicated against each step is to be assigned through seminar/workshop mode.

<b>Identification of problem</b>	<b>Review of literature</b>	<b>Methodology</b>	<b>Analysis</b>	<b>Findings</b>	<b>Viva-voice</b>	<b>Total</b>
10	10	15	15	20	30	100
Internal				Internal and External		

# CBCS

## HERBAL PLANTS FOR HOME GARDENING

Contact Hours per Week	: 4
Credit	: 4
Examination Duration	: 3 Hours
Maximum Marks	: 100

### Unit 1:

Gardening: definition, objectives and scope - Garden tools and implements different types of gardening - computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

### Unit 2 :

Introduction to Herbs: .Herbal Gardening; Planting, propagation, soils, plant nutrition, and container growing. Plant identification, plant names, general characteristics of herbs, the history of herbs, and herb resources (nurseries, seeds, clubs, etc) Growing Herbs to Harvest. Herb products, setting up a herb farm, making compost.

### Unit 3 :

(a) Indoor gardening – Selection of indoor plants, care and maintenance of indoor plants, Bonsai – Principle, Creating the bonsai.(b) Outdoor gardening.(1) Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers Aster, Dahlia, Gerbera, Gladiolous, Marigold,Rose, Liliium, Orchid, Cultivation of Rose, *Jasminum*, *Chrysanthemum*, Orchids, *Anthurium*.

### Unit 4 :

Scope and importance of traditional medicine Plants in primary health care: study of selected Common medicinal plants – *Tinospora cordifolia*, *Oscimum sanctum*, *Piper longum*, *Terminalia chebula* , *Aloe vera* , *Curcuma longa*.*Brahmi* *Phyllanthus emblica*, *Coleus*, *Catheranthus*, *Adathoda*, *Rauwolfia*, *Mentha*,. *Withania somnifera*, *Phyllanthus amarus* and *Phyllanthus emblica*.

### Reference Books:

1. Nishi Sinha: Gardening in India, Abhinav Publications, New Delhi.
2. Andiance and Brison. 1971. Propagation Horticultural Plants.Rekha Sarin. The Art of Flower Arrangement, UBS Publishers,New Delhi.
3. Katyal, S.C., Vegetable growing in India, Oxford, New York.
4. Chanda, K.L. and Choudhury, B. Ornamental Horticulture in India.Premchand, Agriculture and Forest Pest and their Management, Oxford Publication.
5. Prasad, S., and U. Kumar. Green house Management for Horticultural Crops, Agrobios, Jodhpur.
6. Kolay, A.K. Basic Concepts of Soil Science. New Age International Publishers, Delhi.
7. Hudson, T. Hartmann, Dale K. Kester, Fred T. Davies, Robert L. Geneve, Plant Propagation,Principles and Practices.

## Chemistry and Our Life

Contact Hours per Week : 4

Credit : 4

Examination Duration : 3 Hours

Maximum Marks : 100 (Terminal-80, Sessional-20)

### Unit 1:

#### **Food Chemistry (Water, Beverage, Kitchen, Fire chemistry):**

Water, a universal solvent, hard and soft water, demineralized water, water in our body, common beverages: tea, coffee, milk, soft drinks, alcoholic beverages, process in cooking, food ingredients.

### Unit 2:

**Chemistry in day-to-day life (Tooth paste, soap, cosmetics):** toothpaste, soaps, detergents, fairness creams, anti-aging cream, sunscreen creams, shampoos, hair dyes, perfumes and deodorants.

### Unit 3:

**Chemistry in Health and Disease:** Drugs and pharmaceuticals, antiseptics and disinfectants, mosquito repellants, chemical fertilizers, chemical pesticides.

### Unit 4:

a) **Plastics and polymers:** some common plastics: polystyrene, polycarbonate, PET, PVC, Polyurethane, Polymethyl methacrylate, polypropylene, tricot, ABS plastic, nylon, Bakelite, melamine, PTFE.

b) **Fuel Chemistry (Battery and Petrochemicals):** Types of fuels, match box, rocket propellants, solid propellants, liquid propellants, hybrid propellants, fireworks.

Primary cell, secondary cell, rechargeable batteries, fuel cells (zero emission vehicles).

Petroleum and natural gas, their composition, petroleum mining, petroleum refining, octane number and cetane number.

Clean alternative fuels: Compressed Natural Gas (CNG), LNG, LPG, bio diesel.

### Reference Books :

1. Chemistry in Our Life- Biman Basu

### Renewable Energy and Energy Harvesting

	Contact Hours per Week : 4
	Credit : 4
	Examination Duration : 3 Hours
Maximum Marks	: 100 (External-80, Sessional-20)

**Unit 1 : Fossil fuels and Alternate Sources of energy:** Fossil fuels and nuclear energy, their limitation, need of renewable energy, non-conventional energy sources. An overview of developments in Offshore Wind Energy, Tidal Energy, Wave energy systems, Ocean Thermal Energy Conversion, solar energy, biomass, biochemical conversion, biogas generation, geothermal energy tidal energy, Hydroelectricity.

**Unit 2 : Solar energy:** Solar energy, its importance, storage of solar energy, solar pond, non plate collector, solar distillation, solar cooker, solar green houses, solar cell, absorption air conditioning. Need and characteristics of photovoltaic (PV) systems, PV models and equivalent circuits, and sun tracking systems.

**Unit 3 : Wind Energy harvesting:** Fundamentals of Wind energy, Wind Turbines and different electrical machines in wind turbines, Power electronic interfaces, and grid interconnection topologies.

**Ocean Energy:** Ocean Energy Potential against Wind and Solar, Wave Characteristics and Statistics, Wave Energy Devices.

Tide characteristics and Statistics, Tide Energy Technologies, Ocean Thermal Energy, Osmotic Power, Ocean Bio-mass.

**Unit 4 : Geothermal Energy:** Geothermal Resources, Geothermal Technologies.

**Hydro Energy:** Hydropower resources, hydropower technologies, environmental impact of hydro power sources.

#### Reference Books:

1. Non-conventional energy sources - G.D Rai - Khanna Publishers, New Delhi
2. Solar energy - M P Agarwal - S Chand and Co. Ltd.
3. Solar energy - Suhas P. Sukhative Tata McGraw - Hill Publishing Company Ltd.
4. Godfrey Boyle, "Renewable Energy, Power for a sustainable future", 2004, Oxford University Press, in association with The Open University.
5. Dr. P. Jayakumar, Solar Energy: Resource Assessment Handbook, 2009
6. J. Balfour, M. Shaw and S. Jarosek, Photovoltaics, Lawrence J. Goodrich (USA).

### **General Mathematics**

	Contact Hours per Week : 4
	Credit : 4*
	Examination Duration : 3 Hours
Maximum Marks	: 100 (Terminal-80, Sessional-20)

#### **Unit 1 :**

What is Mathematics, Role and real life application of Mathematics, History of Mathematics, Introduction to number systems: Natural numbers, Integers, rational numbers, real numbers, complex numbers. Elements of set theory: Set, Types of set with examples. Representation of sets. Basic operations on sets ( union, intersection, complementation). Venn diagram. Verbal reasoning: Logical Venn Diagrams; Mathematical Operations-Problem solving by substitution, Interchange of signs and numbers, Logical sequences of words.

#### **Unit 2 :**

Number series, letter series, coding-decoding, analogy test, Relationship problems, Calendar problems. Arithmetical reasoning: number series completion, calculation based problems, data based problems, problem on ages, work and time problems, percentage problems.

#### **Unit 3 :**

Logical deductions: logical reasoning, logical deductions, two-premise and three-premise arguments; Statement-Arguments; Statement-Assumptions; Statement-Courses of Action; Statement-Conclusions.

#### **Unit 4 :**

Organisation of data: Frequency table, Grouping. Pictorially displaying data: dot plots, bar graphs, line graphs, pie charts. Data interpretation: Numerical based on analysis of data presented in tabular, bar chart, pie-chart or line graph.

#### **Reference Books :**

1. R.S. Aggarwal A modern approach to Verbal and non-verbal reasoning. S. Chand and Co.

### **FOOD, NUTRITION AND PUBLIC HEALTH**

Contact Hours per Week :	4
Credit :	4*
Examination Duration :	3 Hours
Maximum Marks :	100 (Terminal-80, Sessional-20)

#### **Unit1: Food and Nutrients**

Food, Nutrients (Macro and Micro) Synthetic foods, Diet and dietary guidelines, Junk foods, Function of food, Food adulteration, Food poisoning, Balanced diet, Nutrient need and dietary pattern for various age groups, Food hygiene, potable water source and methods of purification.

#### **Unit 2: Nutritional Disorders**

Nutrition – related disorders: Under nutrition and over nutrition, obesity, Nutritional deficiencies: Vitamins deficiencies, Protein- energy malnutrition ( marasmus and kwashiorkor; iodine deficiency disorder; Anaemia.)

#### **Unit 3: Health and Communicable Diseases**

Concept of Health; Communicable and non-communicable diseases. Control, prevention and Management of some vector- borne diseases ( Malaria, filaria, chikungunya) and other communicable diseases ( Rabies, leprosy, thyphoid and AIDS)

#### **Unit 4: Non-communicable Diseases**

Non communicable diseases and their preventive measures, Cardiovascular diseases, Diabetes, Cancer, Alzheimers & parkinsons Diseases, Osteoporosis.

#### **Reference Books :**

1. Arora, D.R and Arora, B. (2001) Medical Parasitology. II Edition. CBS Publications and Distributers.
2. K. W. Appeal et al (2012), Zoonoses: Infectious diseases Transmissible from animal to human.
3. MJ. Gibney, Barrie M. Margetts, JM. Kearney and L. Arab.(2004), Public Health Nutrition, Blackwell Publishing company U.K.
4. P Agarwal (2014), Human Nutrition : Meal Planning Health Care & Common Diseases. Premier publishing house Calcutta.
5. Park, K. (2007) Preventive and social medicine. XVI Edition. B.B Publisher.

## BASICS OF SOCIAL SCIENCES

Contact Hours per Week : 4  
 Credit : 4\*  
 Examination Duration : 3 Hours  
 Maximum Marks : 100 (Terminal-80, Sessional-20)

### Unit –I Histoty

- The French revolution, Socialism in Europe and Russian revolution
- Causes of first world war , Causes of Second world war, Cold war and its impact

### Unit-II Geogrphy

- India-Major physiographic units, the monsoons its characteristics, rain fall and temperature distribution
- Natural distribution, land degradation in India and Conservation measures

### Unit-III Political Science

- Democracy, Indian constitution and its main features;
- Fundamental rights and duties, rights, Rights of the child

### Unit-IV Economics

- Poverty as a challang, food security in India, consumer awareness
- Role of government in ensuring food security.

## References

### History

1. William Doyle, The Oxford History of the French Revolution, Oxford University press, London, 2003.
2. James Joll, Europe since 1870 : An International History, Pelican series.
3. Arjun Dev, History of contemporary world, Orient Black Swan, New Delhi, 2007
4. Cambridge Modern History of Europe, Cambridge University series, London 1962
5. John Lewis Gaddis, The Cold War : A new History, Penguin, London, 2007.
6. Peter McPhee, The French Revolution. 1789-1799, Oxford University Press, 2003
7. Sean McMeekin, The Russian Revolution; A new History 1<sup>st</sup> Ed., Basic Books, 2017.
8. Rex A. Wade, The Russian Revolution, 1917 (Vol. 53 of New Approaches to European History), Cambridge University Press, 2017.
9. Eric Dorn Brose, A History of the Great War : World War first and the International crisis of the Early Twentieth Century, Oxford University Press, 2009
10. Martin Gilbert, The Second World War ; A complete History, Holt Paperbacks, 2004.
11. Norman Lowe, Mastering Modern World History, Palgrave Macmillan, 2013

### Geography

1. Majid Husain, Geography of India, Mac Grow Hill Publication
2. Khular, India a comprehensive Geography, Kalyani Publishers.
3. V. S. Katiyar, The Indian Mansoon and it Frontiers, Inter India Publisher
4. R. L. Singh, India a regional Geography
5. Mukaram Bhagat, Land degradation: India's silent crises, Centre for Information technology and Education
6. V.C. Jha, Land degradation and desertification, Rawat Publication.
7. P. K. Das, The Monsoon

8. P. A Menon, Ways of weather, National book trust
9. R. C. Tiwari, Geography of India, Pravalika Publication.

#### Political Science

1. Basu,D.D(2002).Introduction to Constitution of India,Lexis nexis.Delhi

#### Economics

1. Rudder Dutt and Mahajan, Indian Economy, S. Chand and Company, New Delhi
2. I.C. Dhingra, Indian Economy, Environment and Policy, S. Chand and Company Ltd, New Delhi.
3. S. K. Mishra and V. K. Puri, Indian Economy, its development experience Himalaya Publishing House, Mumbai, 2001.
4. Food security of India – An overview Suresh C. Modgal, NBT, India.

### ENGLISH CREATIVITY IN TRANSLATION

Contact Hours per Week :	4
Credit :	4*
Examination Duration :	3 Hours
Maximum Marks :	100 (Terminal-80, Sessional-20)

#### Unit I:

Literature, fiction and translation.

Indian fiction in English translation: problems and perspectives.

#### Unit II:

Rabindranath Tagore: *Selections from Galpaguchcha 1; Kabuliwala and other stories*, by R.N.Tagore, trans. Ratan K. Chattopadhyay. The following stories only: The Postmaster, Return of the Little Master, Holiday, The Visitor, The Exercise Book, The Pedlar from Kabul

#### Unit III:

*The Boatmanboy and Forty Poems* by Sachi Routray, Trans. Harindranath Chattopadhyay and B.Sinha. The following poems only: Red Flower, To the Poet, To the Mother, To the Wayfarer, Return.

#### Unit IV:

*Karukku* by F.Bama, trans. Laxmi Holmstrom

#### List of books:

- Rabindranath Tagore: *Selections from Galpaguchcha 1; Kabuliwala and other stories*, by R.N.Tagore, trans. Ratan K. Chattopadhyay, Orient Blackswan. 2013
- *The Boatmanboy and Forty Poems* by Sachi Routray, Trans. Harindranath Chattopadhyay and B.Sinha. Prabasi Press, Calcutta.
- *Karukku* by F.Bama, trans. Laxmi Holmstrom. OUP
- *The Twice Born Fiction* by Meenakshi Mukherjee
- *Theories of Translation* by J.Williams, Palgrave Macmillan, 2013
- *Introducing Translation Studies* by J.Munday, Routledge, 2016.

## Hindi Bhasha aur Sahitya ka Samanya Gyan

संपर्क-घंटे	:	4 प्रति सप्ताह
क्रेडिट	:	4
अधिकतम	:	100 अंक
सत्र - अंत	:	80 अंक
आंतरिक	:	20 अंक

उद्देश्य: पाठ्यक्रम के अंत में विद्यार्थी हिंदी भाषा की कविता, गद्य और भाषा - प्रयोग को आलोचनात्मक ढंग से समझ सकेंगे।

विस्तृत अध्ययन

यूनिट -I पाठ्य पुस्तक ---- श्रेष्ठ हिंदी निबंध ----- सं. डॉ. अजय कुमार पटनायक, शबनम पुस्तक महल, कटक - 12

पाठ्य विषय

- (क) हजारी प्रसाद द्विवेदी ..... कुटज  
 (ख) रामधारी सिंह 'दिनकर' ..... साहित्य और राजनीति  
 (ग) मोहन राकेश ..... विज्ञापन युग

यूनिट -II पाठ्य पुस्तक ---- काव्य सौरभ ----- सं. पुरुषोत्तम दास मोदी, विश्वविद्यालय प्रकाशन, वाराणसी

पाठ्य विषय

- (क) कबीर दास ..... साखी (11 से 25 )  
 (ख) सूरदास ..... बाल लीला (3, 7, 8) भ्रमरगीत (1 से 5)  
 (ग) तुलसीदास ..... धनुर्भंग  
 (घ) जयशंकर प्रसाद ..... भारतवर्ष, बीती विभावरी जाग रही  
 (ङ) सूर्यकांत त्रिपाठी 'निराला' ..... संध्या सुंदरी

यूनिट -III सामान्य अध्ययन

पाठ्य पुस्तक ---- प्रतिनिधि कहानियाँ ---- सं. डॉ. बच्चन सिंह, अनुराग प्रकाशन, वाराणसी

- (क) प्रेमचंद ..... कफन  
 (ख) उषा प्रियंवदा ..... वापसी  
 (ग) जानरंजन ..... पिता

यूनिट -IV

- (क) शब्द- शुद्धि (ख) वाक्य- शुद्धि  
 (ग) पर्यायवाची और विलोम शब्द (घ) अनेक शब्दों के लिए एक शब्द

कार्य -सम्पादन - पद्धति

व्याख्यान, विचार-विमर्श, समूह चर्चा, सामग्री - समीक्षा और प्रस्तुतीकरण आदि।

संदर्भ - ग्रंथ

- हिंदी का ज्ञान - डॉ. हरदेव बाहरी, लोकभारती प्रकाशन, इलाहाबाद।
- शब्द - सामर्थ्य - डॉ. कैलाशचंद्र भाटिया, प्रभात प्रकाशन, नयी दिल्ली।
- आधुनिक हिंदी व्याकरण और रचना - डॉ. वासुदेव नंदन प्रसाद, भारती भवन, पटना।
- शुद्ध हिंदी कैसे सीखें ? - राजेन्द्र प्रसाद सिन्हा, भारती भवन, पटना।

## Communicative Language – Odia

### ଓଡ଼ିଆ ଭାଷା ଓ ସାହିତ୍ୟର ପରିଚୟ

Contact Hours per Week	: 4
Credit	: 4*
Examination Duration	: 3 Hours
Maximum Marks	: 100
(Terminal-80, Sessional-20)	

#### Unit-I

- ଓଡ଼ିଆ ଭାଷାର ପରିଚୟ : ୧. ଓଡ଼ିଆ ଭାଷାର ଉତ୍ପତ୍ତି, ବିକାଶ ଓ ବୈଶିଷ୍ଟ୍ୟ  
୨. ଓଡ଼ିଆ ଶବ୍ଦ ଭଣ୍ଡାର  
୩. ଓଡ଼ିଆ ବ୍ୟାକରଣ

#### Unit-II

- ଓଡ଼ିଆ ସାହିତ୍ୟ ପରିଚୟ : ୧. ଓଡ଼ିଆ ସାହିତ୍ୟର ଯୁଗକ୍ରମ (ପ୍ରାଚୀନ ଓ ମଧ୍ୟଯୁଗ)  
(ପ୍ରାକ୍ ସାରଳା ଯୁଗ, ସାରଳା ଯୁଗ, ପଂଚସଖା ଯୁଗ, ରାତିଯୁଗ ଓ କାବ୍ୟ ଯୁଗ)  
୨. ଓଡ଼ିଆ ସାହିତ୍ୟର ଯୁଗକ୍ରମ (ଆଧୁନିକ ଯୁଗ)  
(ରାଧା ନାଥ ଯୁଗ, ସତ୍ୟବାଦୀ ଯୁଗ, ସବୁଜ ଯୁଗ, ପ୍ରଗତି ଯୁଗ ଓ ସ୍ୱାଧୀନତା ପରବର୍ତ୍ତୀ ଯୁଗ)

#### Unit-III

୧. ଅବବୋଧ ପରୀକ୍ଷଣ  
ପ୍ରଦତ୍ତ ଅନୁଚ୍ଛେଦ / ପଦ୍ୟାଂଶ ପାଠକରି ଆଧାରିତ ପ୍ରଶ୍ନୋତ୍ତର  
୨. ଇଂରାଜୀରୁ ଓଡ଼ିଆ ଅନୁବାଦ

#### Unit-IV

ବ୍ୟବହାରିକ ଲିଖନ :

୧. ପତ୍ର ଲିଖନ - ସରକାରୀ, ଅର୍ଦ୍ଧସରକାରୀ ଓ ବ୍ୟକ୍ତିଗତ ପତ୍ର  
୨. ଇଂରାଜୀରୁ ଓଡ଼ିଆ ଅନୁବାଦ

ପ୍ରତ୍ୟେକ ଯୁନିଟ୍ ରୁ ଦୁଇଟି ପ୍ରଶ୍ନ ଆସିବ । ଯେ କୌଣସି ଗୋଟିକର ଉତ୍ତର ଦିଆଯିବ, ପ୍ରତ୍ୟେକ ପ୍ରଶ୍ନର ମୂଲ୍ୟ ସମାନ ।

ସହାୟକ ଗ୍ରନ୍ଥ ;

୧. ଓଡ଼ିଆ ଭାଷାର ଉତ୍ପତ୍ତି ଓ କ୍ରମ ବିକାଶ - ଡଃ କୁଞ୍ଜବିହାରୀ ତ୍ରିପାଠୀ  
୨. ଓଡ଼ିଆ ଧ୍ୱନି ତତ୍ତ୍ୱ ଓ ଶବ୍ଦ ମଲ୍ଲର - ଡଃ ଧନେଶ୍ୱର ମହାପାତ୍ର  
୩. ନିର୍ଭୟଲ ଲେଖାର ମୂଳସୂତ୍ର - ଡଃ ନୀଳାଦ୍ର ଭୂଷଣ ହରିଚନ୍ଦନ  
୪. ଓଡ଼ିଆ ସାହିତ୍ୟର କ୍ରମ ବିକାଶ - ସୁରେନ୍ଦ୍ର ମହାନ୍ତି  
୫. ଓଡ଼ିଆ ସାହିତ୍ୟର ଇତିହାସ - ମାୟାଧର ମାନସିଂହ

**Bangla Sahitya O Bhakaran Gyan**  
**Bangla Sahityer Itihas (Sankripta Bhabe)**

Contact Hours per Week : 4

Credit : 4\*

Examination Duration : 3 Hours

Maximum Marks : 100 (Terminal-80, Sessional-20)

**Unit-I :**

- i. Pracheen Yug.
- ii. Adhunik Yug.

**Unit-II :**

- i. Bhab – Samprasarn (Pradatya Kobita ba Gadyer angsha)
- ii. Patra Likhan Byektigata Patra, Samajik Patra O Sarkari Patra.

**Unit- III**

- i. Bangla Shabda Bhandar.
- ii. Bangla Banan.

**Unit- IV : Engrajee theke Bangla Anubad.**

**Ref. books –**

- i. Bangla Sahitya Sampurna Itibritta.  
By Dr. Ashit Kumar bandopadhyae.
- ii. Bhashar Itibritta.  
By sukumar Sen.
- iii. Bhasha Tatwa  
By Ateendra Majumdar.
- iv. bangabhasa O Sahitya  
By Deenesh Chandra Sen.

### **Educational Planning, Management and Leadership**

<b>Semester-VIII</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal:20 External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

#### **Introduction:**

The course intends to introduce the basic concepts, types, conditions, approaches and techniques of educational planning, management and leadership styles. It makes an attempt to introduce the concept of decentralized planning and planning practices currently being adopted in various education sub-sectors in India, including the secondary education sub-sector. It also attempts to discuss the concept and application of strategic planning techniques in education and the way these techniques have been contextualized and built into district planning models in India. As such, the course would provide an overview of the changing landscape of educational planning in India, including the latest planning approaches and frameworks. A discussion of the theoretical approaches to educational planning would help enable student teachers to contextualise and analyse educational planning models and practices in India. It would help them to participate in the current debate on ‘whether educational planning and management in India is rhetoric or a reality?’ The course also intends to provide the student teachers exposure to the concept, theory and various dimensions of educational school management and leadership styles. The student teacher should be aware about how the job of the teacher has changed immensely in last decade. The teacher as the head of the school or class teacher has to perform many managerial functions in relation to the management of human and material resources. A professionally trained teacher is expected to have know-how of managing instructional and other school activities. The core paper “Educational Planning, Management and Leadership” is intended to enable the development of skill how to plan and manage for effective schooling of the children at the secondary level. The paper will be taught through deliberations, discussion, reflection, school visit, library reading and presentations.

#### **Objectives**

The course will enable the student teachers to;

- Understand Concepts, types and approaches of educational planning
- Develop institutional plan and school development plan
- Understand recommendations of different five year plans relating to school education
- Develop understanding about educational decentralization in India and district planning practices
- Understand concept, nature and approaches of educational management
- Develop understanding and skills in managing material and human resources of school
- Understanding the skills of using different managerial and leadership styles for effective management of a school.

#### **Unit-I: Understanding Educational Planning**

- Educational planning: Meaning, Nature, purpose
- Traditional educational planning and strategic educational planning-steps and benefits
- Approaches to educational planning: Social demand, manpower requirement and cost benefits
- Planning for human resource development in school: Manpower forecasting and Manpower planning
- Institutional Planning: School development plan as per the RTE Act 2009

## Unit-II: Educational Planning in India

- Beginning of five year Plans: its historical background; Main features of five year plans with special reference to education, Impact of five year plans on education.
- 12<sup>th</sup> Five year plan: Major recommendations relating to school education(elementary and secondary education)
- Educational decentralization in India: legal provisions and institutional framework and planning machinery
- District planning under the on-going country-wide education development programmes like the SSA and the RMSA
- Financing school education in India, fund flow and related issues

## Unit-III: Educational Management: Concept, Processes

- Educational management: Concept and Process( Planning, organization, control ,decision making and evaluation) and approaches to management: Classical, Human relation and system
- Structure of education management in India and in states
- Management of resources:Material resource,general class room equipments; school building, library, laboratory ,assembly hall play ground and surroundings of school ;Human resource -organizational climate in school, Professional development of teachers-Self learning, reflective practices, orientation, seminars and colloquium
- Management of teaching learning context:C;assroom,Time, curricular and other curricular activities.
- Total quality management

## Unit-IV: Leadership: Concepts, Traits and Styles

- Leadership: Concept, types-administrative and instructional
- Leadership traits: responsible, self disciplined, innovative, imaginative, good at organization, correct in judgment, visionary etc.
- Educational administration leadership skills: Decision making, Planning and Co-Ordinating, Communicating, Evaluating and Feedback
- Styles of educational leadership: autocratic, Laissez-faire and democratic

## Suggested Activities

1. Read school development plan of elementary schools and prepare reflective notes on it.
2. Prepare report after collecting views of SMC members about their contribution to school improvement.
3. Critically analyze district educational planning of your district.
4. Interact with five HMs/Principals of nearby schools and prepare a report management of material and human resources.
5. Make a case study on a successful HM/principal of a school; Leadership quality and styles

## Suggested Readings:

1. Ayyar, R.V. Vaidyanatha (1993). Educational Planning and Administration in India: Retrospect and Prospect. *Journal of Educational Planning and Administration*, VII (2): 197-214.
2. Blaug, Mark (1972). *An Introduction to Economics of Education*. The Penguin: London.
3. Bray, Mark and N.V. Varghese (ed.) (2010): *Directions in Educational Planning: Report on an IIEP Symposium*. IIEP: Paris.
4. Brown, D. (1990): *Decentralisation and School-based Management*. Falmer Press: London.
5. Bullock, A. and H. Thomas (1997). *Schools at the Centre? A Study of Decentralisation*. Routledge: London.

6. Bush, T., L. Bell, R. Bolam, R. Glatter and P. Ribbins (eds.) (1999). *Educational Management: Redefining Theory, Policy and Practice*. Paul Chapman: London.
7. Carron, Gabriel (2010). *Strategic Planning: Concept and Rationale*. IIEP Working Paper 1. IIEP: Paris.
8. Carron, Gabriel (2010). *Strategic Planning: Techniques and Methods*. IIEP Working Paper 3, IIEP: Paris.
9. Chau, Ta-Ngoc (2003). *Demographic Aspects of Educational Planning*. IIEP: Paris.
10. Coombs, P.H. (1969). *What is Educational Planning?* Paris: International Institute of Educational Planning (IIEP).
11. Government of India (2011). *SarvaShikshaAbhiyan: Framework for Implementation*, Department of School Education and Literacy, Ministry of Human Resource Development: New Delhi.
12. Govinda, R. and M. Bandyopadhyay (2010). *Changing Framework of Local Governance and Community Participation in Elementary Education in India*, CREATE PATHWAYS TO ACCESS, Research Monograph No. 35, available at [http://www.create-rpc.org/pdf\\_documents/PTA35.pdf](http://www.create-rpc.org/pdf_documents/PTA35.pdf).
13. Hallack, Jack (1977). *Planning the Location of Schools: An Instrument of Educational Policy*, IIEP: Paris.
14. Jha, Jyotsna, K.B.C. Saxena and C.V. Baxi (2001): *Management Processes in Elementary Education: A Study of Existing Practices in Selected States in India*. The European Commission: New Delhi.
15. Kaufman, Herman, Watters (eds.) (1996). *Educational Planning: Strategic Tactical Operational*. Pa. Technomic: Lancaster.
- Kochhar, S. K. (1994). *Secondary School Administration*, Sterling Publisher New Delhi
16. Litvack, Jennie, Junaid Ahmed and Richard Bird (1998). *Rethinking Decentralization in Developing Countries*. World Bank: Washington D.C.
17. Mathur, S.S. (1990). *Educational Administration and Management*. The Indian Publications: India.
18. MHRD. (2009). *RashtriyaMadhyamikShikshaAbhiyan: A Framework for Implementation*. Department of School Education and Literacy, GOI: New Delhi.
19. MHRD. (2011). *SarvaShikshaAbhiyan: A Framework for Implementation*. Department of School Education and Literacy, GOI: New Delhi.
- Mohanty, J. (2000) *School management, Administration and Supervision*, Deep and Deep, New Delhi
20. Mukhopadhyay, Marmar and R.S.Tyagi (2005). *Governance of School Education in India*. NIEPA: New Delhi.
21. Mukundan, Mullikottu-Veetil and Mark Bray (2004). The Decentralisation of Education in Kerala State, India: Rhetoric and Reality. *International Review of Education*, Vol. 50: 223–243.
22. Nanjundappa, D.M. (1995): *Approaches and Techniques of Decentralized Planning in Readings in Decentralized Planning*, B.N. Yugandhar and Amitabh Mukherjee (ed.) Concept: New Delhi.
23. Pareek, Udai: ‘Institution Building: the Framework for Decision-making’, in Ravi Mathai, UdaiPareek and T. V. Rao (eds.) *Institution Building in Education and Research: From Stagnation to Self- Renewal*, All India Management Association: New Delhi.
24. Psacharopolous, G. (1985): *Planning of Education: Where Do We Stand?* World Bank: Washington.
25. Ruscoe, G. C. (1969): *Conditions for Success in Educational Planning?* Paris:IIEP.
26. Tilak, J.B.G. (1977): “Approaches to Educational Planning and their Applications in India”, *Indian Economic Journal*, 24 (3).
27. UNESCO (2007): *Education Sector-Wide Approaches (SWAs): Background, Guide and Lessons*. Paris. Available at: <http://unesdoc.unesco.org/images/0015/001509/150965e.pdf>.
28. Varghese N.V. and K. Biswal (1999): *School Mapping: An Analysis of Educational Facilities in Dhenkanal District*, Orissa, Mimeo. NIEPA: New Delhi.
29. Varghese, N. V. (1996): “Decentralization of Educational Planning in India: The Case of District Primary Education Programme.” *International Journal of Educational Development*, Vol. 16 (4): 355-365.

30. Varghese, N. V. and J.B.G.Tilak (1991): *The Financing of Education in India*. IIEP: Paris.
31. Varghese, N.V. (ed.) (1997): *Modules on District Planning in Education*, NIEPA: New Delhi.
32. Zaidi, S.M.I.A., K.Biswal, N.K.Mohanty, and A.A.C.Lal (2012): *Secondary Education Planning and Appraisal Manual*. NUEPA: New Delhi. available at [http://www.nuepa.org/Download/Publications/1-Secondary%20Education% 20Manual\(Prof%20Zaidi%20\)](http://www.nuepa.org/Download/Publications/1-Secondary%20Education%20Manual(Prof%20Zaidi%20)) .

# **PROFESSIONAL EDUCATION COMPONENTS**

## Professional Education Component (Structure of the BSc. B,Ed Course)

Sl.No	Subject/Semester	Marks	I (Th + Pr)	II (Th + Pr)	III (Th + Pr)	IV (Th + Pr)	V (Th + Pr)	VI (Th + Pr)	VII (Th + Pr)	VIII (Th + Pr)
	<b>Perspective in Education (PE)</b>									
1.	PE-1: Basics in Education	100	PE-1 (4CH) (4Cr)							
2.	PE-2: Childhood and Growing Up	100		PE-2 (4CH) (4Cr)						
3.	PE-3: Learning and Teaching	100			PE-3 (4CH) (4Cr)					
4	PE-4: Schooling, Socialization and Identity	100			PE-4 (4CH) (4Cr)					
5	PE-5: Assessment for Learning	100				PE-5 (4CH) (4Cr)				
6	PE-6: Creating an Inclusive Classroom	50				PE-6 (CH)(2Cr)				
7	PE-7: Knowledge and Curriculum	100							PE- 7(4CH)(4Cr)	
8	PE-8: Vision of Indian Education	100								PE-8 (4CH) (4Cr)
	<b>Total Marks/ Total Credit (PE)</b>	<b>750/30</b>								
	<b>Curriculum and Pedagogic Studies (CPS)</b>									
1	CPS 1: Language across the Curriculum	50		CPS-1 (2CH) (2Cr)						
2	CPS 2: Pedagogy of School Subject-1- Part I: Mathematics; Biological Science	100					CPS 2 Part - 1(4CH) (4Cr)			
3	CPS 3: Pedagogy of School Subject-2-Part I Physical Science	100					CPS 3 Part -1 (4CH) (4Cr)			

4	CPS 2: Pedagogy of School Subject-1- Part II: Mathematics; Biological Science	100						CPS 2 Part - 2 (4CH)(4Cr)		
5	CPS 3: Pedagogy of School Subject-2-Part II: Physical Science	100						CPS 3 Part - 2(4CH)(4Cr)		
	<b>Total Marks/ Total Credit ( CPS)</b>	<b>450/18</b>								
	<b>Enhancing Professional Capacities (EPC)</b>	<b>Marks</b>	<b>I (Th + Pr)</b>	<b>II (Th + Pr)</b>	<b>III (Th + Pr)</b>	<b>IV (Th + Pr)</b>	<b>V (Th + Pr)</b>	<b>VI (Th + Pr)</b>	<b>VII (Th + Pr)</b>	<b>VIII (Th + Pr)</b>
1	EPC 1: Understanding ICT and Its Application	50	EPC 1 (2CH) (2Cr)							
2	EPC 2: Learning to Function as a Teacher	50					EPC- (4CH) (2Cr)			
3	EPC 3: Arts in Education (2 weeks)	50							EPC 3 (2Cr)	
4	EPC 4: ICT Practicum (2 weeks)	50							EPC 4 (2Cr)	
5	EPC 5: Understanding the Self (2 weeks)	50								EPC5 (2Cr)
6	EPC 6: Health, Yoga and Physical Education	50								EPC 6(2 CH)(2Cr)
7	EPC 7: Reading and Reflecting on Texts	50								EPC 7(2CH)(2Cr)
	<b>Total Marks/ Total Credit( EPC)</b>	<b>350/14</b>								
	<b>Field Engagement (FE)</b>									
1	FE-1: Multicultural Placement (2 weeks)	<b>50</b>						<b>FE-1 (2c)</b>		
2	FE-2: Internship (16 weeks)	<b>350</b>							FE-2(14 Cr)	
3	FE-3: Community work (2 weeks)	<b>50</b>								FE-3(2Cr)
	<b>Total Marks/ Total Credit (FE)</b>	<b>450/18</b>								
	Total Marks	<b>2000</b>	<b>150</b>	<b>150</b>	<b>200</b>	<b>150</b>	<b>250</b>	<b>250</b>	<b>550</b>	<b>300</b>
	Total Credit	<b>80</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>10</b>	<b>10</b>	<b>22</b>	<b>12</b>
	Total Hours	<b>56 hours+ 24 weeks</b>	<b>6</b>	<b>6</b>	<b>8</b>	<b>6</b>	<b>12</b>	<b>10+ 2 weeks</b>	<b>16 weeks internship +4weeks workshop =20 weeks</b>	<b>8 contact hours+4 weeks</b>

\*CH-contact hours, \*\*Cr-credits

**SEMESTER-I**  
**PE 1: Basics in Education**

<b>Semester-1</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal: 20 External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

**Introduction**

India, as a country and society has been in transition and has evolved as the melting pot for various diversities including religious, cultural, socio-economic, linguistic, geographical, regional and philosophical thoughts operating through maturing democratic system of interactions and governance. The country administered through rule of law and the constitution embodies the aspirations for our evolution as a cohesive society and a strong and leading nation in the world community. The continuing evolution of our egalitarian society and peaceful transformation of the nation needs to be understood by the student teachers. This will enable them to effectively discharge their role in the society with numerous diversities. The teachers are also required to understand the role of education as an intervention tool for desired changes in the country and also to appreciate the influence of social set-up on education in which it operates.

**Objectives:**

The course will enable the student teachers to;

- Analyse and understand educational concepts, their premises and contexts that are unique to education
- Understand meaning, nature and process of education from oriental and western perspectives
- Understand philosophical, psychological and sociological foundations of education
- Understand and appreciate educational thoughts of Indian and Western philosophers
- Understand education as sub system of social system and its impact on the sub systems of society

**Unit-I: Education: Meaning, Process and Purpose**

- Education: derivational meaning, broad and narrow meanings, Oriental and western views on education
- Nature and process: Bipolar, tri-polar and multi-polar; Schooling and life-long process
- Modes: Formal, Informal and Non formal
- Purpose: individual and social; determinants of aims of education; aims of education as per the SEC (1952-53), Education Commission (1964-66) and NPE,1986

**Unit-II: Foundation of Education**

- Philosophical: Relationship between philosophy and education; Aims of education, curriculum, pedagogy, and school organisation with reference to Idealism, Naturalism and Pragmatism.
- Sociological: Relationship between sociology and education; Implications of sociology for aims of education, curriculum, pedagogy and school organisation.
- Psychological: Relationship between psychology and education; Implications of psychology for curriculum and pedagogy.

**Unit-III: Educational thinkers and their contributions**

- Educational thoughts of Mahatama Gandhi, Rabindranath Tagore and Shri Aurobindo: their relevance to education.
- Educational thoughts of Rousseau, Plato and Dewey: their relevance to education

#### Unit-IV Education, Society ,Culture and Natioanl Development

- Social system: education as sub system of social system and their inter relationship;Social change; Meaning, dimensions and role of education for social change
- Education and Modernization: Meaning, nature and role of education for modernization
- Education and culture: Meaning and role of education for conservation, transmission and promotion of culture. Education as process of acculturation and enculturation
- Education and human resource development,Education for inclusive development.

#### Suggested Activities

1. List different non-formal agency of education available in your locality and prepare report on objectives, process and relevance for school education.
2. Reflect on the aims of education as per the report of Secondary Education Commission, Indian Education Commission, National Policy on Education (1986).
3. Prepare a report on reflections of philosophical, sociological and psychological foundations on school curriculum, organization, textbook, methods of teaching.
4. Reflect on similarity and differences between educational ideas of Indian philosopher and Western philosophers.
5. Observe society (rural and urban) and prepare report on cultural influence on educational practice
6. Critically analyse nearby locality on criteria of inclusive development and suggest strategy for it.

#### Suggested Readings

1. Agrawal, A (1995). *Dismantling the Divide Between Indigenous and Scientific Knowledge : Development and Change*, 26:413-39.
2. Ant Weiler, C. (1998). *Low Knowledge and Local Knowing: An Anthropological Analysis of Contested "Cultural Products" in the Context of Development*. *Anthropos*, 93:46-94.
3. Butchvarov, P. (1970), *The Concept of Knowledge*, Evanston, Illinois: North Western University Press.
4. Chomsky, N. (1986). *Knowledge of Language*, Prager, New York.
5. Datta, D.M. (1972). *Six ways of Knowing*. Calcutta University Press, Calcutta.
6. Dewey, J. (1997). 'My Pedagogic Creed', in D.J. Flinders and S.J. Thorton(eds.) *The Curriculum Studies Reader*, Routledge: New York.
7. Dewey, J. (1997) *Experience and Education*, Touchstone: New York.
8. Dewey, J. (1956). *The Child and the Curriculum and School and Society*, University of Chicago Press, Chicago, Illinois: U.S.A.
9. Keddie, N.(1971). *Classroom Knowledge*, in. M.F.D Young.
10. Krishna Murthy, J. (1947). *On Education*, Orient Longman: New Delhi.
11. Kumar, Krishna (1996). *Learning From Conflict*, Orient Longman: New Delhi.
12. Peters, R.S. (1967). *The Concept of Education*, Routledge: UK.
13. Margaret, K.T. (1999). *The open Classroom*, Orient Longman: New Delhi.
14. NCERT (2014). *Basics in Education: Textbook for B.Ed Course*. NCERT, New Delhi.
15. Prema, Clarke. (2001). *Teaching & Learning: The Culture of Pedagogy*, Sage Publication: New Delhi.
16. Phenix, P.H. (1964). *Realms of Meaning*. MacGraw-Hill: New York.
17. Steven, H. C. (1970). *The Philosophical Foundation of Education*, Harper & Row Publishers: New York.
18. Sykes, Marjorie. (1998). *The Story of NaiTaleem*,NaiTaleemSamiti: Wardha.
19. Thapan. M. (1991). *Life at School: An Ethnographic Study*. Oxford University Press, Delhi.
20. Taneja, V.R (1978). *Educational Thought and Practice*. Sterling Publishers Pvt Limited, New Delhi.

### **EPC.1 Understanding ICT and Its Application**

<b>Semester-I</b>	<b>Credit-2</b>
<b>Marks 50</b> <b>Internal(10)</b> <b>External(40)</b>	<b>Contact Hours- 2hrs.per week</b>

#### **Introduction**

Preparing teachers to use technology in a classroom is an important step for ICT enabled education in the country. The present course focuses on moving beyond computer literacy and ICT-aided learning, to help student-teachers interpret and adapt ICTs in line with educational aims and principles. It explores ICTs along three board strands; teaching-learning, administrative and academic support systems, and broader implications for society. The course will help student-teachers explore comprehensively through the resource reflect critically and act responsibly. It will show student-teachers how ICTs can be adapted to support decentralized structures and processes as well as build the ‘digital public’ to make education a participatory and emancipatory process.

#### **Objectives**

The course will enable the student teachers to;

- Appreciate the historical development of various educational media.
- Demonstrate understanding of the main components of the computer hardware in use.
- Use various digital technologies (hardware and software) for creating resources and enhance learning experiences for all types of learners (including differently abled).
- Use various ICTs for project based/problem based constructivist learning environment
- Explain the role of ICT in authentic and alternative assessment
- Understand the social, economic, and ethical issues associated with the use of ICT

#### **Unit I: Introduction to Information and Communication Technology**

- Information and Communication Technology: Evolution, meaning, nature and application in education
- Hardware Fundamentals: Computer hardware fundamentals (anatomy, input devices, output devices, storage devices, display devices), types of computers and Computer Network; Use of digital camera, mobile, recorder, scanner, printer, interactive white board, visualizer, and multimedia projector for creating and using multimedia resources
- Software Fundamentals: Software – Meaning and types; System software and Application software. Introduction to office applications (Word processing, Spreadsheet Presentations, Databases, Drawing tools, Multimedia tools, File formats and conversion, utility tools

#### **Unit II: ICT and Pedagogy**

- Approaches to integrating ICT in teaching and learning: Technological Pedagogical Content Knowledge (TPCK)
- Determine appropriate ICT and design a learning plan for a topic; Exploration of ICT resources for teaching learning.

- ICT for Pedagogical Innovations  
Development of e-content; Meaning, process and applications  
Web Quest and virtual field trips: Concept, process, and use in the classroom  
Open Educational Resources; Meaning and importance, various OER initiatives
- Assistive technology for children with special needs: Tools and processes; Universal Design for Learning (UDL)
- Role of CIET/SIETs for Integrating ICT in Education; e-pathashala, NROER, MOOC

### Unit III: Use of ICT in Assessment and Management

- ICT and Assessment  
Electronic assessment portfolio – Concept and types; e-portfolio tools  
Creating and using electronic rubrics for assessment  
Online and offline assessment tools – Rubrics, survey tools, puzzle makers, test generators, reflective journal, question bank  
ICT applications for CCE
- ICT and Management  
MIS systems for educational management  
ICT for personnel management: e-mail, task, events, diary, networking  
ICT for educational management: Scheduling, record keeping, student information, electronic grade book, connecting with parents and community  
Computer security: Privacy, hacking, virus, spy ware, misuse, abuse, antivirus, firewall, and safe practices

**Field Work:** Visit to EDUSAT Center/ICT Studio/NIC

#### Suggested activities:

- Analysis of school textbook and identify suitable ICT for teaching learning
- Developing ICT integrated lesson plan in any school subject
- Surfing and collecting OER materials relating to school education
- Developing e-portfolio and rubrics

#### Suggested Readings

1. Ahmad, J., Ahmad, M.S. and Khan, A. (2012), *Computer Applications in Education*, Neelkamal Publication, Hyderabad, PP-288, ISBN: 978-81-8316-293-7.
2. Bharihok, D. (2000). *Fundamentals of Information Technology*. Pentagon Press: New Delhi.
3. CEMCA (2014). *Technology Tools for Teachers*, Commonwealth Educational Media Center for Asia, 13/14 Sarva Priya Vihar, New Delhi.
4. David, M. (2009). *Project Based Learning- Using Information Technology-* Second Edition. Viva Books: New Delhi.
5. James, K.L. (2003). *The Internet: A User's Guide*. Prentice Hall of India Pvt. Ltd: New Delhi.
6. Laxman Mohanty, Neeharika Vora (2008). *ICT strategies for schools- a guide for school administrators*. Sage Publications: New Delhi.
7. MHRD-GOI (2004 and revised 2010) National ICT @ Schools Scheme, Department of School Education and literacy, MHRD, Govt. of India, New Delhi
8. MHRD-GOI (2012) National Mission on Education through ICTs (NME-ICT), Department of Higher Education, MHRD, Govt. of India, New Delhi
9. Mishra, S. (Ed.) (2009). STRIDE Hand Book 08: E-learning. IGNOU: New Delhi. Available at [http://webserver.ignou.ac.in/institute/STRIDE\\_Hb8\\_webCD/STRIDE\\_Hb8\\_index.html](http://webserver.ignou.ac.in/institute/STRIDE_Hb8_webCD/STRIDE_Hb8_index.html)
10. Mohit K (2003). Design and implementation of Web-enabled Teaching Tools: IRM Press, UK.

11. NCERT (2013). Information and Communication Technology for School System: Curricula for ICTs in Education (students and Teachers), Version-1.2, CIET-NCERT, NCERT, New Delhi (www.ictcurriculum.gov.in).
12. NCERT (2013). National Repository of Open Educational resources (NROET), CIET-NCERT, NCERT, New Delhi (nroer.gov.in).
13. Pradeep Kumar (2011). Web Resources in Pedagogy. Apple Academics: Oakville.
14. Semenov, Alexy (2005). Information and Communication Technologies in Schools. A handbook for Teachers. UNESCO.
15. UNESCO. (2002). UNESCO Report: Information and Communication Technologies in Teacher Education, A Planning Guide, Division of Higher Education, UNESCO.
16. UNESCO. (2002). UNESCO Report: Information and Communication Technology in Teacher Education, A Curriculum for Schools and Programme of Teacher Development. Division of Higher Education, UNESCO.

**SEMESTER-II**  
**PE 2: Childhood and Growing Up**

<b>Semester-II</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal:20 External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

### **Introduction**

Human being develops through layers of multiple complex processes starting even before birth. All minute phases of growth and development present interesting avenues of learning. This course introduces student teachers to the study of childhood, child development and adolescence. The main focus in this course is to enable student teachers to have an understanding about childhood as constructed within socio-cultural realities existing in their lived contexts; family, schools, neighborhood and community. The student teachers will learn about concept of adolescence in realistic and contextual frames, theories of child development, childhood and adolescence as developed at different socio-economic and cultural settings and will also learn to situate. The course also addresses issues and concerns of adolescents in Indian situation. The course also highlights why it is essential for every teacher to understand human development at different phases.

### **Objectives**

The course will enable the student teachers to;

- Understand concept of growth and development, factors influence development and individual difference in individuals
- Develop understanding of the role of socio-cultural context in shaping human development, especially with respect to the Indian context.
- Develop theoretical perspectives and understanding of dimensions and stages of human development and developmental tasks.
- Develop understanding on stages and dimensions of development, views of Erickson, Piaget and Vygotsky on development
- Conceptualise nature of memory, transfer of learning, motivation and creativity and process of its development during growing up
- Understand nature of adolescence and life skills education and role of teacher counselor and parents in dealing with adolescence problems.

- Understand the nature of child abuse, substance abuse, peer pressure and its bearing on childhood and adolescence

### **Unit I: Child as a Developing Individual**

- Growth and Development: concept, principles and characteristics; Development and maturation.
- Factors Influencing Development: Development as a result of interactions between individual-potential and external environment (physical, socio-cultural, ecological, economic and technological).
- Individual differences: Concept and Types (intra and inter); Implications of individual differences (biological, physical, emotional, cognitive, social and moral) for organizing educational programmes (Curricular, Other Curricular, School and Classroom climate building)
- Understanding child in home and school context; Case study

### **Unit II: Development during Childhood and Adolescence**

- Stages and Dimensions of Development: Stages- Childhood and adolescence (early and late); Dimensions- physical, social, emotional, cognitive and moral development;
- Developmental tasks during different stages facilitating holistic development (individual and social).
- Erickson's views on psychosocial development and Kohlberg's views on moral development
- Cognitive and language development: cognitive developmental stages of Piaget; Vygotsky's theory of concept and language development; language development theory of Chomsky

### **Unit-III: Memory, Motivation and Creativity during Growing up**

- Memory: Meaning, Types; Sensory, working and long term, strategy for developing memory
- Transfer of learning: Meaning, nature, types and role of teacher for promoting positive transfer of learning
- Motivation: Meaning, nature and techniques of motivating learners. Developing self-motivation.
- Creativity: Meaning, nature and strategies for nurturing creativity

### **Unit IV: Understanding Adolescence Education**

- Adolescence Education: Concept, Nature and Importance
- Peer pressure: Meaning, importance, consequences and strategies
- Life skill education for adolescents: Meaning, importance, different life skills and strategy for developing life skills
- Role of teacher, counsellor and parents in dealing adolescence problems

### **Suggested Activities**

1. Observe children during their playtime in your practicing school (or nearby school) for a week; observe their play activities, relationships, communication with their peers. On the basis of that prepare a report about understanding childhood.
3. Observe and interact with ten adolescent children living in different contexts (rural areas, urban slum, dalit household, urban area, and working/street people) and compare their lifestyle and problems.
4. View any two movies out of the following : 1. Smile Pinky (2008), 2. Born into Brothels (2014), 3. Salaam Bombay (1988), 4. Slumdog Millionaire (2009), 5. Gippie (2013) and 6. Mehek (2007). Discuss their content, picturization, characters and messages in the context of issues and concerns of childhood/adolescence
5. Collect five folk tale/stories/indigenous games from children told by elders from nearby community. Discuss them in your class.
6. Compile a status of Adolescence population and academic profile for the last 5(five) years and make a presentation in a seminar mode (focus area can be chosen from any specific component such as: disability, girl student, tribal, Muslim girls etc).

### Suggested Readings

1. Cole, M and Cole, S (1989). *The Development of Children*, Scientific American Books, New York
2. Huslok, E.B. (2003). *Child Growth and Development*, Tata McGraw Hill
3. Kakkar, S (1978). *The Inner World: A Psychoanalytic Study of Childhood and Society in India*. Oxford University Press, New Delhi
4. NCERT: Module on Adolescence Education
5. Mishra, A (2007), *Everyday Life in a Slum in Delhi*. In D.K. Behera (Ed.0. *Childhood in South Asia*. New Delhi: Pearson Education India
6. Nambissan, G.B. (2009). *Exclusion and Discrimination in Schools: Experiences of Dalit Children*. Indian Institute of Dalit Students and UNICEF
7. Parry, J. (2005). *Changing Childhoods in Industrial Chattisgarh*. In R. Chopra and P. Jeffery (Eds), *Educational regimes in Contemporary India*. Sage
8. Piaget, J. (1997). *Development and Learning*. In M. Gauvain and M. Cole (Eds), *Readings on the development of children*. New York: WH Freeman and Company
9. Saraswathi, T.S. (1999). *Adult-Child Continuity in India: Is Adolescence a myth or an emerging reality?* In T.S. Saraswathi (Ed), *Culture, Socialisation and Human Development: Theory, research and applications in India*. New Delhi. Sage
10. Sharma, N (2011). *Understanding Adolescence*, MBT India
11. Singh, A (Ed), (2015). *Human Development: A Life Span Approach*. Orient Black Swan, Delhi
12. Woolfolk, A. (2008). *Educational Psychology*. Pearson Education.

### CPS.1: Language across the Curriculum

<b>Semester-II</b>	<b>Credit-2</b>
<b>Marks 50</b>	<b>Contact Hours- 2hrs.</b>
<b>Internal(10)</b>	<b>per week</b>
<b>External(40)</b>	

### Introduction

The role of languages across the curriculum is being increasingly recognized. We need to understand that language education is not confined to the language classroom. A science, social science or mathematics class is *ipso facto* a language class. Learning the subject means learning the terminology, understanding the concepts, and being able to discuss and write about them critically. Language is the medium for comprehending ideas, for reflection and thinking, as well as for expression and communication. Enhancing one's faculty in the language of instruction is thus a vital need of student-teachers, irrespective of the subject areas that they are going to teach. No matter what the subject, teaching cannot take place in a language-free environment. Assumptions about the language and literacy background of students influence classroom interactions, pedagogical decisions and the nature of students' learning. It is important to understand the language background of the students and know how oral and written language can be used in the classroom to ensure optimal learning of the subject area.

This course is visualized to create sensitivity to the language diversity that exists in the classrooms; understanding the language background of students, as first or second language users of the language used in teaching the subject. The focus is to help student-teachers understand the nature of classroom discourse and develop strategies for using oral language in the classroom in a manner that promotes learning in the subject area as well as to develop critical reading comprehension in the content areas, informational reading and developing writing in specific content areas with familiarity of different registers.

### Objectives

The course will enable the student teachers to;

- Understand the language background of students.
- Understand the nature of classroom discourse.
- Understand the nature and need of communication skills including reading and writing

#### **Unit I: Concerns for Language in Curriculum**

- Varied language contexts of the learners: dialect, regional varieties and standard language
- Understanding multilingualism in the classroom : challenges and strategies
- Home language and school language

#### **Unit II: Language and Curriculum Transaction**

- Classroom Discourse: strategies for using oral language in the classroom
- Discussion as an approach for learning: mode (participatory, interactive, collaborative)
- Questioning and classroom discussion-importance and relationship

#### **Unit III: Developing Communication Competencies: Reading and Writing**

- Reading school texts (Language, social science, science, mathematics): expository texts vs. narrative texts; transactional text vs. reflective texts.
- Reading strategies — scanning, skimming and reading for extracting information
- Forms of Writing: note taking, note making, summarizing; writing with purpose
- Analyzing students' reading and writing; developing reading and writing competencies

#### **Suggested Activities**

- Preparation of a report on diversity of languages in a classroom and connect it with classroom discourse.
- Re-telling the text - in one's own language from different points of view and narrating / describing a related account from one's life experience.
- Choose a few words from different texts of content areas and give examples how similar word / language can be used in different context to convey the meaning.
- Critical reading for attending to 'framing' of the article, point(s) of view presented, possible biases or slants (small group discussion)
- Writing articles/reports on topics related to content areas and current issues.

#### **Suggested Readings:**

1. Anderson, R.C. (1984). Role of the Reader's Schema in Comprehension, Learning and Memory. In R.C. Anderson, J. Osbon & R.J. Tierney (ed) *Learning to Read in American schools: Based Readers and content texts*. Hillsdale, Lawrence Erlbaum Associates: New Jersey.
2. Applying a Vygotskian Model of Learning and Development in B. Spodek (ed.) *Handbook of research on the education of young children*. Macmillan: New York.
3. Armbruster, Bonnie B. (1984) The Problem of "Inconsiderate Text" In Duffy, G. G. (ed.) *Comprehension Instruction, Perspectives and Suggestions*. Longman: New York.
4. Butler, A. and J. Turnbull, (1984) *Towards Reading-Writing Classroom* Primary English Teaching Association Cornell University: New York.
5. Freedman S. W. and A. H. Dyson (2003) Writing in Flood J. et. al. *Handbook of Research on Teaching English Language Arts*: Lawrence Erlbaum Associates Inc: New Jersey, USA..
6. Kumar Krishna (2007) *The Child's Language and the Teacher*. National Book Trust: new Delhi.
7. Labov, W. (1972) The logic of Non- Standard English. In *Language in Education*. Prepared by Language and Learning course Team. Routledge: London.
8. Martin, Jr. B. (1987) The Making of a Reader: A Personal Narrative. In Bernice E. Cullinan, *Children's Literature in the Reading Programme*. International Reading Association: Michigan..

9. Mason, J. M. and S. Sinha (1992) *Emerging Literacy in the Early Childhood Years*.
  10. Monson, R. J. (1991) *Charting a New Course with Whole Language. Edn. Leadership*.
  11. Pinnell, G.S. (1985) *Ways to Look at the Functions of Children's Language*. In A. Jaggar, M. Trika and Smith-Burke (ed.) *Observing the language learner*. International Reading Association: Newark, DE.
  12. Purves, Alan C. (1988). *The Aesthetic Mind of Louise Rosenblatt. Reader 20*.
  13. Rhodes, L. K. and N. L. Shanklin (1993) *Windows into Literacy*. Heinemann, The University of Michigan: UK.
  14. Rothleen, L. and A. M. Meinbach (1991) *The Literature Connection: Using Children's Books in Classroom*. Good Year Books: Tucson, USA.
  15. Sinha, S. (2000) *Acquiring Literacy in Schools. Redesigning Curricula: A symposium on working a framework for School education Seminar*.
  16. Sinha, Shobha. (2009). *Rosenblatt's Theory of Reading: Exploring Literature. Contemporary Education Dialogue*.
- Teals, W. and E. Sulzby (1986) *Introduction: Emergent Literacy as a perspective for Examining how young Children Become Writers and Readers*. In W. Teals, E. Sulzby (ed.) *Emergent Literacy: Writing and Reading*. Norwood: New Jersey.

**SEMESTER III**  
**PE 3: Learning and Teaching**

<b>Semester-III</b>	<b>Credits-4</b>
<b>Total Marks:100</b> <b>(Internal:20 External: 80)</b>	<b>Contact Hours: 4 hours</b> <b>per week</b>

### Introduction

This course brings together the perspectives from many other courses and draws upon theoretical understanding from psychology, philosophy, sociology and language learning. It provides an opportunity to student teachers to reflect on and critically analyze notions of learning and teaching on the basis of their own experiences and to move beyond them. Student teachers will understand various theories of learning. They will engage theoretically and through observation with the notion of learning as construction of knowledge. The student teachers will also critically analyze and discuss complex nature of teaching. They will analyze teaching as a profession and will reflect on how to teach effectively in a diverse classroom.

### Objectives

The course will enable the student teachers to;

- Develop an understanding about the differential learning needs of the learners with regard to abilities, learning styles, socio-cultural differences, language, and learning difficulties.
- Differentiate learning as transmission and reception Vs. learning as construction
- Understand different theoretical perspectives of learning including the constructivist perspective
- Understand nature and strategy of meaningful and concept learning, role of multiple intelligence in it.
- Develop understanding about teaching as profession

### Unit I: Understanding Learning

- Meaning and nature: learning as process and outcome

- Understanding learning styles of students at elementary and secondary levels; Its implications for teachers
- Different viewpoints on learning and their classroom implications: Behaviourist (Skinner), Cognitivist (Piaget), Humanist (Roger) and Constructivist (Piaget and Vygotsky)
- Factors affecting learning: individual differences, conditions of learning and methods.

### **Unit II: Learning in ‘Constructivist’ Perspective**

- Learning as ‘construction of knowledge’ and learning as ‘transmission and reception of knowledge’- differences
- Understanding processes facilitating ‘construction of knowledge’: Experiential learning and Reflection, Social mediation, Cognitive negotiation, Situated learning and Cognitive apprenticeship, Meta-cognition.
- Facilitative learning environment: teachers’ attitude, expectation- enhancing motivation, positive emotion, self-efficacy, collaborative and self-regulated learning.

### **Unit III: Meaningful and Concept Learning**

- Meaningful learning: Nature and characteristics, Views of Ausubel and Bruner; Facilitating meaningful learning in and outside school-strategies and role of teacher
- Gardner’s theory of multiple intelligence: Implications for meaningful learning
- Learning as meaning-making: concept, process, learner as meaning maker-characteristics of the learner; role of inquiry in meaning making
- Concept Learning: Meaning, prototypes and exemplars: strategies for teaching concepts-concept map.

### **UNIT-IV: Teaching and Learning**

- Teaching: Meaning and Nature-Teaching as Instructing Vs. Teaching as facilitating learning, teaching as empowering learners, Phases of teaching: preactive, interactive and post active; levels of teaching-memory, understanding and reflective; Models of Teaching- information Processing Models,. Personal Models, Social Interaction Models and . Behaviour Modification Models
- Characteristics of effective teachers : content knowledge, pedagogical knowledge and technological knowledge, professional attitude, reflective practice
- Action research: meaning, nature and importance for improvement of teaching learning process
- Teacher’s professional ethics and accountability-meaning, importance and dimensions; recommendations of NPE 1986/92, RTE Act 2009; strategies for ensuring teacher accountability

### **Suggested Activities**

1. Visit to nearby schools (at least four different schools). Observe teaching learning process in some classrooms for few days. Make records and prepare a presentation highlighting various kinds of learning and teaching which you observed there.
2. Observe a class in your practising school for few days and prepare a note highlighting how teachers addressed the learning needs of different learners. Give examples with respect to gender, inclusion, culture and language.
3. Prepare concept maps on pedagogy subject, teach in school and write a reflective note on how it helps learner.
4. Read few diaries written by teachers, analyse their text in the context of teaching activities.
5. Interact with your peers and few teachers. Discuss whether teaching is a profession and prepare a report on the basis of their perception.
6. Interact with few teachers in a nearby school and discuss with them the relevance of training they received with respect to the classroom teaching.

### **Suggested Readings**

0. Bhutt, H. *The dairy of a school teacher: An AzimPremji University publications*, [www.arvindguptatoys.com/arvindgupta/diary - school teacher- eng.pdf](http://www.arvindguptatoys.com/arvindgupta/diary-school-teacher-eng.pdf)
  1. Burden, Paul R; Byrd, David. M. (1999). *Methods for Effective Teaching* (Sec Edition), Allyn and Bacon.
  2. Carr, D (2005), *Making sense of education: An introduction to the philosophy and theory of education and teaching*, Routledge.
  3. Delpit, L (2006). *Other people's children, cultural conflict in the classroom*. The New press.
  4. Dhar, T.N. (Ed). 1996. *Professional status of Teachers*, NCTE, New Delhi.
  5. Kauchak, D. P and Eggen, P. D (1998). *Learning and Teaching, : Research based methods*, Boston: Allyn and Bocan
  6. Ladsen – Billings, G (1995). Toward a theory of culturally relevant pedagogy. *American Educational Research Journal*, 32 (3), 465-491.
  7. Lampert, M. (2001). *Teaching problems and the problems of teaching*. Yale University press.
  8. Mohalik, R. (2010). *In-service Teacher Education*. Mahamaya Publishing House, New Delhi.
  9. NCERT (2005). *National Curriculum Framework*, New Delhi
  10. Olson, D.R. & Bruner, J.S. (1996). “Folk Psychology and Folk Pedagogy”. In D.R. Olson & N. Torrance (Eds.). *The Handbook of Education and Human Development* (PP.9-27).Blackwell.
  11. Piaget, J. (1997). “Development and Learning”, In M. Gauvain& M. Cole (Eds.), *Reading on the Development of Children*. New York: WH Freeman & Company.
- Rogeff, B; Baker-Sennatt, T., Lacasa, P. and Goldsmith, D. (1995). Development through participation in socio-cultural activity, *New Directions for child and adolescent development*, 1995 (67), 45-65.
  - Sethy, R. (2014). *Style and Strategy of In-service Teacher Education*. LAP Publication, Germany.
  - Shulman, L.S. (1986). Those who understand: Knowledge growth in teaching. *Educational Researcher*, 4-14.
  - Vygotsky, L. (1997). “Interaction between Learning and Development”, In M. Gauvain& M. Cole (Eds.) *Reading on the Development of Children*, New York: WH Freeman & Company.
  - Woolfolk, A. (2008). *Educational Psychology*. Pearson Education.

**PE.4: Schooling, Socialization and Identity**

<b>Semester-III</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal:20 External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

**Introduction:**

Schools, apart from transmitting curricular knowledge and skills, serve as crucial sites for processes of socialization and transmission of value frameworks that are more often than not, unexamined. Schooling may thus be seen as a key ingredient in the socialization of the young. This socialization ultimately contributes to and results in the formation of identity. However, children who attend school have, already, been socialized into certain value frame by the time they enter school. The value-frame, sense of self, and identity imbibed by the child at home and in the wider society, interacts in complex ways with school and its socialization processes, more often than not being in conflict. This is furthermore also true of adult learners who join teacher education. Therefore, this course, precisely, intends to analyze and critique the way self and its identities are constructed through socialization process within as well as outside the school. In the process of analyzing the self and identity critically, the course deliberately brings in the social categories such as, caste, class, gender, religion, as well as other factors that are at work in constructing the self and identity of individuals and collectives.

Gender is a social construct that impacts attitudes, roles, responsibilities and behavior patterns of an individual in societies. Gender relations vary from society to society. Gender determines power relations in multicultural societies like India. It deals with human concerns encompassing diversities and differences. It has been the most visible form of discrimination operating across cultures in developing societies.

Further, the course intends to provide opportunities to contest the value frame emanating from these processes of socialization. An understanding of the multiple processes that form the self and identity ought to result in a capacity to reflect on one's own self and identity, putting this under critical scrutiny. In becoming conscious of the many factors that influence identity and self, the student-teachers should become more sensitively aware of these and begin to 'free' themselves from limiting conceptions of self and identity, thus becoming proactive in shaping their own identities as 'teachers' and 'professionals'.

**Objectives**

The course will enable the student teachers to;

- Reflect critically on factors that shape identity formation and influence sense of self of the growing 'student' as well as 'teacher' in school as well as in out of school situations
- Understand the processes that have shaped/continue to shape one's own sense of identity as 'student' and a 'person' located in multiple social contexts and roles
- Develop basic understanding and familiarity with key concepts-gender, gender bias, gender stereotype, empowerment, gender parity, equity and equality, patriarchy and feminism and transgender
- Understand the need to address gender based violence in all social spaces and evolve strategies for addressing it.
- Critically aware of 'self' and 'identity' and 'free' oneself through self-understanding, from tendencies that lead to crystallizing and limiting of one's identity as a teacher and a human being.
- Reflect on one's aspirations and possibilities in order to develop a growing sense of agency as a 'teacher', a 'professional', as well as a 'human being'.

**Unit I: Socialization and Development of Self**

- Socialisation: Meaning nature and process

- Role of social institutions :Family- impact of parenting style/child rearing practices, family culture and values; Community-neighbourhood, extended family, religious groups and their socialization functions; School- School as a social institution; value-formation in the context of schooling;
- Interface between family, community and school; inter-linkages within wider socio-cultural context
- Development of self: Meaning of self, dimensions and impact of socialization.

### **Unit II: Emergence of ‘Person’ and ‘Identity’**

- Understanding ‘identity formation’: emergence of multiple identities in the formation of a person placed in various social and institutional contexts; the need for inner coherence; managing conflicting ‘identities’.
- Determinants of identity formation in individuals and groups: Social categories such as caste, class, gender and religion
- The influence of peer group, media , technology, and globalization on identity formation in contemporary society

### **Unit III: Socialization Processes: Gender, School and Society**

- Gender Bias, Gender Stereotyping and Empowerment of women
- Equity and Equality in Relation with Caste, Class, Religion, Ethnicity, Disability and Region.
- Gender Identities and Socialization Practices in different types of families in India.
- a. Assertion of identities, oppression, conflict and violence ;Addressing sexual abuse in family, Neighborhood and School and in other formal and informal institutions

### **Unit IV: Evolving Identity as a Teacher**

- Teacher’s ‘professional identity; Meaning and various dimensions
- Choosing to be a teacher: Role of family, community, schooling
- Teacher identity formation: Role of pre-service and in-service teacher education programmes
- The impact of one’s own socialization processes; awareness of one’s own shifting identities as ‘student’, ‘adult’ and ‘student teacher’, and influences that have acted/continue to act on oneself
- Reflections on one’s own aspirations and efforts in becoming a ‘teacher’

### **Suggested Activities**

1. Group work and discussion on the influence of peer group, media message, technology, and globalization on identity formation in contemporary society
2. Group work and discussion on the factors that contribute positively and negatively in the development of teacher identity
3. Organize Debates on Equity and Equality cutting across Gender, Class, Caste, Religion, Ethnicity Disability and Region.
4. Prepare a project on Issues and Concerns of Transgender.
5. Collection of Folklores reflecting Socialization Processes and its Influence on Identity formation.
6. Project on Women Role Models in various fields with Emphasis on Women in Unconventional Roles.
7. Visit to organizations connected with peace and inter cultural harmony and aesthetic appreciation to experience peace as reality and submission of report.
8. Developing action plan for peace in self, home, school and community.

### **Suggested Readings**

1. Amalendu Misra, (2004). Identity and Religion Foundations of Anti-Islamism in India. Sage Publications, New Delhi

2. Butler, J. (1990). *Gender Trouble: Feminism and the subversion of Identity*. New York; Routledge.
3. Chap. 6: Parents and Teachers
4. Desai, Neera and Thakkar, Usha. (2001). *Women in Indian Society*. National Book Trust, New Delhi
5. Dipankar Gupta (Ed.) (2004). *Caste in question Identity or Hierarchy*. Sage Publications, New Delhi.
6. Dunne, M. et al. (2003). *Gender and Violence in Schools*. UNESCO.
7. Kamala Ganesh & Usha Thakkar (Ed.) (2005). *Culture and Making of Identity in India*, Sage Publications, New Delhi.
8. Kirk Jackie e.d. , (2008), *Women Teaching in South Asia*, SAGE, New Delhi
9. Krishnamurti, J., *Education and the Significance of Life*, KFI Publications
10. Kumar Krishna (2004), *What is Worth Teaching?* 3<sup>rd</sup> edition, Orient Longman
11. Kumar, K.(2001) *Prejudice and Pride: School Histories of the Freedom Struggle*. New Delhi: Viking/Penguin.
12. Leach, Fiona. (2003). *Practising Gender Analysis in Education*, Oxfam
13. National Curriculum Framework 2005: Position Paper, National Focus Group on Gender Issues in Education, 3.2, NCERT, 2006.
14. Nayar, Sushila and Mankekar Kamla (ed.) 2007, 'Women Pioneers in India's Renaissance, National Book Trust, New Delhi, India.
15. NCERT (2014). *Scholling Socialisation and Identity*. NCERT, New Delhi.
16. Pathak, Avijit (2002), *Social Implications of Schooling*, Rainbow Publishers, Delhi
17. Saraswati, T.S. (Ed.) (1999). *Culture, Socialization and Human Development. Theory: Research and Applications in India*, Sage Publication, New Delhi.
18. Sen Amartya (2006). *Identity and Violence. The Illusion of Destiny*. Allen and Lane: Penguin Books India Pvt. Ltd. New Delhi.
19. Sharma, R & E. Annamalai. (2003). *Indian Diaspora: In Search of Identity*. Mysore: CIIL.
20. Shashi Tharoor (2007). *The Elephant, the Tiger & the Cell phone*. (Particularly part two of the book). Penguin Viking, New Delhi.
21. Sherwani, Azim. (1998). *the girl child in crisis*. Indian Social Institute, New Delhi.
22. Srinivas M.N., (1986). *Social Changes in Modern India*, Allied Publishers, Bombay.
23. Srivastava Gouri, (2012), *Gender and Peace in Textbooks and Schooling Processes*, Concept Publishing Company Pvt. Ltd, New Delhi
24. UNICEF (2005). *2005 and Beyond – Accelerating Girls' Education in South Asia*. Meeting Report.
25. Unterhalter, Elaine. (2007). *Gender, Schooling and Global Social Justice*, Routledge.
26. Vidyanathan, T.G. (1989), 'Authority and Identity in India', in 'Another India' *Daedalus*, Fall, 118 (H): 147-69.

**SEMESTER-IV**  
**PE 5: Assessment for Learning**

<b>Semester-IV</b>	<b>Credits-4</b>
<b>Total Marks:100</b> <b>(Internal:20 External: 80)</b>	<b>Contact Hours: 4</b> <b>hours per week</b>

### Introduction

This Course – as its title suggests - proposes that teacher-learners become conscious of the distinction between assessment *for* learning and assessment *of* learning. Whereas both have their place in school education, a constructivist paradigm indicates a shift in emphasis towards the former. The course intends to enlarge current perspectives on assessment and evaluation, and enable teacher-learners to view student learning along multiple dimensions. It brings a specific focus on assessment of subject-based learning, as well as processes of feedback and reporting, which are among the core competencies needed by teachers. A critical review of the examination system and the assessment practices that derive from this is also felt to be a necessary component of the course; so that teacher-learners may learn to evolve more flexible and richer forms of assessment, even as they respond to current examination practices.

Assessment (and evaluation) is integral to school education and more specifically to teaching-learning. Since education in schools presupposes certain aims and objectives, it is crucial for teachers to be aware of how the progress and growth of students is to be assessed. This in turn implies that teachers become cognizant of what dimensions of growth or learning are to be assessed, what means are available to them for this purpose, and what effects are likely to flow from various kinds of assessment.

### Objectives

The course will enable the student teachers to;

- Understand the nature, purpose and types of educational assessment and evaluation.
- Develop and use different types of tools and techniques for continuous and comprehensive assessment of learning in the school situation.
- Explain the importance of assessment for learning and its processes for enhancing the quality of learning and teaching
- Analyze the trends and issues in learning and learner assessment.
- Analyze and interpret results of the assessment using elementary statistical methods.

### Unit-I:Assessment, Evaluation and Learning

- Assessment and Evaluation: Meaning, purpose of assessment (improving learning and teaching);purpose of evaluation (placement, diagnosis, promotion, certification, providing feedback); Interrelationship between assessment and evaluation
- Classification of Assessment based on Purpose (Placement, Formative, Diagnostic, and Summative), Scope(Teacher-made, Standardized), Attributes Measured (Achievement, Attitude, Aptitude etc.), Nature of Information gathered(Qualitative, Quantitative), Mode of Response (Oral, Written and Performance), Nature of Interpretation(Norm-referenced and Criterion- referenced),and the Context(Internal , External).
- Continuous and Comprehensive Assessment: Assessment of Learning, Assessment for Learning, and Assessment as Learning; CCA vs CCE,Mode of assessment: formative and summative; continuous and comprehensive; culture responsive
- Tools and techniques: Formal (testing, observation schedules, video recording etc.), Informal (taking notes , Interviewing, Participant observation etc.) methods, use of testing devices (achievement test,

diagnostic test, proficiency test etc and non-testing devices (assignment, projects, reflective journals, portfolio etc), use of multiple methods and tools (situation specific combinations)

### **Unit-II. Construction of Test and Use**

- Planning the test: Development of table of specifications (blueprint)
- Preparing the test: principles of preparing test items-objective based items-Extended and Restricted response types, Objective type items (free response type-short answer and completion; fixed response type- matching, forced/alternate choice, multiple choice); Assembling and editing the items
- Administration of the test and analysis of students' performance; Preparation of report and its use in enhancing learning.

### **Unit-III: Issues in Assessment and Policy Provisions**

- Current practices: Over-emphasis on Summative Assessment(Periodic and common/year-end examinations) and marking; competitive examination-its adverse effects on learners, education system and society
- Issues and Problems : Marking vs. Grading, objectivity vs. subjectivity, Close-ended vs. Open-ended test items, relative neglect of non-cognitive aspects, non-use of diverse methods and tools for assessing diverse learners
- Policy perspectives: Recommendations of NPE1986/92, NCF-2005, RCFCE Act 2009; Non-detention policy and its implications for assessment and quality of learning
- Emerging practices in assessment – online assessment, participatory assessment, Self and peer assessment; Feedback mechanism: Reporting to students and parents-need and modes, feedback for teachers, role of community in CCA for assessment of learning

### **Unit-IV: Elementary Statistics in Evaluation**

- Raw score, Tabulation and Frequency distribution
- Graphical representation of data
- Measures of central tendency (mean, median and mode), dispersion (range, quartile deviation and standard deviation) and their uses in evaluation
- Standard scores; T score, Z score, percentile and their uses
- Correlation: Meaning, types (product moment and rank difference), calculation and uses

### **Suggested Activities**

- Preparation of 50 objective-based items, at least 5 from each type of test items in any school subject.
- Construction of an achievement test on any topic(carrying 25 marks), its administration and interpretation of the results.
- Preparation of a plan for CCA activities for any class during an academic session.
- Appraisal of current CCA practices in the secondary schools.
- Analysis of examination marks obtained by the students in any subject in a class and preparation of a report for sharing.

### **Suggested Readings**

- Anderson, L.W.(2003). *Classroom assessment: Enhancing the quality of teacher decision making*. Mahwah, New Jersey: Lawrence Erlbaum Associates.
- Burke, K.(2005). *How to assess authentic learning* (4th Ed.). Thousand Oaks, CA: Corwin.
- Cooper, D.(2007). *Talk about assessment: Strategies and tools to improve learning*. Toronto, Ontario: Thomson Nelson.
- Danielson, C.(2002). *Enhancing student achievement: A framework for school improvement*. Alexandria, VA: Association for Supervision and Curriculum Development

- Garrett, H.E. (1973). *Statistics in psychology and education* (6<sup>th</sup> ed.). Bombay: Vakils, Feffer & Simon.
- Gronlund, N.E. & Linn, R.L. (2009). *Measurement and assessment in teaching* (10<sup>th</sup> Edn). Upper Saddle River, NJ: Pearson Education, Inc.
- Newman, F.M. (1996). *Authentic achievement: Restructuring schools for intellectual quality*. San Francisco, CA: Jossey-Bass.
- Nitko, A.J. (2001). *Educational assessment of students* (3<sup>rd</sup> ed.). Upper Saddle River, NJ: Prentice Hall.
- Popham, W.J. (1993). *Modern educational measurement*. Englewood Cliffs, N.J.: Prentice Hall.
- Popham, W.J. (2010). *Classroom assessment: What teachers need to know* (6<sup>th</sup> ed.). New York: Prentice Hall.
- Shepard, L.A. (2000). The role of assessment in learning culture. *Educational Researcher*, 4-14.
- Stiggins, R. (2005). *Student-involved classroom assessment*. (4<sup>th</sup> ed). Columbus, Ohio: Merrill

**Semester-IV**  
**PE 6: Creating an Inclusive School**

<b>Semester-IV</b>	<b>Credits-2</b>
<b>Total Marks: 50</b> <b>(Internal: 10 External: 40)</b>	<b>Contact Hours: 2</b> <b>hours per week</b>

### Introduction

The diversity in society is a fact and the reflection of it in the school is natural. Traditionally these diversities were considered as inability of the individual to be able to meet the requirement of the school/classroom. Now diversities are considered as imposed by the hurdles created by the society. Similarly the difficulties of students to learn in the classroom are due to the expectation of the system, architecture of the building and classroom, design of teaching and many other related factors. The philosophy underlying this course is that every student is unique and each one has the potentiality to learn. The management of individual difference is a social responsibility which a school has to accept. Creating a learning environment to provide opportunity to participate fully in the process of learning is the task for a teacher. This is an effort with an intention to develop a mindset in the teacher which results in accepting 'all' children in the class as his/her responsibility. This is a small beginning to a teacher towards a major shift towards change in the system and society. With this course it is expected that the teacher will understand student who is 'different' in the class as 'unique' who needs the input and attention like other students. The modalities of transaction will include case studies and interactions with eminent speaker, group discussions, book reviews, self-learning, ICT based teaching learning, visits to various schools (special, integrated and inclusive) and institutions (national and regional centers), viewing relevant documentaries and films, critical analysis and reflections

### Objectives

The course will enable the student teachers to;

- Understand the meaning and significance of Inclusive education
- Gain knowledge on Policy and legislative frameworks promoting inclusion
- Learn to create inclusive classrooms using inclusive pedagogy (teaching strategies, CCE)
- Understand the linkages and collaborations for resource mobilization.

### **Unit I: Understanding Inclusion in Education**

- Concept of inclusion in education: need and importance; paradigm shift from segregation to inclusion
- Inclusive school: concept and characteristics
- Policy perspective: Initiatives to promote inclusive education- equity and equality
- International Focus: Salamanca 1994, UNCRPD, EFA (MDG)
- National Focus: Constitutional obligations for education of diverse groups, RTE 2009, NPE, 1986-92, PWD Act 1995 and revised PWD Bill 2012, NCF 2005 and NFG paper, SSA, RMSA, National Commission on Minority Education Institutions(NCMEI), National Commission for Education of SC, ST
- Educational concessions, facilities and provisions.

### **Unit II: Understanding Diversity for Inclusive Education**

- Diversity due to disability (Nature, Characteristic and Needs)
- Special needs of children with sensory disabilities,
- Special needs of children with cognitive disabilities
- Special needs of children with physical disabilities
- Girls with disabilities, multiples disabilities
- Diversity due to socio- cultural and economic factors:Special needs of children arising due to language difference, gender, class, caste, religion and other factors

### **Unit III: Addressing Diversities in Inclusive Set Up**

- Curricular Issues: Content, Relevance and contextualization; Curricular process; managing inclusive classroom; Assessment
- Promoting gender equality through education
- Learning and learners: support/assistive and adaptive devices, ICT use; Universal Design for Learning (UDL)

### **Suggested Activities**

1. During the field visit, observe the teaching learning processes, infrastructure available and assess the nature of inclusive indicator/practices. List the existing challenges and factors that promote inclusive practices. Please give justifications.
2. Prepare the need profile of all children in a class. Critically analyze the profile prepared for establishing relation between students' needs and their abilities/disabilities. Identify relationship between students' needs and their socio-economic and educational status.
3. Adapt at least one pedagogical practice studied in the pedagogy course and suggest ways to make it appropriate for addressing the needs of all learners in the class.
4. Study the assessment and evaluation practices being followed in a school. Critically reflect on the practices in the context of inclusive education.
5. Review the characterization of challenged persons/children in the popular media. If possible draw correlations between popular myths and current beliefs and media representations.
6. Visit a nearby special, inclusive and regular school. Make observations in terms of time table, teaching learning activities, infrastructure, child to child interaction and parental support. Compare the practices.
7. Carry out interaction with the regular teachers and ascertain the current challenges for promoting inclusive education. Try to collect their opinion on the subject. Talk to at least 25 teachers.
8. Is inclusion a new concept? Find evidence of inclusion in Vedic era and trace the journey to modern times. Think. Reflect and Discuss.

**Suggested Readings**

- Ainscow, M. and Booth, T (2002) *Index for Inclusion: Developing Learning and Participation in Schools*. Bristol: CSIE.
- Ainscow, M., Dyson, A. and Booth, T. (2006) *Improving Schools, Developing Inclusion*, London: Routledge.
- Hegarty, S. and Mithu Alur (2002) *Education and Children with Special Educational Needs- Segregation to Inclusion*, New Delhi: Sage Publication India Pvt. Ltd
- Julka, A, *Index of Incusion* (2012) NCERT, New Delhi.
- Jha.M.( 2002) *Inclusive Education for All: Schools Without Walls*, Heinemann Educational publishers, Multivista Global Ltd, Chennai
- Julka, A (2006) *Meeting special needs in schools” A manual*, NCERT, New Delhi
- UNICEF (2003) *Examples of Inclusive Education*, UNICEF ROSA, Kathmandu
- World Bank (2003) *Inclusive Education: Achieving Education for All including those with Disabilities and Special Educational Needs*.
- Ysseldyke, J.E. and Algozzine, B. (1998) *Special Education A Practical approach for Teachers*, New Delhi: Kanishka Publishers Distributors.
- Julka, A.(2014) *Including Children with Special Needs: Primary Stage*
- Julka, A.(2015) *Including Children with Special Needs: Upper Primary Stage*
- Julka, A. (2014) *Teachers Creating Inclusive Classrooms: Issues and Challenges – A Research Study*
- NCERT(2006), *Position Paper : National Focus Group on Education of children with Special Needs*, NCERT; DEGSN, New Delhi
- NCERT(2006), *Position Paper: National Focus Group on Problems of Scheduled Castes and Scheduled Tribe Children* NCERT, DEGSN, New Delhi.
- MHRD (2009), *The Right of Children to Free and Compulsory Education Act, 2009*. Ministry of Human Resource Development, New Delhi

**SEMESTER V**  
**CPS 2: PEDAGOGY OF MATHEMATICS (Part-I)**

<b>Semester-V</b>	<b>Credit-4</b>
<b>Marks 100</b> <b>(Internal 20 + External 80)</b>	<b>Contact Hours- 4hrs.</b> <b>per week</b>

**Introduction**

Mathematics is considered as a basic subject at the school stage enabling the students to acquire basic human values along with developing fundamental mathematical abilities like computation and logical thinking. It has its utilitarian value, practical value and disciplinary value. It contributes a lot to development of human civilization. This course is intended to develop methods and skills of teaching Mathematics and students will understand its importance along with contribution to the field of knowledge.

**Objectives**

The course will enable the student teachers to;

- Understand the nature, scope, and values of Mathematics and its place in the school curriculum'
- Specify comprehensively the objectives of teaching and learning Mathematics at the secondary and higher secondary levels of school education.
- Develop long term and short term plans along with daily lesson plans for teaching and learning mathematics at the school stage.
- Understand different approaches and methods of teaching and learning mathematics.
- Develop plans along with tools and procedures for conducting continuous and comprehensive assessment of and for students' leaning mathematics.

**Unit 1: Concept and Importance of Mathematics Education**

- Nature and Scope of Mathematics: Nature of Mathematical propositions, Mathematical proof, structure and logic;
- Meaning and building blocks of mathematics-undefined terms, definitions, axioms, theorems; the nature of mathematical propositions- truth values, truth tables, Open sentences, logically valid conclusions, use of quantifiers, implications - necessary and sufficient conditions, a mathematical statement and its variants—converse, inverse and contrapositive , compound propositions
- Values of Mathematics : Cultural , Disciplinary and Utilitarian values
- Place of Mathematics in School Curriculum, Correlation of Mathematics with other subjects
- Contribution of the Indian Mathematicians, Vedic Mathematics

**Unit 2: Objectives of Teaching and Learning Mathematics**

- Objectives of teaching Mathematics at Secondary and Higher Secondary Levels: [As recommended in various reports]
- General and Specific/ Learning Objectives of teaching Mathematics w.r.t. the taxonomy of educational objectives (Bloom's Taxonomy with Anderson's revision)
- Objectives of teaching and learning School Mathematics like Algebra, Geometry, Mensuration, Trigonometry etc.

**Unit 3: Planning Teaching-Learning of Mathematics**

- Content categories in Mathematics: [Facts, Concepts, Illustrations, Generalizations etc.]
- Content Analysis in Mathematics, Concept mapping in Mathematics taking sample contents from Algebra, Geometry, Trigonometry etc.
- Designing of learning experiences in Mathematics
- Yearly plan, Unit plan, Lesson plan; Elaborating specific steps of each type of plan

**Unit 4: Approaches/Methods and Assessment for Teaching and Learning Mathematics**

- *Learning by Discovery*: Nature and purpose of learning by discovery; guided discovery strategies in teaching Mathematical concepts, Laboratory Methods;*Teaching for Understanding Proof*: Proof by induction and

- deduction; proof by analysis and synthesis,
- *Problem Solving in Mathematics*: Importance of problem solving in Mathematics, Steps of problem solving in Mathematics, Problem Posing, Generating and solving real life problems using Mathematical principles, Situation model for solving word problems.
  - *Constructivist approaches*: Self-learning and peer learning strategies, Projects and Collaborative strategies; 5E and ICON Models.
  - Assessment of Mathematics learning: Unit test – Designing blue print, item construction, marking schemes, Assessment for Mathematics Learning: Assignments, Projects and portfolios in Mathematics, group and collaborative assessment in Mathematics,
  - Non-testing methods of assessment of mathematics Learning: Observation of learners in action, rating of participation in various Mathematics tasks and activities

### Suggested Activities

1. Collection of the names of Mathematicians and preparation of a report about their contribution to Mathematics.
2. Group activity for preparation of concept maps on any topic of school mathematics.
3. Development of learning activities on different topics of Mathematics (at least 5 activities on any 2 topics of Algebra, 2 from Geometry and 2 from any other area.
4. Preparation of Annual, Monthly and Unit Plans for teaching-learning Mathematics.
5. Development of Lesson plans in Mathematics
6. Reflective paper on any problem of teaching and learning mathematics in a socio-cultural context.

### Reference Books :

1. Beckmann C.E ,Thompson D.R and Rubenstein,R.N.(2010).*Teaching and learning high school mathematics*.New Jersey: John Wiley and Sons Inc.,
2. Britton E, Huntley M.A., Jacobs G and Weinberg A.S.(1999). *Connecting mathematics and science to workplace contexts : A Guide to Curriculum materials*, Corwin Press Inc., California
3. Chambers P,(2010).*Teaching Mathematics: Developing as a reflective secondary teacher*. New Delhi: SAGE.
4. Cowan, Pamela (2006).*Teaching mathematics, A handbook for primary and secondary school teachers*. London: Routledge.
5. Davis D.R.(1951). *The teaching of mathematics*.London: Addison Wesley Press,
6. Hollands, Roy (1990).*Development of mathematical skills*, Oxford, London: Blackwell Publishers.
7. James,Anice(2005). *Teaching of mathematics*.Hyderabad: Neelkamal Publications.
8. Katz, V.J. (Ed.)(2007).*The Mathematics of Egypt, Mesopotamia, China, India and Islam :A Sourcebook*. Princeton, NJ: Princeton University Press.
9. Kothari, R.G., and Shelat, P.H. (2011).*Mathematical weaknesses among secondary school students*. Germany: VDM Verlag Publishers.
10. Kilpatrick J, Hoyles C and Skovsmose,O. (Eds.) (2005). *Meaning in mathematics education*.New York, NY: Springer.
11. NCERT (2006).*Position Paper: National Focus Group On Teaching of Mathematics*. New Delhi: National Council of Educational Research and Training.
12. NCERT (2012).*Pedagogy of Mathematics: Textbook for Two-Year B. Ed Course*. New Delhi: NCERT..
13. Noss R.(19988). The Computer as a cultural influence in mathematical learning. In Bishop A.J. (Ed.),*Mathematics education and culture*, London : Kluwer Academic Publishers.
14. Novak,J.D. & Gowin, D.B.(1984). *Learning how to learn*. New York, NY: Cambridge University Press.
15. Polya, George (1965). *Mathematical discovery*(Vol.II). London: John Wiley and sons, INC.,
16. Schonnel, F.J. (1965). *Diagnostic and remedial teaching in arithmetic*.London:Lever and Boyd.
17. Shetty, Balkrishna(2013). *What is mathematics?* NewDelhi: National Book Trust.
18. Skemp,R.R., (1971), *The Psychology of Learning mathematics*, Penguin Books
19. William D.(1998).A Framework for Thinking About Research in Mathematics and Science Education.In Malone J.A., Atweh B. and Northfield J.R. (Eds.),*Research and supervision in mathematics and science education*.New Jersey: Lawrence Erlbaum Associates.

### CPS 2 - Pedagogy of Biological Science (Part I)

<b>Semester-V</b>	<b>Credit-4</b>
<b>Marks 100</b> (Internal 20 + External 80)	<b>Contact Hours- 4hrs.</b> per week

#### Introduction

Being one of the disciplines of science, concerns and approaches of Biological Science are almost similar to that of Science in general i.e. quest for and enhancement of scientific enquiry. Teachers of Biological science also need to understand the nature of the discipline and arouse curiosity among young learners about natural surroundings vis-à-vis the entire living world. It is an established fact that concepts, theories and principles pertaining to living organisms have evolved over a period of time and are highly organized. Therefore, teaching-learning practices of biological sciences are expected to address the dynamism of evolving subject knowledge along with its organizational principles by following the strategies of scientific enquiry.

#### Objectives

The course will enable the student teachers to;

- Developing insight about nature of Biological sciences and facilitate inculcation of scientific attitude among learners
- Nurture curiosity among learners about her/his natural surroundings and relationships of every day's experience with concepts of Biological sciences
- Appreciate that Biological science is a dynamic and expanding body of knowledge
- Formulate appropriate and meaningful inquiry episodes, problem-solving situations and investigatory projects, based on curriculum
- Determining strategies of teaching-learning

#### Unit 1:

##### Nature and Scope of Biological Science

- Biological Science as a domain of scientific enquiry: Characteristics of scientific enquiry, Nature of enquiry in Biological Science, Distinguishing characteristics of Biological Science from other domains of scientific enquiry
- Scope of Biological Science for understanding the diversity of the living world, origin of life and its evolution, environment, health and well being, sustenance of the ecosystem vis-à-vis values and ethics.
- Linkages of Biological science with other branches of science and other disciplines.

#### Unit 2:

##### Aims and Objectives of Teaching and Learning Biological Science

- General and specific aims of teaching and learning Biological science in secondary and higher secondary classes.
- Development of knowledge and understanding of Biological facts, principles and its application in conformity with the developmental stages of learners.
- Acquiring skills to understand processes of studying Biology e.g. observation, exploration, experimentation; Generalisation of observations and validation of knowledge.
- Problem solving relating to Biological sciences; Relationship of Biology education with environment and its sustenance.

**Unit 3:****Curriculum and Learning resources of Biological Science at School Stage**

- Place of Biological Science in school curriculum (at elementary, secondary and senior secondary levels)
- Selection and organisation of content in Biology (on the basis of forms of knowledge { viz. declarative, procedural and situational } and themes)
- Analysis of school syllabus, textbooks and other printed materials in Biology (NCERT, State) on the basis of NCF 2005 and position paper on teaching of science.
- Learning resources in Biological Science: Preparation, collection, procurement and use of Charts, Graphs, Bulletin Boards, and Models. ICT materials like film strips, slides, transparencies, and open education resources.
- Laboratory as learning resource; Preservation of Biological specimens and building Biological museum, Science exhibitions and Science clubs. Locality and community as learning resources

**Unit 4:****Approaches and Methods of Learning Biology**

- Observation: Types, importance in Bio-Science, process, recording of observation
- Experimentation: Experimentation under controlled conditions within laboratory and beyond laboratory situations; Process and limitations
- Problem solving: Problem identification, formulation of hypotheses, collection of data, testing hypotheses and arriving at solution (with suitable examples from Biological Science).
- Project: Situation analysis, selection of the project, preparation of the project proposal, implementation, evaluation and reporting the project.
- Use of ICT for self- learning and collaborative learning in learning concepts of Biological science. Concept mapping in the major areas of Biology: the process ( inclusion of ICT facilities) and utility

**Suggested Activities**

1. Developing two learning resource for Biology (one including using ICT).
2. Interviewing the practitioners of Biological Science (University teachers and school teachers) on nature and practices in biological science and preparing a report
3. Comparing the Biology text books (elementary and secondary) on the basis of conceptual development, unifying themes and forms of knowledge.
4. Analyze NCF 2005, position paper on teaching of science and habitat and learning w.r.t. nature and aims of teaching and learning of Bioscience.

**Reference Books :**

1. Fraser, B. J. and Tobin, K. G. (Eds.). *International handbook of science teaching (Part 1)*. Dordrecht, The Netherlands: Kluwer Academic.
2. Mintzes J., Wandersee, J. and Novak, J. (Eds.) (2000). *Assessing science understanding: A human constructivist view*. San Diego, CA.: Academic Press.
3. NCERT (2000). *Position paper of national focus group (NFG) on aims of education*. National Council of Educational Research and Training (NCERT), New Delhi.
4. NCERT (2000). *Position paper of national focus group (NFG) on education for peace*. National Council of Educational Research and Training (NCERT), New Delhi.
5. NCERT (2000). *Position paper of national focus group (NFG) on examination reforms*. National Council of Educational Research and Training (NCERT), New Delhi.
6. NCERT (2000). *Position paper of national focus group (NFG) on gender issues in education*. National Council of Educational Research and Training (NCERT), New Delhi.
7. NCERT (2000). *Position paper of national focus group (NFG) on habitat and learning*. National Council of Educational Research and Training (NCERT), New Delhi.
8. NCERT (2000). *Position paper of national focus group (NFG) on teaching of science*. National Council of Educational Research and Training (NCERT), New Delhi.

9. NCERT (2005). *National curriculum framework for school education*. National Council of Educational Research and Training (NCERT), New Delhi.
10. Sutton, C.R. & Hayson, J.H. (1974). *The art of the science teacher*, McGraw Hill Book Company Ltd.
11. Vaidya, N. (1999). *Science teaching for 21<sup>st</sup> Century*. Deep & Deep Publication.
12. *Journal of Research in Science Teaching* (Wiley-Blackwell)
13. *Science & Children*. A peer reviewed journal published by National Science Teachers Association (NSTA).
14. *The Science Teacher*. A peer reviewed journal published by National Science Teachers Association (NSTA).

### CPS 3- Pedagogy of Physical Science (Part-I)

<b>Semester-V</b>	<b>Credit-4</b>
<b>Marks 100 (Internal 30 External 70)</b>	<b>Contact Hours- 5 hrs. per week</b>

#### Introduction

Science is an organized system of knowledge based on inquiry born out from natural curiosity, logical reasoning and experimentation. Therefore, student-teachers are expected to appreciate that every child is unique and possesses natural curiosity. The course focuses to develop the proficiency in the student-teachers to design teaching-learning situations keeping in view the nature of science, learning needs, context of all children through a variety of approaches. The course is intended to enable students-teachers to design and organize learner-centered, activity based, participatory learning experiences through observation, inquiry, dialogue, discussion, experiments, projects and field work. It is suggested that student-teachers perform various activities interacting with their classmate, textbooks of Upper Primary, Secondary and Higher Secondary stages and other relevant resources available.

#### Objectives

The course will enable the student teachers to;

- Gain insight on the meaning and nature of physical science
- Understand various aims and objectives of learning physical science
- Familiarize with different types of curricular projects in physical science, their purpose and themes
- Understand the process of science and role of laboratory in teaching- learning situation
- Appreciate and use various approaches of teaching-learning of physical science
- Explore and develop different learning resources and materials in learning different units in Physical Science.

#### Unit 1: Nature and Scope of Physical Science

- Physical Science as a domain of inquiry, as a dynamic and expanding body of knowledge
- Historical Perspectives in Physical Science
- Scope of Physical Science
- Interdisciplinary linkages and social concerns in physical science
- Scientific methods in Physical Science: a critical view

#### Unit 2: Aims and Objectives of Learning Physical Science

- Knowledge and understanding through science, Nurturing process skills of science, developing scientific attitude and scientific temper
- Nurturing curiosity, creativity and aesthetic sense in Physical science
- Imbibing various values related to Science
- Developing problem solving skills in Physical Science

#### Unit 3: Physical Science Curriculum and Learning resources

- Place of Physical Science in School Curriculum
- Selection and Organization of Content in Physical Science
- National Curriculum Frameworks of NCERT with specific reference to Physical Science Education, Analysis of school syllabus, textbooks and other printed materials in Physical Science (NCERT, State)
- Preparation, collection, procurement and use of learning resources in Physical Science such as Charts, Graphs, Bulletin Boards, Models, ICT resources etc ;Laboratory as a learning resource to facilitate induction, deduction, process Skills acquisition, nurturing creativity,

- Experiences in organizing physical science laboratory; Role of Science museum, Science exhibitions and Science clubs in facilitating learning Physical Science
- Innovative materials and processes, Community resources in learning Physical Science

#### **Unit 4: Approaches and Strategies in Learning Physical Science**

- Selecting appropriate approach and strategy in learning Physical Science based on content, learner, context
- Role of Observation and Experimentation in learning Physical Science
- Approaches and Strategies of learning Physical Science: Collaborative learning, Problem solving, Concept mapping, Conceptual Change Model, Experiential learning, Inquiry approach, Project Method, Analogy strategy
- ICT integrated Physical Science Learning

#### **Suggested Activities**

1. Interviewing a few Secondary school Science teachers, University Professors on nature and practice of Science
2. Assignment on Contribution of eminent scientists- Isaac Newton, John Dalton, J.C. Bose, Albert Einstein, Niels Bohr, C.V. Raman, Marie Curie, De Broglie, V. Ramakrishnan, etc.
3. Comparing the Science text books at Secondary stage on the basis of different validities of Science curriculum stipulated in NCF 2005
4. Design a learning situation in Physical Science by selecting an appropriate strategy
5. Design and develop at least two learning resources for physical science (one out of them has to be an ICT based learning resource)

#### **Reference Books:**

1. Fraser, B. J. and Tobin, K. G. (Eds.). *International handbook of science teaching (Part 1)*. Dordrecht, The Netherlands: Kluwer Academic.
2. Mintzes J., Wandersee, J. and Novak, J. (Eds.) (2000). *Assessing science understanding: A human constructivist view*. San Diego, CA.: Academic Press.
3. NCERT (2000). *Position paper of national focus group (NFG) on aims of education*. National Council of Educational Research and Training (NCERT), New Delhi.
4. NCERT (2000). *Position paper of national focus group (NFG) on education for peace*. National Council of Educational Research and Training (NCERT), New Delhi.
5. NCERT (2000). *Position paper of national focus group (NFG) on examination reforms*. National Council of Educational Research and Training (NCERT), New Delhi.
6. NCERT (2000). *Position paper of national focus group (NFG) on gender issues in education*. National Council of Educational Research and Training (NCERT), New Delhi.
7. NCERT (2000). *Position paper of national focus group (NFG) on habitat and learning*. National Council of Educational Research and Training (NCERT), New Delhi.
8. NCERT (2000). *Position paper of national focus group (NFG) on teaching of science*. National Council of Educational Research and Training (NCERT), New Delhi.
9. NCERT (2005). *National curriculum framework for school education*. National Council of Educational Research and Training (NCERT), New Delhi.
10. Mohan, R. (2002), *Innovative Science Teaching for Physical Science Teachers*, Prentice Hall of India Pvt. Ltd., New Delhi
11. Steve Alsop, Keith Hicks (2007). *Teaching Science : A Handbook for Primary and Secondary School Teachers*, Kogan Page, New Delhi.
12. Sutton, C.R. & Hayson, J.H. (1974). *The art of the science teacher*, McGraw Hill Book Company Ltd.
13. Vaidya, N. (1999). *Science teaching for 21<sup>st</sup> Century*. Deep & Deep Publication.
14. *Journal of Research in Science Teaching* (Wiley-Blackwell)
15. *Science & Children*. A peer reviewed journal published by National Science Teachers Association (NSTA).
16. *The Science Teacher*. A peer reviewed journal published by National Science Teachers Association (NSTA).

### EPC-2 Learning to Function as a Teacher

<b>Semester-V</b>	<b>Credit-2</b>
<b>Marks-50 (Internal )</b>	<b>Contact Hours- 4hrs. per week</b>

#### **Introduction**

Teaching is a purposeful process of facilitating learning which involves the students/ learners in an interaction to enhance their potentialities to become self-learners. The secondary school is a crucial stage in the educational hierarchy as it prepares the learners for higher education & also for the world of work. Teacher in the present day has to be conversant with managing diversity and contextuality in the classroom. Hence student teachers need orientation and reflection on different activities and strategies to be employed during engagement with the field particularly for preparing them for the internship. Student teachers need to be oriented on processes like critical thinking, observation, communication and use of resources for effective functioning.

#### **Objectives**

The course will enable the student teachers to;

- Develop an ability to engage students in various activities as per the emerging demands in the classroom.
- Develop self-confidence and skill to engage learners and meet their diverse needs.

The following process based skills essential for secondary schools to be taken up.

- Content analysis
- Content organization through concept mapping
- Core teaching process: Introducing the lesson, Questioning, Explaining, illustrating with examples, Reinforcement (Verbal and non verbal), Stimulus Variation, Using Blackboard /white board/ smart board and using learning resources
- Use of ICT
- Critical thinking and reflection,
- Managing diversity
- Contextualization
- Organization of group activity/project

**Guidelines for Assessment:** The above stated process-based skills will be practised by the student-teachers which will be observed and evaluated during the simulated classroom transaction. The evaluation will be continuous and internally assessed.

**SEMESTER VI****CPS 2: PEDAGOGY OF MATHEMATICS (Part-II)**

<b>Semester-VI</b>	<b>Credit-4</b>
<b>Marks 100 (Internal 20 + External 80)</b>	<b>Contact Hours- 4hrs. per week</b>

**Introduction**

As a sequel to the Part I of the Pedagogy of Mathematics, this course (Part II) is designed to broaden the scope of Mathematics learning focusing on enhancing quality of Mathematics learning and teaching strategies including the use of ICT and other resource materials. The prospective teachers in Mathematics are expected to develop abilities to create, adopt and use innovative materials and strategies to enrich Mathematics teaching and learning practices while aiming at continuing their professional development as a lifelong mission.

**Objectives**

The course will enable the student teachers to;

- Understand and adopt ways in enhancing quality of Mathematics learning.
- Develop competency in the use of learner friendly information and communication technologies for widening scope and enhancing quality of Mathematics learning.
- Acquire expertise in development, adoption and use of different types of teaching learning material for effective Mathematics learning and teaching.
- Develop awareness of innovations in the teaching-learning processes of Mathematics and ways to adopt those in the classroom practices.
- Understand the various ways of continuing professional development as Mathematics.

**Unit 1:****Enhancing Quality of Mathematics Learning**

- Exploring the learner: Identifying students' strengths and weaknesses in Mathematics learning; Remediation of weaknesses in Mathematics,
- Activities for enhancing motivation in Mathematics learning: Participation in Mathematics competitions (like Mathematics Olympiads, National Talent Search) quizzes, debates and exhibitions, Collection of mathematical riddles, puzzles, life sketches of great mathematicians,
- Encouraging Creativity in Mathematics: Developing innovative materials and games in mathematics, Collaborative peer activities, Mathematics club activities, Peer Learning Groups for brainstorming and developing alternative ways of solving problems and framing mathematical problems and activities

**Unit 2:****Use of ICT in Teaching and Learning Mathematics**

- Concept of ICT
- Need of Technological, Pedagogical Content and Knowledge (TPACK) in Mathematics
- Use of Computer and other ICT equipments
- Using open education resources (OERs) in Mathematics (like *Geogebra, C-map*)

**Unit 3:****Teaching Learning Materials of Mathematics**

- Mathematics Textbooks: Characteristics and functions of a good Mathematics textbook,
- Evaluation of Mathematics Text books: Physical aspects, Concept load, Presentation styles- Diagrams, Graphs, Boxes, Anecdotes, Interesting , Clarity and precision, Activities, Practice and enrichment

problems

- Use of various Teaching-Learning Material in Mathematics - Charts, models, overhead projector, films with their specific use and limitations
- Innovative Materials in Mathematics learning: Using community resources for mathematics learning, pooling of learning resources in school complex/block/district level.

#### **Unit 4: Innovations and Professional Development in of Mathematics**

- Teaching of Mathematics in the socio-cultural context
- Recreation in Mathematics (Mathematics Club & Activities for Mathematical creativity & Vedic Mathematics)
- Mathematics Laboratory: Need, Materials in the laboratory, Setting the Laboratory, Functions of the Math. Laboratory
- Developing methodology for teaching children with dyscalculia: Symptoms, Types, Treatment and Strategies of teaching
- Role of mathematics teachers association;
- Journals and other resource materials in mathematics education; Using ICT and internet for professional development outside the school.

#### **Suggested Activities**

- Preparation of a report of observation of children doing everyday Maths, playing folk games;or community numeracy practices.
- Case study of slow learners or child with dyscalculia
- Action Research on selected classroom problems in teaching and learning Mathematics.
- Development and trying out of innovative teaching-learning strategy for teaching of specific Mathematical concepts.
- Analysis of Mathematics text book.
- Use of Computer in Teaching of Mathematical concepts. (PowerPoint presentation)
- Use of Mathematics activities for recreation.
- Plan for development and use of Mathematics laboratory.
- Preparation of report after observing a 'Mathmela' or Mathematics exhibition in a school or a locality.
- Development of innovative teaching-learning materials and activities in Mathematics

#### **Reference Books :**

1. Anice, J. (2008). *Methods of Teaching Mathematics*. New Delhi: Neelkamal Publications.
2. Butler, C.H., Wren, F.L. and Banks, J.H. (1971). *The teaching of Secondary Mathematics*. New York: McGraw Hill.
3. Coney, T.J., Davis, G.J., and Hen Derson, K.B. (1975). *Dynamics of teaching secondary school mathematics*. Boston: Houghton-Mifflin Co.
4. Ediger, M., and Rao, B. (2000). *Teaching mathematics successfully*. New Delhi: Discovery Publishing House.
5. Kidd, P.K., Myers, S.S., Cilley David, M. (1970). *The Laboratory Approach to Mathematics*. Chicago: Science Research Associates Inc.
6. Kinney, L.B., and Purdy, C.R. (1965). *Teaching of mathematics in secondary school*. New York; Holt, Rinchart and Winston.

7. Kolb, J.R., & Bassler, O.C. (1979). *Learning to teach secondary school mathematics*. London: In text Educational Pub.
8. Kothari, R.G., and Mistry, H.S. (2012). *Diagnosis of Learning Difficulties on Fractions and Decimals: A study on the students of upper primary schools*. Germany: Lambert Academic Publishers.
9. Kothari, R.G., and Shelat, P.H. (2011). *Mathematical weaknesses among secondary school students*. Germany: VDM Verlag Publishers.
10. Kumar, S. (1993). *Teaching of mathematics*. New Delhi: Anmol Pub. Pvt.
11. Mottershead, L. (1978). *Sources of mathematical discovery*. Oxford: Basil black Wall.
12. Nickson, M. (2006). *Teaching and learning mathematics: A guide to recent research and its application*. London: Continuum.
13. Pandya, B. (2007). *Teaching of mathematics*. Agra: Radha Prakashan Mandir.
14. Paul Chambers (2008). *Teaching mathematics: developing as a reflective secondary teacher*. New Delhi: Sage Publication.
15. Rao, N.M. (2007). *A manual of mathematics laboratory*. New Delhi: Neelkamal Publications.
16. Reeve, W.D. (1954). *Mathematics for the secondary school*. New York: Holt, Rinehart and Winston, Inc.
17. Servais, W., and Varga, T. (ed.) (1971). *Teaching school mathematics. A UNESCO Source Book*. UNESCO, Penguin books.

### Web Resources

- <https://www.youtube.com/watch?v=hbDkSaSnbVM> (Unit I)
- <https://www.youtube.com/watch?v=IO19-MTWTwThI> (Unit I)
- <https://www.youtube.com/watch?v=MrIdc-Hs-is> (Unit I)
- <https://www.youtube.com/watch?v=lhwAMhZQ6kU> (Unit I)
- <http://mathigon.org/resources/value-of-mathematics.pdf> (Unit I)
- <http://mathedu.hbcse.tifr.res.in> (Unit 3)
- [http://www.ncert.nic.in/departments/nie/dee/publication/pdf/CCE\\_Math.pdf](http://www.ncert.nic.in/departments/nie/dee/publication/pdf/CCE_Math.pdf) (Unit V)
- [http://www.ncert.nic.in/departments/nie/niew/school\\_kits/kit\\_manuals.html](http://www.ncert.nic.in/departments/nie/niew/school_kits/kit_manuals.html)
- <http://nrich.maths.org>
- <http://www.slideshare.net/MiraculeDanielGavor/ict-tools-in-mathematics-instruction>
- <http://www.arvindguptatoys.com/math-magic.php>
- <http://karnatakaeducation.org.in/KOER/en/index.php/Portal:Mathematics>
- <http://www.mathcelebration.com/index.html>
- <http://map.mathshell.org>
- <http://www.cimt.plymouth.ac.uk/projects/mep/default.htm>
- <http://nrich.maths.org/students>
- <http://mathbits.com>
- <http://www.math-play.com>
- <http://www.geogebra.org>
- <http://classroom-aid.com/educational-resources/mathematics>
- <http://etc.usf.edu/math>
- <http://mathworld.wolfram.com>
- <https://www.merlot.org/merlot/materials.htm?category=2513>
- <http://www.ck12.org>
- <https://www.khanacademy.org>
- <http://www.learner.org/resources/browse.html?d=5>
- [https://blossoms.mit.edu/resources/math\\_resources](https://blossoms.mit.edu/resources/math_resources)
- Matthew J. Koehler, Punya Mishra, Mete Akcaoglu & Joshua M. Rosenberg (2013), The Technological Pedagogical Content Knowledge Framework for Teachers and Teacher Educators,

[http://cemca.org.in/ckfinder/userfiles/files/ICT%20Integrated%20Teacher%20Education%20\(Chapter%201\).pdf](http://cemca.org.in/ckfinder/userfiles/files/ICT%20Integrated%20Teacher%20Education%20(Chapter%201).pdf)

- Integrating Open Educational Resources Lesson Plan Integration Model Designed for Pre-Service Elementary Educators Course: Mathematics Methods,
- [https://currikicdn.s3-us-west-2.amazonaws.com/resource\\_files/54d2dd15bb67b.pdf](https://currikicdn.s3-us-west-2.amazonaws.com/resource_files/54d2dd15bb67b.pdf)
- Teaching of Mathematics,  
NCERT [http://www.ncert.nic.in/departments/nie/dse/activities/advisory\\_board/PDF/teaching\\_maths.pdf](http://www.ncert.nic.in/departments/nie/dse/activities/advisory_board/PDF/teaching_maths.pdf)

### **CPS 2: Pedagogy of Biological Science (Part II)**

<b>Semester-VI</b>	<b>Credit-4</b>
<b>Marks 100</b> <b>(Internal 20 +</b> <b>External</b> <b>80)</b>	<b>Contact Hours- 4hrs.</b> <b>per week</b>

#### **Introduction**

The discourse of teaching-learning process may include situations leading to understanding of Biological facts and phenomena in conceptually organized manner revolving around the fundamental themes. For this, proper planning of teaching-learning process, allocation/development of appropriate learning resource along with continuous and comprehensive evaluative criteria and strategies are required to be addressed. Further, learners are required to engage in critical enquiry regarding the process of knowledge development in Biological science as well as its pedagogy. Future teachers should also be encouraged toward their continuing professional development on the basis of life-long learning principles.

#### **Objectives**

The course will enable the student teachers to;

- Develop understanding about linkage among different concepts and themes in Biological sciences and also with real world/ life
- Explore different ways to create learning situations for different concepts of Biological sciences for learners of different abilities
- Effectively use different activities and laboratory experiments for facilitating learning of Biological sciences
- Develop appropriate assessment tools for the evaluation of learning of different concepts of Biological sciences

- Examine different issues in Biological science and well as in pedagogical processes.

### **Unit 1: Planning the Process of Teaching and Learning in Biological Science**

- Identification of concepts and unifying themes related to teaching-learning of Biology; Designing year and unit plan along with appropriate selection of learning resources
- Planning for transaction of concepts as well as to create the big picture by making connections: across concepts/ themes; between scientific advances and the real world and outside the class.
- Designing lesson plans based on different approaches (Behaviorist and Constructivist-5E and ICON) by considering students' pace, learning styles and learning needs; Steps involved in developing lesson plans.

### **Unit 2: Learning Assessment in Biological Science**

- Learning indicators in Biological sciences and assessment of these learning indicators in the form of learning evidences/ outcome in classroom and laboratory
- Development of assessment framework on the basis of CCE: Tools and techniques for learning assessment in Biology like construction of classroom tests and unit test.
- Alternative strategies for assessment like assignments; reports and records (laboratory record, reports of field visits and excursion, Project work report); Portfolios and Rubrics; Preparation of learners' profile.
- Recording and reporting of learning evidences/outcome: Marks and grades; Assessment as reflecting process to facilitate further learning.

### **Unit 3: Pedagogical Treatments in Biology**

- Using different pedagogical approaches (Behaviorist and Constructivist) and strategies (Problem solving, experimenting, project based, cognitive conflict) along with identification of major concepts, themes and criteria for assessment to treat major concepts in school Biology content:
  - Cell and its organization
  - Plant and animal kingdom
  - Environment and its protection
  - Principles of evolution
  - Principles of Genetics and heredity

### **Unit 4: Issues and Challenges in Biological Science**

- Changing trends in Biological science; Role of Biotechnology in society
- Democratization of science learning, Critical pedagogy (Critical theory) as basis to analyze progress in Biological science as well as pedagogy of Biology (from the perspective of economic development and politics of knowledge)
- Professional development programmes for teachers: In-service teacher training, Seminar, Conferences, participation in professional learning communities.
- Field visits of teachers to botanical garden, National parks and Collaboration with different schools, institutions of higher education and research in the field of Biology
- Exploration of ICT based online platforms for sharing the ideas, methods, strategies and teaching learning resources.

### **Suggested Activities**

1. Design a year plan considering the content and time.
2. Designing lesson plan for a particular concept in Biology keeping in mind the expected operational level of child.
3. Construction of tools (including alternative tools) for assessment.
4. A case study on pedagogy of Biology from critical point of view.

### **Suggested Reading**

1. Fraser, B. J. and Tobin, K. G. (Eds.). *International handbook of science teaching (Part 1)*. Dodrecht, The Netherlands: Kluwer Academic.

2. Mintzes J., Wandersee, J. and Novak, J. (Eds.) (2000). *Assessing science understanding: A human constructivist view*. San Diego, CA.: Academic Press.
3. NCERT (2000). *Position paper of national focus group (NFG) on aims of education*. National Council of Educational Research and Training (NCERT), New Delhi.
4. NCERT (2000). *Position paper of national focus group (NFG) on education for peace*. National Council of Educational Research and Training (NCERT), New Delhi.
5. NCERT (2000). *Position paper of national focus group (NFG) on examination reforms*. National Council of Educational Research and Training (NCERT), New Delhi.
6. NCERT (2000). *Position paper of national focus group (NFG) on gender issues in education*. National Council of Educational Research and Training (NCERT), New Delhi.
7. NCERT (2000). *Position paper of national focus group (NFG) on habitat and learning*. National Council of Educational Research and Training (NCERT), New Delhi.
8. NCERT (2000). *Position paper of national focus group (NFG) on teaching of science*. National Council of Educational Research and Training (NCERT), New Delhi.
9. NCERT (2005). *National curriculum framework for school education*. National Council of Educational Research and Training (NCERT), New Delhi.
10. Sutton, C.R. & Hayson, J.H. (1974). *The art of the science teacher*, McGraw Hill Book Company Ltd.
11. Vaidya, N. (1999). *Science teaching for 21<sup>st</sup> Century*. Deep & Deep Publication. Journal of Research in Science Teaching (Wiley-Blackwell)
12. *Science & Children*. A peer reviewed journal published by National Science Teachers Association (NSTA).
13. *The Science Teacher*. A peer reviewed journal published by National Science Teachers Association (NSTA).

### CPS 3: Pedagogy of Physical Science (Part-II)

<b>Semester-VI</b>	<b>Credit-4</b>
<b>Marks 100 (Internal 20, External 80)</b>	<b>Contact Hours- 4 hrs. per week</b>

#### **Introduction:**

The course is intended to enable students-teachers to design and organize learner-centered, activity based, participatory learning experiences through observation, inquiry, dialogue, discussion, experiments, projects and field work. This goal will be realized only if teacher-educators actively involve student-teachers in the construction of their knowledge by providing such opportunities to student-teachers and encourage to think critically on the relevant issues.

#### **Objective:**

The course will enable the student teachers to;

- Plan learning designs based on problem situations, inquiry and projects to facilitate learning of Physical Sciences.
- Realise his/her role as a facilitator in enhancing Physical Science learning in the real classroom situation.
- Explore different ways of creating learning situations considering learning needs and context of the learner
- Familiarize with various tools and techniques of assessing physical science learning

- Critically analyse various issues in Physical Science
- Become aware of various professional development programs in Physical Science.

### Unit 1:

#### Planning of Facilitating Learning in Physical Science

- Need for planning teaching-learning experiences in Physical Science
- Identification of Concepts and unifying themes related to Physical Science, inter-relation among various concepts in Physical Science
- Designing of Year plan and Unit Plan in Physical Science and its significance in understanding comprehensive nature of knowledge
- Writing learning objectives for different content areas in Physical Science
- Planning lessons based on behaviourist and constructivist approaches-5E model, ICON model considering learners with different pace, learning styles and learning needs
- Planning laboratory work and ICT application in learning Physical Science

### Unit 2:

#### Learning Assessment in Physical Science

- Planning assessment framework in Physical Science
- Learning Indicators in Physical Science
- Tools and techniques of assessment in Physical Science—assessment of written and oral work, project work, laboratory work, field trips, journal writing, concept map and V mapping
- Assessment of learners with special needs
- Recording and reporting of learning evidences – Measurement of students’ achievement in Physical Science – marks and grading, Measurement of science process skills and aptitude of learners, Portfolio – its role in evaluating students’ performance

### Unit 3:

#### Pedagogical Processes and issues in teaching learning of Physical Science

- Using different pedagogical approaches (Behaviourist and Constructivist) and strategies (Problem Solving, experimenting, project based, cognitive conflict) along with identification of major concepts, themes and criteria for assessment to treat major concepts in school Physical Science content -Motion, Force, Heat, Electricity, Magnetism, Acids and Bases, Physical and chemical changes, Matter
- Social and ethical issues related to Physical Science
- Role of Language in Physical Science, Gender and Physical Science
- Inclusiveness in Physical Science learning
- Physical Science and Sustainable development

### Unit 4:

#### Professional Development of Physical Science Teachers

- Need for professional development of Physical Science Teachers
- Various opportunities for in-service professional development—interaction with peer teachers, membership of professional organization such as National Physics Teacher Association, sharing through conferences, seminars and Journals
- Collaboration with Research Institutes such as IISc, IPA, HBCSE, Regional Science Centre
- Participation in Professional Learning Community and in Online forum for Science Teachers
- Role of reflective practices in professional development

### Suggested Activities

1. Preparation of year plan and unit plan in Physical Science

2. Preparation of 2 lesson plans in Physical Science- one based on behaviourist and another on constructivist approach
3. Preparation of an assessment framework in any one unit in Physical Science
4. Debate(choose any one topic from unit 4)
5. Visit to any of the professional organization and prepare a report on the in-service professional development programmes that they undertake for Science teachers

### Reference Books :

1. NCERT (2000). *Position paper of national focus group (NFG) on teaching of science*. National Council of Educational Research and Training (NCERT), New Delhi.
2. Steve Alsop, Keith Hicks. (2007). *Teaching Science: A Handbook for Primary and Secondary School Teachers*, Kogan Page, New Delhi.
3. Judith Bennett (2003) *Teaching and Learning Science : A guide to recent research and its applications*, Continuum, London.
4. Robin Millar (1984) *Doing Science : Images of Science in Science Education*, The Falmer Press, London.
5. NCERT Textbook in Physics for IX and X Students.
6. State Textbook in Physics for IX and X students.
7. Nathan S Washton (1967). *Teaching Science Creatively*, Saunders Company, London.
7. Novak D J and D Bob Gowin (1984) *Learning how to learn*, Press Syndicate of the University of Cambridge, Ohio.
8. Carin A and B R Sund (1964), *Teaching Science through Discovery*, Charles E. Merrill Books Inc., Columbus Ohio.
9. Ralph Martin, Colleen Sexton, Kay Wagner, Jack Gerlovich (2000) *Science for All Children : Methods for Constructing Understanding*, Allyn and Bacon, London.
10. *School Science Review*, The Association for School Education, College Lane, Hatfield, Hertfordshire, AL 109 AA, UK.
11. *Physics Education*, Institute of Physics Publishing, Dirac House, Temple Block, Bristol BS1 6BE, UK.
12. *Physics Teacher*, American Association of Physics Teachers, Department of Physics and Astronomy, University of Maryland, College Park, MO 20742.

### FE-1: MULTICULTURAL PLACEMENT

<b>Semester-VI</b>	<b>Credit-2</b>
<b>50(Internal)</b>	<b>Contact Hours- 2 Weeks</b>

#### Introduction

Multi-cultural education and teaching for diversity are the needs of contemporary times. India is a culturally plural country and prospective secondary school teacher preparation programme needs to focus on addressing diversity in classroom and managing schools from different cultural set up. Multicultural placement of student teachers aims at exposing them to different type of schools such as urban, schools for differently abled children with a view to develop critical reflection about activities of schools with different cultures and teaching learning process adopted in different types of school .

#### Objectives

The course will enable the student teachers to;

- Experience different type of schools such as urban, rural, tribal, schools for challenged learners with a view to

- Develop understanding about the school activities with different cultures/set up
- Develop the process of engaging students in classrooms through observing the practice adopted by regular teachers
- Develop understanding to manage a substitute(arrangement class)
- Experience of conducting classroom activities
- Conduct case studies

The institute will identify suitable number of cooperating urban schools, rural schools, and tribal schools, and students will be placed by rotation in all the three types of schools. All activities listed below are to be completed within two weeks during the placement of student teachers in three types of schools in rotation. Each pupil teacher performs the following activities under the guidance of supervisor/mentor and prepares reports on all the activities. The report will be assessed as the guideline given below.

### Guidelines for Assessment

Sl.No	Activities	Marks
1	Observing 6 lessons 3 in each method delivered by regular teachers with the help of observation schedule	10
2	Observation of day-to-day school activities and preparation of comprehensive report highlighting working of the library, co-scholastic activities, games and sports, functioning of laboratory, school morning assembly and preparation of reflective report	10
3	Availing at least 6 substitute teaching opportunities in actual school situation	10
4	Teaching 4 lessons (two lessons in each method subject) by using learning resources and ICT.	10
5	Undertaking a case study on students/institution	10
<b>Total</b>		<b>50</b>

## SEMESTER-VII

### PE 7: Knowledge and Curriculum

<b>Semester-VII</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal:20 External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

### Introduction:

The purpose of school education is to make students understand structure of knowledge, ways of knowing and process of its construction. The role teacher is to facilitate learners in creating and transferring knowledge from school to outside. In this context, the teachers are required to be competent about the epistemological thinking of knowledge and also in dealing with the social environment involving transaction of knowledge. This paper imparts necessary preparation to student teachers in dealing with various dimensions of knowledge and its transaction in school set up.

### Objectives

The course will enable the student teachers to;

- Understand concept of knowledge, process and sources of knowing
  - Develop understanding on teacher centric and learner centric knowledge transmission.
  - Understand concept, types of curriculum and differentiate between curriculum framework, curriculum and syllabus

- Apply recommendations of the NCF 2005 in school
- Understand process and principles of curriculum development
- Develop understanding in the process of curriculum transaction, evaluation and renewal.

#### **Unit I: Understanding the Nature of Knowledge**

- Knowledge: Concept, Nature, Types, theories of knowledge
- Constituents of knowledge: Facts, Principles, Laws, Concepts and theories
- Knowing process: Sensation, perception, reason and conception

#### **Unit II: Construction of Knowledge**

- Knowledge transmission (teacher-centric) vs. Knowledge construction (learner-centric)
- Experience: Meaning, nature and role of experience in knowledge construction
- Reason: Meaning, nature and role of reasoning in knowledge construction
- Validation of knowledge: approaches and theories-correspondence, coherence, dialects and pragmatics theory

#### **Unit III: Understanding Curriculum**

- Concept of curriculum(difference between curriculum framework, curriculum, syllabus and textbook)
- Types of curriculum: subject- centered, learner-centered, learning centred, experience-centered, activity-centered, core curriculum
- Curriculum framework–principles and coverage; NCF 2005, and NCFTE 2009 –significant recommendations.
- Interface between the teacher education curriculum and school curriculum

#### **Unit IV: Curriculum planning and evaluation**

- Determinants of curriculum
  - Principles of curriculum development
  - Models of curriculum planning: Top down (Tyler) and Bottom up (Taba) model
  - Processes / stages of curriculum development (preparation, tryout and finalization)
2. Evaluation: Mode(internal and external),periodicity(continuous, periodic), Mechanism (research studies, on-site observation, FGD, on-line feedback),Use of evaluation feedback/inputs for Immediate /long-term revision, Specific / comprehensive improvement

#### **Suggested Activities**

3. Identify concepts, facts, principles, laws and theories in any secondary class school textbook and report
4. Examine your own process of knowing, prepare a report on how you are using knowing process in gaining knowledge
5. Preparation of an appraisal report on any one aspect of the Systemic Reform envisaged in the NCF 2005 and its reflection in current practices.
6. Identification of learning resources and designing of beyond classroomactivities for transacting a lesson.
7. Preparation of a transactional blueprint of any content unit in any school subject at the secondary level.
8. Preparation of an appraisal report on the curriculum renewal process during post NPE(1986) period.

#### **Suggested Readings**

Arora, G.L.(1984).Reflections on curriculum.NewDelhi: NCERT.

- Dewey, John (1956). *The child and the curriculum*. Chicago, Illinois: University of Chicago Press.
- Dewey, John (1997). *Experience and Education*. New York: Touchstone.
- Dewey, John (1997). My pedagogic creed. In D. J. Flinders and S. J. Thorton (eds.), *The Curriculum studies reader*. New York: Routledge, Kegan & Paul.
- Egan, K. (2005). *An imaginative approach to teaching*. San Francisco: Jossey-Bass.
- Erickson, H. L. (2002). *Concept-based curriculum and instruction*. California: Corwin Press.
- Jangira, N. K. & Singh, A. (1982). *Core teaching skills: The microteaching approach*. New Delhi: NCERT.
- Mohapatra, J. K., Mahapatra, M. and Parida, B. K. (2015). *Constructivism: The new paradigm: From theory to practice*. New Delhi: Atlantic Publishers.
- NCERT (2005). *National curriculum framework 2005*. New Delhi: NCERT.
- NCTE (1990). *Policy perspective in teacher education*. New Delhi: NCTE
- Olivia, Peter F. (1988). *Developing the curriculum*. London: Scott and Foresman.
- Sharma, S. (2006). *Constructivist approaches to teaching and learning*. New Delhi: NCERT.
- Taba, Hilda (1962). *Curriculum development: Theory and practice*. New York: Harcourt, Brace and Wald.
- Von Glasersfeld, F. (1995). *Radical constructivism: A way of knowing and learning*. Washington D.C.: Falmer Press.
- Vygotsky, Lev (1986). *Mind in society*. Cambridge, MA: Harvard University Press.
- Taba, H (1962). *Curriculum Development: Theory and Practice*. N Y Harcourt, Brace and World.
- Taylor, Ralph W (2013). *Basic Principles of Curriculum and Instruction*. Amazon Kindle.

### EPC 3: Art in Education

<b>Semester-VII</b>	<b>Credit-2</b>
<b>Marks 50 (Internal)</b>	<b>Contact Hours- 2 Week workshop</b>

#### Introduction

The need to integrate art education in the formal schooling is to retain our unique cultural identity in all its diversity and richness. Art education encourages young students and develop a creative mind to them. The innate potentiality of learners will be given an opportunity to be explored and manifested through the medium of art. An understanding of the arts will give the ability to appreciate the richness and variety of artistic traditions as well as make them liberal, creative thinkers and good citizens of the nation. National Curriculum Framework-2005, introduced art education as a mainstream curricular area, which must be taught in every school as a compulsory subject. It is important that art education is integrated in the school curriculum to provide an aesthetically viable atmosphere in schools encouraging creativity. For this, not only the art teachers but every teacher should be sensitive to appreciate different form of art.

#### Objectives:

The course will enable the student teachers to;

- Express ideas and emotions about different aspects of life through different art forms
- Appreciate and distinguish different art forms.

- Develop aesthetic sensibility among learners about the good and beautiful environment, including classroom, school, home and community through an integrated learning approach.
- Integrate the knowledge of art with daily life through learning with different media and techniques by using creative expression and making objects of common use.
- Make learners aware about the rich cultural heritage of their own locality/state/region as well as that of the nation.
- Get acquainted with the life and work of artists and their contribution to teaching and learning.

### Theme I: Forms of Art

- music, dance, theater and visual arts
- appreciate different art forms
- integration of art forms in classroom process
- analyse text books for integration of different art forms

### Theme II: Expression through art forms

- Expressing ideas about different aspects of life
- Expressing various emotions
- Enhancing communication and presentation skills, developing imagination, creativity and aesthetic sensibility among the student teachers
- Utilizing different art expressions in teaching learning situation

### Theme III: Cultural heritage of India

- Exposure to the cultural heritage of
  - Locality
  - state/region
  - Nation
- Reflection and incorporation of the rich cultural heritage during the celebrations of festivals, functions and special days
- document processes of an art or craft form from the pedagogical point of view; such as weaving or printing of textiles, making of musical instruments, folk performances in the community
- Acquaintance with the life and work of artists and their contribution to teaching and learning.

### Guidelines for Assessment:

Sl no	Activity	Marks
1	Presentation on any one art form	10
2	Text book analysis to find out integration of art forms	5
3	Prepare a lesson incorporating one or more artistic expression	15
4	Documentation of any one heritage art form	10
5	Write up on life and work of any one artist (local or national)	10
<b>Total</b>		<b>50</b>

### Suggested Readings

1. Position Paper- National Focus Group on Arts, Music, Dance and Theater NCERT, 2006, New Delhi
2. Position Paper- National Focus Group on Heritage Crafts, NCERT, New Delhi, 2006
3. NCF 2005

4. NROER- National Repository of Open Educational Resource, Department of School Education & Literacy, MHRD.

The following NCERT books may also be referred to

5. Living Craft tradition of India (Textbook in Heritage Crafts) NCERT
6. Exploring the Craft Tradition of India NCERT
7. BharatiyaHastakalakiParamparayen, NCERT
8. An Introduction to Indian Art, NCERT
9. BharatiyaHastkalaParamparakiKhoj, NCERT
10. Craft Tradition of India (Textbook in Heritage craft for class XII)
11. Art Education- Teachers' Handbook for Class I, II, III, IV, V, VI, VII, VIII, IX
12. Source Book on Assessment for Classes I- V, Art Education

#### **EPC 4: ICT Practicum**

<b>Semester-VII</b>	<b>Credit-2</b>
<b>Marks 50 (Internal)</b>	<b>Contact Hours-2Week workshop</b>

#### **Introduction**

The main purpose of this practicum is to provide hands on experience to student teachers in creating and using ICT related teaching learning materials. For realizing this, the following activities will be organized in the workshop.

#### **Theme I: Providing an exposure on hardware/software and its uses in Teaching process**

#### **Learning**

- Hands on experience in setting up a desktop/PC and working with various input devices, output devices, storage devices, and display devices
- Practicing word processing using Indian language software
- Using word processor, spread sheet, and presentation software to produce various teaching learning resources.

#### **Theme II: Awareness and exposure to ICT Tools**

- Locating internet resources – navigating, searching, selecting, saving and evaluating (use standard internet evaluation criteria)
- Creating screen cast video of a lessons, Embedding Audio , Video With Photos Embedding Animations and Transitions Uploading You Tube Video (Using Movie Maker Software)
- Shooting, editing, and sharing of videos segment on any educational topic
- Creating a podcast using audacity and sharing it on podcasting site.

**Theme III: Developing an ICT based lesson Plan**

- Creating technology based lesson plan
- Developing lesson plan by using 5E Model and ICON Model and ICT
- Creating e-content

**Theme IV: Use of ICT in Assessment and management**

- Creating e-portfolio
- Creating data base of group of students
- Creating and using rubrics for assessment (online, offline)
- Connecting with parents and community through ICT
- Any other activity may also be taken up as per the experience and expertise of the resource person.

**Guidelines for Assessment**

Sl no	Activity	Marks
1	Preparing a document using word / PPT	10
2	Create a documentary film	10
3	Design a project using e portfolio	10
4	Develop an e-content and share it using blog/Wikipedia/word press/YouTube	10
5	Create a data base for student management system	10
<b>Total</b>		<b>50</b>

**Suggested Readings**

Ahmad, J., Ahmad, M.S. and Khan, A. (2012), *Computer Applications in Education*, Neelkamal Publication, Hyderabad, PP-288, ISBN: 978-81-8316-293-7.

Bharihok, D. (2000). *Fundamentals of Information Technology*. Pentagon Press: New Delhi.

CEMCA (2014). *Technology Tools for Teachers*, Commonwealth Educational Media Center for Asia, 13/14 SarvaPriyaVihar, New Delhi.

David, M. (2009). *Project Based Learning- Using Information Technology-* Second Edition. Viva Books: New Delhi.

James, K.L. (2003). *The Internet: A User's Guide*. Prentice Hall of India Pvt. Ltd: New Delhi.

LaxmanMohanty, NeeharikaVora (2008). *ICT strategies for schools- a guide for school administrators*. Sage Publications: New Delhi.

**EF-2 School Internship**

<b>Semester-VII</b>	<b>Credit-14</b>
<b>Internal: 350 (300 + 50*)</b>	<b>Contact Hours- 16 Weeks</b>

\* Marks will be given by the cooperative/mentor teachers/HM/Principal of mentoring schools

**Introduction:**

In any professional pre-service course, the theory learnt by the student has to be tried out in a real situation. Internship provides this opportunity and thereby complements the course. In teacher development programmes, internship provides the opportunity where the student-teachers can find for themselves the extent to which the methods and techniques of teaching they have learnt during the course, are useful in classroom situation. Internship is the period during which the student teacher stays in the school for a certain extended

period, mingles with the school community, gets the first-hand knowledge of the school situation and the associated problems, participate in the programmes of the school, organizes new and productive programmes for the benefit of the school. These helps in developing the right skills, attitudes, interests and appreciation and make the best use of the expertise and resources in the school to blossom into good teachers who could be an asset to any school.

An intern is like an apprentice working under the guidance of highly motivated and experienced teachers of the school. For the first time he faces a cross section of the students which is a mixture of different ability groups often having varied social backgrounds, in a real classroom. While he will have learnt techniques of teaching for different uniform ability groups, he will be called upon to tailor new techniques and methods to suit mixed ability groups and this real challenge gets the best in the interneer.

### **Objectives**

The course will enable the student teachers to;

- Develop the ability to define clearly the general and specific objectives of teaching the subject, the different units, and the individual lessons.
- Develop the ability to select units and subject matter suitable to the class, and resource material and aids - readymade, improvised - suitable to the units.
- Develop the ability to plan the lesson effectively with an understanding of the principles of learning and organize the subject matter suitably indicating the appropriate techniques and aids to be used at each stage and for each purpose.
- Develop the ability to prepare the pupils adequately for each lesson and develop it in ways most suitable to the occasion and most appropriate for realizing the objectives set forth.
- Develop the ability to motivate the pupils sufficiently and sustain their interest as well as maintain discipline in the class.
- Develop the ability to adjust the programme to the varying needs interests and abilities of the pupils, while making for maximum group progress.
- Develop the ability, to use different methods and techniques of teaching and use them effectively in appropriate situations.
- Develop the ability to plan the details of the curriculum with the pupils (teacher pupil planning) and work out resource units, spelling out the experiences, activities, aids, techniques, etc.
- Develop the ability to develop and apply different techniques and tools for the continuous evaluation of the achievement and progress of the pupils, taken as individuals and as a group, especially the ability to construct and use oral, written and performance tests.
- Develop the ability to judge the effectiveness of teaching and the success of each programme in relation to the goals, from the participation and performances of the pupils.
- Develop the ability to diagnose the strengths and weaknesses and the achievements and failures of the individual pupils, in relation to the objectives and decide, plan and organize the reinforcement of remedial assistance needed by each.
- Develop the ability to correlate his subject and its teaching with other subjects taught in the class, with other activities in the school with life, so that, the education of the child becomes an integrated programme.
- Develop the ability to plan, organize and guide enrichment activities and field programmes related to the subjects taught.
- Develop the ability to plan, organize and guide various co-curricular activities, which are considered as important constituents of a rich education for the citizens of tomorrow.

- Develop the ability to see the school as organized center of the community and relate the provisions and practices in the school to the needs and conditions of the pupils and of the community.

### ***Duration 16 Weeks***

16 weeks internship shall be carried out during the third semester. The student teachers are required to be placed in the schools selected by the Institute. The number of student teachers to be allotted to a particular school shall be 10-12 or as decided by the institute. The institute may appoint a senior faculty as coordinator of the entire programme, who, *inter alia*, would identify and allot schools to student teachers, and maintain liaison with the schools. In addition, a separate coordinator may be appointed for each state knowing the regional language of the respective state.

### ***Nomination of Mentor Teachers***

The internship coordinator/s while visiting the schools for identification purposes, would seek information about different teachers of the schools, who may be nominated as mentor teachers. The role of the mentor teacher would be to share his/her professional experiences, present model lessons, assess student teachers' performance, and provide on-site guidance and support during internship.

### ***Identification of Supervisors***

The faculty members of the institute would be allotted to different schools as supervisors during the internship period. Along with the names of the faculty members, the subject/subjects to be observed and the schools for observation may be written. A chart depicting the names of the internship schools, names of student teachers, name (s) of faculty members (supervisors), and the dates of visit shall be prepared and notified by the coordinator every week. The supervisor shall coordinate the activities of the mentor teacher of the school; and assess student teachers' performance, and provide on-site guidance and support during internship.

### **The institute will:**

1. Provide Internship handbook to the internship schools
2. Organize orientation cum -consultation meetings with the school principals and mentors teachers
3. Develop supplementary material for additional activities in collaboration with mentor teachers
4. Hold fortnightly review meetings with mentor teachers
5. Hold follow -up meetings with student -teachers at regular intervals in the TEI.
6. Monitor implementation of internship including observation of practice teaching.
7. Assess, in collaboration with school mentor -teachers, the internship performance of student -teachers.

Student teachers shall undertake the following activities during the internship period:

#### **I. Planning and Facilitating Teaching Learning**

- Unit/ Lesson planning
- Classroom teaching in two school subjects
- Lesson observation of mentor teacher and peers
- Developing and Using Teaching Learning Resources
- Integrating ICT in regular teaching

#### **II. Assessment, Remediation and Action Research**

- Preparation of CCE activities including unit tests
- Preparation of diagnostic tests and identifying learning difficulties
- Planning and executing remediation
- Conducting action research

#### **III. Understanding School Context**

- Prepare Profile of the school (Type of School/infrastructure, facilities teachers, students and community information)

- Analyze Learner Performance(One class)

#### **IV. Participation in School Activities**

- Organize all types of curricular activities, e.g. sports and games, debate, song, art, music, painting

#### **V. Community and school Activities**

- Survey of households in local community
- Interaction with SDMC/SMC/PTA/MTA members
- Interacting with parents

The 16 week school internship will be organized in three phases: (i) pre internship; (ii) internship (iii) and post internship.

#### **Phase-1: Pre internship**

The pre internship will be of one week duration during which necessary orientation programmes for Mentor Teachers and Heads of the selected schools will be organized in the institute. The following activities shall be organized during pre-internship phase:

- Orientation of the mentor teachers and Heads of the schools regarding the objectives and different aspects of internship in teaching
- Orientation about the roles and responsibilities of different personal involved in internship in teaching specially roles of mentor teachers/HM/Principal
- Discussion on process involved in unit planning/ lesson planning
- Discussion on process of developing achievement test and its administration and uses
- Discussion on records to be maintained by student teachers during internship.
- Orientation about process of giving constructive feedback to student teachers
- Demonstration of model lessons by the experts/supervising teacher followed by discussion, preferably in DMS
- Demonstration and criticism lessons of at least 2 lessons, by the student teachers, of their peers in each subject followed by discussion

#### **Phase-2: Internship**

Every student teacher shall undergo an internship of 15 weeks in an identified school. During this period the student teacher shall be attached to a school and he/she shall undertake such duties as are assigned to him / her by the Head Master/Principal of the school in all school related activities. During this period, he/she shall teach at least 120 lessons in the school, taking equal number of lessons from each of his/her pedagogy subjects, under the supervision of the mentor teacher and respective teacher educator (s) from RIE. The first week will be utilized for developing rapport with school (Students, teachers, Principal/Head Master/other staffs, etc.) and familiarity with school system.

#### **Practicum during Internship**

Student teachers shall perform the following during internship:

- Prepare 120 lesson plans in two school subjects and deliver at least 60 lessons in each subject
- Integrate student assessment activities with teaching learning process
- Development and use learning resources related to pedagogy courses
- Observation of peer teaching: 10 in each school subject
- Observation of teachers' lessons: 5 in each school subject
- Develop, administer, score and analyze at least 2 unit tests: one in each school subject
- Conducting action research based on real classroom problems
- Prepare and maintain student portfolios

- Preparation of the school time table
- Organize and participate in: morning assembly, literary and cultural activities , Club activities, Exhibitions, Excursions and field trip, Mock parliament, Quiz, Games and sports and PTA/SMC meetings
- Maintenance of school library and laboratory
- Maintaining a reflective diary of his/her school experience

### Records to be submitted

- Lesson plans/ Unit plans
- School profile: infrastructure; Social Science Laboratory - physical facilities, Equipment, School Library- facilities
- Record of Participation/organization of school activities
- Record of observation of peer teaching
- Report of action research
- Assessment record
- Reflective Journal

### Phase – 3: Post Internship

The post internship is required to be organized in the Institute for one week just after completion of internship in teaching programme. The following activities shall be organized in the Post Internship phase:

- Preparation of brief report by each student teacher on his/her internship experiences.
- Presentation of the reflections of internship by student teachers, which will be conducted in smaller group/subject wise and assessed by the supervisors.
- Some of the video clippings of lesson delivering developed earlier during internship will be shown for critical reflection
- Inviting feedback from cooperating schools/mentor teachers/HM/Principal/institute faculty.

### Internal Assessment

The assessment of the performance of student teachers shall be based on the feedback received from all associated with the programme, including mentor teachers/HM/Principal, peers, supervisors of the institute; and various records submitted by the student teachers.

### The weightage to different components of internship shall be assigned as under:

Component	Minimum Number	Maximum Marks	By the faculty of the Institute	By the Mentor School Teachers and Head Teachers
Demonstration and criticism classes by student teachers in group (16-17 students in group)	2 criticism lesson (1 in each pedagogy course)	10 (5+5)	10	--
Unit Plan	2 in each subject/pedagogy	20 (10+10)	20	--
Lesson Plan (PC-1)	50 Lesson Plan 10 Lesson Notes	20	20	--
Lesson Plan(PC-2)	50 Lesson Plan 10 Lesson Notes	20	20	--

Classroom observation record of peers	20 Lesson (10 in PC-1 and 10 in PC-2)	20 (10+10)	20	--
Records of participation/organization in curricular activities	1	10	10	--
Records of school profile	1	10	10	--
Action Research	1	20	20	--
Student Assessment Records	2 (one for each subject)	20 (10+10)	20	
Teaching Learning Resources	-	10	--	10
Reflective Diary	-	10	10	--
Assessment by mentor teacher(s)/HM/Principal /Inst supervisors based on overall performance in school including teaching and participation in other school activities	60 lesson in PC-1 and 60 lesson in PC-2	120	120= (PC-1(60)+ PC-2(60))	
Overall Assessment of Trainee by Head Teacher/Principal		40	--	40
Presentation of reflections on internship experiences (Post Internship)		20	20	--
Total for III Semester		350	300	50

**SEMESTER VIII**  
**PE-8 Vision of Indian Education**

<b>Semester-VIII</b>	<b>Credits-4</b>
<b>Total Marks:100 (Internal:20,External: 80)</b>	<b>Contact Hours: 4 hours per week</b>

**Introduction**

Education is essentially a normative endeavor, hence is intentional. It intends, rather deliberately, to socialize children into a value frame or normative structure. That is why history reveals that every education system, at different historical periods, had been guided by certain value concerns. In contemporary times, the education system in India derives its values from the Constitution of India. While socializing children education has to negotiate within the frame of Constitutional values. Indian Constitution envisioned a humane society based on freedom, equality and justice, and this led to evolving many institutions to realize the vision. In this regard, education has been considered as an agency of social transformation and classroom as the shape of the envisioned destiny. Since teachers ought to play crucial role in realizing the vision, they are to be informed the Constitutional vision so as to develop normative perspectives regarding education and thereby emerging

concerns and issues. This normative perspective a teacher holds in turn guides his/her actions and acquires a meaning to action.

Education being an operational area, every citizen perceives several issues related to it through personal experience. The student-teachers need to understand the main issues that touch their functioning as also situate themselves in context. Such an understanding on at least a few issues and concerns will equip student teachers to be ready for dealing with other issues and concerns in the field. This is very relevant as it may not be possible to bring under scrutiny all issues and concerns. Since, concerns and issues cannot and should not be ‘informed’ like ‘ready to cook facts’, the course is designed in such a fashion that prospective teachers would be encouraged to come to terms with concerns and issues that would emerge out of their reasoned engagement with contemporary educational reality in the light of professed humanistic values.

### **Objectives**

The course will enable the student teachers to;

- Understand evolution of education in India from Vedic period to post Independence era.
- Develop understanding on issues and concerns relating to Elementary education and implementation of the RTE Act 2009.
- Develop understanding on issues and concerns relating to secondary/sr. secondary education and implementation of the RMSA and other schemes
- Understand school education in India with reference to global educational development and role of International organizations for promoting education
- Formulate vision for school education on basis of new social order and technological advancement

### **Unit I - Education in India: Historical perspectives**

- Education during Vedic and Post Vedic period and its relevance to present education
- Educational development in the Pre-independence period :Macaulay’s Minutes,Woods Despatch, Hunter Commission; Basic Education,Sargent Report.
- Educational development in Post-Independence Period: Constitutional provisions on education .Recommendations of University Education Commission (1948) Secondary Education Commission(1952) Education Commission (1964-66);NPE 1968;NPE 1986/1992 with reference to school education.

### **Unit II: School Education: Concerns and Issues**

- Universalization of Elementary Education: Concept ,need and dimensions.
- Policy and programmes for Universalisation of Elementary Education(UEE): DPEP, SSA, RTE Act 2009.Issues of quality in elementary education and strategies.
- Secondary Education: Concept, need and importance. Policy and programmes for development of Secondary and Higher Secondary Education: RMSA, ICT @ School, Rashtriya Avishkar Abhiyan,
- Issues of quality in Secondary and Higher Secondary education and strategies.,Vocationalisation of Higher Secondary Education: Policy Initiatives, Programmes and strategies.

### **Unit-III: Global Perspectives in School Education**

- International Commissions on Education: Learning to Be (1975);Learning:The Treasure Within(1996) with reference to aims of education, learning society and life long education.
- Role of International Agencies for development of education: UNICEF, World Bank, UNESCO.
- Global Monitoring Report on Millenium Development Goals(MDG) and Sustainable Development Goals(SDG)- 2015

#### Unit IV: Meeting the Emerging Challenges in School Education

- Changing Trends in socio-cultural ,political and economic scenario:Their bearings on School Education;Emerging challenges in School organisation,Curricular Proccseses ,Learning Climate.
- Addressing Challenges in :
- School Organisation(Physical Space and Personnel Management,Client Relationships in terms of management)
- Curricular Processes(CurriculumTransaction,Contextualisation,Assessment)

#### Suggested Activities

0. Prepare report on relevance of Vedic/ Buddhist/ Islamic educational ideas for present school education by studying original literature.
1. Conduct surveys in the local area for examining status of implementations of the RTE Act 2009
2. Visit five secondary schools nearby and prepare report on quality of teaching and learning as the RMSA guidelines.
3. Read any educational project sponsored by the UNESCO and present to the class
4. Study writings on analysis of education-development from news papers and make presentations

#### Suggested Readings

- Arial, J.C. &Agrawal S.P. (1992).Role of UNESCO in Educational, Vikas Publishing House, Delhi.
- Anand, C.L. et.al. (1983). Teacher and Education in Emerging in Indian Society, NCERT, New Delhi.
- Govt. of India (1986). National Policy on Education, Min. of HRD, New Delhi.
- Govt. of India (1992).Programme of Action (NPE).Min of HRD.
- Mani, R.S. (1964). Educational Ideas and Ideals of Gandhi and Tagore, New Book Society, New Delhi.
- Mistry, S.P. (1986).Non-formal Education-An Approach to Education for All, Publication, New Delhi.
- Mohanty, J., (1986). School Education in Emerging Society, sterling Publishers.
- Mukherji, S.M., (1966). History of Education in India, Acharya Book Depot, Baroda.
- Naik, J.P. & Syed, N., (1974). A Student's History of Education in India, MacMillan, New Delhi.
- NCERT (1986). School Education in India – Present Status and Future Needs, New Delhi.
- Ozial, A.O. 'Hand Book of School Administration and Management', London, Macmillan.
- RadhaKumudMookerji.Ancient Indian Education (Brahmanical and Buddhist), Cosmo Publications, New Delhi – 1999.
- Sainath P. (1996). Every body loves a good drought. Penguin Books New Delhi.
- Salamatullah, (1979).Education in Social context, NCERT, New Delhi.
- Sykes, Marjorie (1988): The Story of NaiTalim, NaitalimSamiti: Wardha.
- UNESCO; (1997).Learning the Treasure Within.
- Dr. VadaMitra. Education in Ancient India, Arya book Depot, New Delhi – 1967
- Ministry of Education. 'Education Commission "Kothari Commission".1964-1966. Education and National Development.Ministry of Education, Government of India 1966.
- Learning without Burden*, Report of the National Advisory Committee.Education Act. Ministry of HRD, Department of Education, October, 2004.
- National Policy on Education. 1986.* Ministry of HRD, Department of Education, New Delhi.
- Seventh All India School Education Survey, NCERT: New Delhi. 2002
- UNDPA.*Human Development Reports.* New Delhi. Oxford: Oxford University Press.
- UNESCO. (2004) *Education for All: The Quality Imperative. EFA Global Monitoring Report.* Paris.
- Varghese, N.V. (1995). *School Effects on Achievement: A Study of Government and Private Aided Schools in Kerala.* In Kuldip Kumar (Ed.) School effectiveness and learning achievement at primary stage: International perspectives. NCERT. New Delhi.

World Bank, (2004). *Reaching The Child: An Integrated Approach to Child Development*. Oxford University Press, Delhi.

### EPC 5: Understanding the Self

<b>Semester-VIII</b>	<b>Credit-2</b>
<b>Marks 50 (Internal)</b>	<b>Contact Hours- 2 Week workshop</b>

#### Introduction

What is self? Is self the experience of internal talk? What characterizes “self-ness”? Can identities change? Will the identity of a first generational learner belonging to a family of migrant labourer change when she is identified as a gifted child? What are the influences of parents and peers on the identity of a learner?

The above queries and similar questions trigger the exploration and need to understand the ‘self’. Indulging in self-exploration and self-queries is an important exercise for clarity of identity. Developing an understanding of the ‘self’ is essential for an individual to utilize the optimal potential for the benefit of one’s own self as well for the society. As an integral member of the society an individual have various identities – gender, relational, linguistic, cultural etc. and it is essential to understand and address one’s implicit beliefs, stereotypes and prejudices resulting from these identities. The student-teachers need to become aware of their own selves and their identities as well as the political, historical, and socio-cultural forces that shape them. The course thus provides an interdisciplinary view in the development of the understanding of one’s own self. This exploration and understanding will enable the student-teachers to develop sensibilities, dispositions, and skills that will help in their personal and professional development and facilitate the personal growth of their students. This course provides opportunity to the student teachers to gain an understanding about their own ‘self’ both as an individual and as a student-teacher.

#### Objectives

The course will enable the student teachers to;

- Gain an understanding of the central concepts in defining ‘self’ and ‘identity’
- Reflect critically on factors that shape the understanding of ‘self’
- Build an understanding about themselves , i.e. the development of self as a person as well as a teacher
- Reflect on one’s experiences, aspirations and efforts towards becoming a humane individual and teacher
- Develop effective communication skills including the ability to listen, observe etc.
- Build resilience to deal with conflicts at different levels and learn to draw upon collective strengths to live in harmony with one’s surroundings
- Appreciate the critical role of teachers in promoting ‘self’ and students’ well-being.

#### Theme I: Understanding of Self

- Reflections and critical analysis of one’s own ‘self’ and identity
- Identifying factors in the development of ‘self’ and in shaping identity
- Building an understanding about philosophical and cultural perspectives of ‘Self’ and
- Developing an understanding of one’s own philosophical and cultural perspectives as a teacher

#### Theme II: Development of Professional Self and Ethics

- Understanding and sharing one’s identity and socio-cultural, historical and political influences in shaping the professional identity
- Exploring, reflecting and sharing one’s own aspirations, dreams, concerns and effort in becoming a teacher
- Reflections on experiences, efforts, aspirations, dreams etc. of peers

- Building an understanding about values and professional ethics as a teacher to live in harmony with one's self and surroundings
- Understanding the role of teacher as facilitator and partner in well-being among learners

### Theme III: Role of Teacher in Developing Understanding of Self among Learners

- Creating a situation opportunity/context in reflecting on one's own childhood and adolescent years of growing-up for learners
- Facilitating awareness about identity among learners through reflective practices
- Developing skills of effective listening, accepting, positive regard, understanding body languages among the learners.

### Mode of Transaction:

The course will be transacted in workshop mode through individual and group experiential activities such as

- Personal narratives and storytelling, group interactions, film reviews to help explore one's self and identity. Student-teachers to engage in varied forms of self-expression such as poetry, painting and creative movements, humour, aesthetic representations, etc.
- Sharing of case studies by student-teachers, critical analysis of biographies and presentations, group readings and sessions on stories children raised in different circumstances and how this affects self and their personal and social identity formation.
- Reflective discussions on films/documentaries where the protagonist undergoes trials and finally discovers her/his potential
- Development of reflective journals/diaries by the student teachers.
- Introduction of Yoga, meditation as one of the important component to enhance student-teachers understanding of body and mind.

### Guidelines for assessment

Sl.No	Activities	Marks
1	Exploring the 'known' and 'unknown' self in relation to what one and others know about one self and what others do not know (group activity)	5
2	Reflecting, recording and sharing of critical moments in one's life (individual activity and presentations)	10
3	Reflections on critical moments in the lives of peers (small group activity)	5
4	Exploring one's strengths, weaknesses, opportunities and threats (SWOT analysis)	10
5	Group activities involving community participation	20
<b>Total</b>		<b>50</b>

### Suggested Readings

Bhatt, H. (n.d.). *The diary of a school teacher*. An AzimPremji University Publication. Retrieved from [www.arvindguptatoys.com/arvindgupta/diary-school-teacher-eng.pdf](http://www.arvindguptatoys.com/arvindgupta/diary-school-teacher-eng.pdf)

Bhattacharjee, D.K (ed). (2010). *Psychology and Education – Indian Perspectives*, Section III ' Self and Growth Process' pg. 255-402, NCERT Pub

Dalal, A.S. (ed) (2001). *A Greater Psychology – An Introduction to the Psychological thoughts of Sri Aurobindo*. Puducherry, Sri Aurobindo Ashram Pub.

Delors, J. (1996). *Learning the Treasure within –Twenty First Century Education*. UNESCO Education Commission Report.

- Goel, D.R. (2005). *Quality Concerns in Education*. Centre for advanced study in Education-M. S. University of Baroda
- Gulati, S., and Pant, D. (2012). *Education for Values in Schools – A Framework*. NCERT Pub
- Krishnamurti, J. (1998) *On Self- knowledge*. Chennai, Krishnamurti Foundation India.
- Krishnamurti, J. (2000). *Education and Significance of Life*. Chennai, Krishnamurti Foundation India.
- Mukunda, K.V. (2009). What did you ask at school today? A handbook of child learning, Harper Collins
- Olson, D.R, and Bruner, J.S. (1996). *Folk Psychology and folk pedagogy*. In D.R. Olson & N. Torrence (Eds.), *The Handbook of Education and Human Development* (pp. 9 -27), Blackwell
- Pant, D. and Gulati, S. (2010). *Ways To Peace – A Resource Book for Teachers*. NCERT Pub
- Venkateshamurthy, C. G., and Rao, A.V.G (2005). *Life Skills Education Training Package*. R.I.E., Mysore

### **EPC 6: Health, Yoga and Physical Education**

<b>Semester-VIII</b>	<b>Credit-2</b>
<b>Marks 50 (Internal)</b>	<b>Contact Hours- 2 hrs. per week</b>
<b>External -40</b>	
<b>Internal 10</b>	

#### **Introduction**

It is well acknowledged that health is a multidimensional concept and is shaped by biological, physical, psychological, social, economic, cultural and political factors. There are many opportunities for cross curricular learning and integration in other subject areas like science, social science and languages. The organization of activities under this should ensure a wide range of activities, so as to enable student and teacher participate according to his/her interest and need. The syllabus, therefore, focus on "what as a students, teacher. I should learn and what should I expected that the children should learn and practice". This course therefore, focuses on acquisition of habits of healthy living and participation in games & sports for maintenance of fitness among the student teachers, with an aim to inculcate the same among their students in future.

#### **Objectives**

The course will enable the student teachers to;

- Understand the concept of holistic health, its various dimensions and determinants for all round development.
- Know the health status, identify health problems and be informed for taking remedial measures;
- Aware about rules of safety in hazardous situation (illness, accident and injury) and equip them with first aid measures about common sickness and injuries;
- Encourage to form right habits about exercise, games and sports, sleep, rest and relaxation;
- Understand various policies and programmes related to health, physical education and yoga.
- Understand the process of assessment of health and physical fitness.

#### **Unit I: Health Education**

- Concept of health, importance, dimensions and determinants of health; Health needs of children and adolescents, including differently-abled children
- Impact of Physical activities, games, sports and yoga on different body systems, Management of stress and strain and life skills.
- Food and nutrition, food habits, timing of food, nutrients and their functions, diversity of Indian food, seasonal foods and festivals, economics of food, malnutrition, including obesity,

- Dietary requirements of human body with special emphasis on the nutritional needs according to age, sex, occupation, pregnancy and also with reference to sports-personship; Need for diet planning, Balanced diet.

### **Unit II: Physical Education**

- Physical fitness, strength, endurance and flexibility, its components, sports skills, indigenous and self-defense activities
- Development of physical fitness; Postures; Importance of relaxation; Fitness tests; Resources and services for games and sports and Health. Common Sports Injuries and First aid.
- Games and sports — athletics (general physical fitness exercises), games (lead-up games, relays and major games) rhythmic activities, gymnastics and their impact on health
- Fundamentals skills of games and sports; Sports for recreation and competition; Rules and regulations of sports; sports ethics; sports awards and scholarships, sports-person ship.
- Drawing of Fixtures for conducting Tournament, knock-out, league, Layout of Track & Field areas.
- Commonly-abused substance and drugs and ways of prevention and inhabitation.

### **Unit III: Yoga**

- Concept, need and importance of yoga, History of yoga
- Yogasanas- Standing, Sitting, Prone and Supine positions ( 5 Asanas each)
- Surya Namaskar and Pranayams, Meditation
- Precautionary measures for yogic practices.
- Role of yogasanas for prevention of common diseases

### **Suggested Activities for internal**

- Project on Health/Sports and Yoga, analysis of various textbooks from Health and Physical Education point of view
- Activities for development of physical fitness, i.e. strength, speed, endurance, flexibility and body composition (Fundamental Sports Skills ); Basics of track and field (100 mts., 200 mts., long jump, shot put, 4 × 50 mts. relay) .Any two team games (Kabaddi, Kho-Kho, Basketball, Cricket, Hockey, Volleyball and Football) or any individual game
- Organization of games and sports tournaments
- Learning and performing of basic yogic activities, asanas and pranayam, Surya Namaskar and Meditation

### **Suggested Readings**

#### **Health Education**

- K. Park, “Preventive and Social Medicine” BanarsidasBhanoth, Publishers Nagpur Road, Jabalpur, India.
- NCERT (2013). Training and resource materials on Adolescence Education, NCERT, New Delhi (This material is also available on [www.aeparc.org](http://www.aeparc.org).[www.ncert.nic.in](http://www.ncert.nic.in))
- NCERT (2014). Population Education: Source Material, NCERT, New Delhi
- Stephen J. Williams, Paul R. Torrens, “Introduction to Health Service, Delmore Publications

### **Physical Education**

- Deborah A. Wuest, Charles A. Bucher, “Foundation of Physical Education Exercise Science and Sports” Tata McGraw Hill, Pvt. Ltd., New Delhi
- John E. Mixton, Ann E. Jewett, “An Introduction to Physical Education, W.B. Saunders Company, London
- John Cheffers, Tom Evaul, “Introduction to Physical Education-Concept of Human Movement Prentice Hall Engle Wood” New Jersey
- Bette J., Logdson & Others, “Physical Education for Children”, Lea &Febiger, Philadelphia
- Roberts S. Weinberg & Daniel Gould, “Foundation of Sports and Exercise Psychology”, Human Kinetics Publication
- A.K. Uppal, Lawrance Gray Kumar, “Biomechanics in Physical Education and Exercise Science” Friends Publication, New Delhi
- Jack H. Wilmore, David L. Costill, W. Larry Kenney, “Physiology of Sports and Exercise” Human Kinetics Publication

### Yoga

- Swami SatyanandSaraswati, “Asana Pranayama Mudra Bandh”, Bihar School of Yoga, Munger
- M.M. Ghore, “Anatomy and Physiology of Yogic Practices” Lonavala Yoga Institute, Lonavala
- Gharote M.L. (2004). Applied Yoga, Kaivalyadhama S.M.Y.M. Samiti, Lonvala
- “Yogasana” Morarji Desai National Institute of Yoga, New Delhi
- “Pranayama” Morarji Desai National Institute of Yoga, New Delhi
- MDNIY (2010). “Yoga Teachers Manual for School Teachers, New Delhi
- NCERT (2015). Yoga: A Healthy Way of Living Upper Primary Stage, New Delhi
- NCERT (2015). Yoga: A Healthy Way of Living Secondary Stage, New Delhi

### EPC 7: Reading and Reflecting on Texts

<b>Semester-VIII</b>	<b>Credit-2</b>
<b>Marks 50</b>	<b>Contact Hours- 2 Hrs Per Week</b>

### Introduction

A number of studies have shown that the teachers as well as student teachers do not read books other than the textbooks they have to teach or the books related to the syllabi of the course they are pursuing. As the goal of any teacher education programme is to prepare teachers as reflective practitioners, one of the strategies to achieve this goal could be to provide opportunities to the student teachers to read the given texts and then to critically examine the ideas presented in the texts and organize debates/discussions around the ‘ideas’. The given texts could be excerpts from short stories, novels, biographies, autobiographies, literary essays or educational, philosophical, psychological and sociological texts. The Teacher Education Institutions offering the B.Ed. programme can select 10-15 books available in their library for teaching the course in the light of its objectives listed below. The course shall be based on the use of multiple texts which address issues of multiculturalism, gender racism and texts which relate with current issues and contemporary trends. The literary, educational and scientific texts shall also form part of the course.

### Objectives

The course will enable the student teachers to;

- Develop proficiency in reading and responding to written texts.
- Examine and appreciate authentic literary and non-literary texts.
- Develop study and reference skills
- Reflect on the ideas expressed in the texts.

- Plan, draft, edit and present a piece of writing related to their understanding of a text.

### Unit I: Stories and Excerpts from Narratives (any one or more)

- *How I Taught My Grandmother to Read and other Stories*- Sudha Murthy-Puffin. Books, 2004
- *Tales from the Indian Jungle*-Kenneth Anderson- Rupa& Co. 2001
- *Tales of the Open Road*- Ruskin Bond- Penguin UK-2006
- *Encounters with Animals*- Gerald Durrell-Penguin-2012

Excerpts from the following:

- *The Diary of a Young Girl:Anne Frank*, Random House.
- *The man who planted trees*- Jean Giono, Chelsea Green Pub.
- *'I have a Dream'*Texts of speech delivered on Aug 28, 1963-Martin Luther King (Text and You tube version available.)

### Unit II: Essays /Excerpts from Literary Texts (any one or two)

- *The Elephant, the Tiger and the Cellphone*-ShashiTharoor, Penguin, India.
- *Nine Lives- In Search of the Sacred in Modern India*- William Dalrymple, Bloomsbury, London.
- *Running in the Family*- Michael Ontage, Bloomsbury, London.
- *Interpretor of Maladies – (Title Story)*–JhumpaLahari, Mariner Books.

### Unit III: Essays /Excerpts from Educational and Scientific Texts (Choose any three)

- *Medium of education* (The selected works of Gandhi- Vol.6), Navajeevan Publication.
- *A Brief History of Time*- Stephen Hawking, Random House.
- *Fall of a Sparrow*- Salim Ali, Oxford.
- *Education and world peace. In Social responsibility, (Krishnamurti, J.) Krishnamurti Foundation.*
- *National curriculum framework – 2005. NCERT*
- *Civilization and progress. In Crisis in civilization and other essays. (Tagore, R.) Rupa& Co.*
- *RTE Act, 2009*

### Guidelines for Assessment

Sl no	Activity	Marks
1	Narrating any one story selected from Unit 1 in own words; writing the summary of the story, extrapolation of the story; discussion on the ideas expressed	10
2	Converting any one situation from the text specified under Unit 1 into a dialogue followed by role-playing	10
3	Interpretation of the text, reflecting on the key ideas exposed in the texts specified under Unit 2 and preparing a write up based on any one text	10
4	Reflection on the ideas expressed in the selected essays/ excerpts specified under Unit 3	10
5	Seminars and open forum for discussion based on themes related to selected texts from Unit 3	10
<b>Total</b>		<b>50</b>

### FE-3: WORKING WITH COMMUNITY

<b>Semester-VIII</b>	<b>Credit-2</b>
<b>Mark:50 (Internal)</b>	<b>Contact Hours- 02 Weeks</b>

#### Introduction:

School is a miniature community and a big gap is found between school and community. Mutual exchange and sharing of resources and facilities between the two is essential for national development. The student teachers need to have knowledge and awareness about the community and neighbourhood and the relationship between school and community. Considering the value of relationship between school and community and the facilitating role of teachers in this the B.Ed. curriculum has provision for fieldwork with community. The programme aims at enhancing their ability to enlist community support for School and contribute for national development. The programme aims at acquainting them with social realities, developing dignity of labour among them and prepare them for sustainable development.

### **Objectives:**

The course will enable the student teachers to;

- Acquaint the student teachers with the factors working within the society, community i.e. knowledge of social realities
- Develop the dignity of labour among student – teachers
- Arouse their interest in the social and economic reconstruction of the country
- Make the student-teacher aware with the educational problems and needs of the society
- Prepare youth for sustainable development
- Develop the personality of the student-teacher through community service

Student teachers shall be provided exposure to community life for at least one week during which they shall live with the community members and act in terms of preparing school development plan, sharing cultural practices, holding cultural programmes and gaining community's perception about and aspirations from formal education system. The members of SMC/VMC should be associated in these activities.

The institution will form a committee, including faculty members, student teachers and community/SMC members for the smooth organization of this programme. The student teachers shall prepare a detailed report of the programme, individually and/or in group during the activity and submit at the end of the programme.

### **Transaction Mode**

Discussion, Rally, Competitions (Debates) Posters and Banner displays Working in community setting, Mass movement, *Nukkad* Performances, Local action group formation, surveys, interviews, action research, case study, dissemination of success stories etc.

### **Suggested Activities**

1. Micro planning of a school community relationship
2. Study of the nature of community participation in a secondary school
3. Survey of community resources for participation in scholastic and co-scholastic activities of a school educational survey of a slum area
4. Report on social customs, traditions and superstition
5. Survey of a village/town with at least 20 households in order to study the socio-economic and educational status of the villager
6. Study of wastage and stagnation in local primary schools
7. Study of an area in regard to consumption of electricity and water and suggest remedial measures
8. Tree plantation programme in the campus/nearby village
9. Survey of parent's attitude towards education of their children
10. Organization of non-formal education centers for dropouts and out of school children in a locality
11. Organization of campus beautification programme
12. Identification of problems of parents with respect to education of their children

13. Aids awareness, electoral awareness, road safety, human rights, women rights etc literacy programmes in the community
14. Cleanliness drives in the community and awareness about its needs
15. Developing healthy food habits among the community members
16. Training of community in some simple vocations for self-employment
17. Action research on local problems in consultation with the community
18. Micro – planning exercises for assessing the educational status of the community
19. Establishment of peace-committees and making them functional effectively
20. Critical review of implementation of rte act (2009).
21. Assistance and working with local community in actual relief work whenever needed
22. Training of community in first aid
23. Exploiting the community resources and finding means and ways of using them for school

Many more such exercises could be conceived. Any such activities could be planned at the institutional level and executed. It is suggested that these activities may be conducted individually or collectively under the supervision of teacher education.

विद्यया ऽ मृतमश्नुते



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