

# **PROGRAMME GUIDE**

# **BACHELOR OF SCIENCE**



**KARNATAKA STATE OPEUNIVERISTY**

**Mukthagangothri, Mysuru 570 006**

## VICE-CHANCELLOR'S MESSAGE

### Dear Learner,

The family of Karnataka State Open University (KSOU) welcomes you to pursue the academic programmes you have chosen to achieve not only academic excellence, but also to fulfill the desire of your career. The university established by the Act of State Legislature, has created a wonderful academic ambience. The programmes offered by the university have been recognized by University Grants Commission. Therefore, the degrees are valid for employment opportunities across the country. The 'core values' of the university is derived from its vision **'Higher Education to Everyone, Everywhere'**. The ultimate touchstone of providing quality higher education is the motto of the university. Today, higher education stands at the crossroads of keeping pace with the emerging needs of the country.

The university has adopted a school concept in its functioning. Different schools headed by the Directors offer academic programmes in Humanities, Commerce, Education, Science and Social Sciences. It combines an inter-disciplinary and professional approach to pedagogy and research. The university believes that rigors of the contemporary world require competent quality human resources to create a knowledge-based society. The academic activities of B.A./B.Com./B.Sc.programmes are routed through well-established department/s led by the Chairperson/s. Well-qualified teaching faculty with equally dedicated non-academic team is an asset to the university, which is always committed for the welfare of the students.

The university functions in a 3-tier system of student support service, namely Headquarters, Regional Centres and Learners Support Centres spread all over Karnataka. The learners can undergo teaching learning process in the notified Regional Centres/Learner Support Centres. The university has adopted a mechanism to deliver Self Learning Material by print, limited audio visual and Counselling/Personal Contact Programme (PCP). As a learner, you will have greater opportunity to gain knowledge and skills through these mechanisms. The academic counsellors will play a strategic role and enable you from the enrolment of the programme till you accomplish the goal. A proper blending of knowledge and skills will be

imparted so that you will be transformed as a good citizen to contribute to the development of society and the country.

The UGC in its Public Notice dated: 23.02.2018 stated that the Degree/Diploma/Certificate Programmes awarded through distance mode are on par with corresponding Degree/ Diploma/ Certificate Programmes obtained through conventional universities. The degrees acquired through distance education are recognized for the purpose of employment in State/Central Government, MNCs, and Private Sector etc. It also enables you to pursue higher education in other educational institutions. Therefore, you have greater opportunity of pursuing Higher Education without any kind of fear about your career.

I am sure you will enjoy good experience with services rendered by the university through its Regional Centres and Learner Support Centres, besides Headquarters. I wish you all the best in your academic endeavors.

Prof. Vidyashankar S.

## **MESSAGE FROM DEAN (ACADEMIC)**

**Dear Learner,**

As you know, education imparts knowledge and skills which empowers all to build a civilized society. The education policy of the government provides a greater opportunity to accelerate Gross Enrolment Ratio (GER). Higher education is imparted both by conventional system and Innovation in Open and Distance Learning (ODL) system. The ODL system operates under access, flexibility and success.

The KSOU, which came up in 1996 under the Act of state legislation 1992 plays a pivotal role in imparting quality education. As one of the premier institutions in ODL system of the country, the university strives hard to empower various dis-advantaged sections of the society like, house wives, economically and culturally backwards, tribals, senior citizens, working groups, differently abled, professionals, prison inmates etc., The university caters to the needs of students ranging from the age of 18 to 80 years. The programmes offered by KSOU are strictly in conformity with quality and standards set by regulatory bodies UGC/AICTE etc.,

The KSOU operates on dictum quality first, and students foremost. Further, the university is highly committed to provide need-based education to the door steps of the students. The eminent teaching faculty and dedicated non-academic staff in various departments and student support services create a conducive environment for teaching learning. I am confident that, as a learner in the university, you will enjoy a good experience in the system.

I wish you all the best in your academic endeavors.

Prof. Ashok Kamble

**Dear student,**

Welcome to the family of distance learners and KSOU's Bachelor Degree Programme in Sciences (B.Sc.) under UGC-CBCS scheme. It is a three-year programme during which you will study a wide range of courses in the area of Sciences such as Biochemistry, Botany, Chemistry, Computer Science, Environmental Science, Food Science and Nutrition, Mathematics, Microbiology, Physics and Zoology. Apart from these core subjects, you will also study skill enhancement courses and compulsory courses in language and environment. You will receive support from KSOU through the Regional Centre and Study Centre which will be allotted to you and also from KSOU's website. We expect you to be directly in contact with us and your peers through the Internet also, at the email address given below. This Programme Guide contains instructional system of KSOU B.Sc. programme, syllabus of the courses which are presently approved from UGC, and other important information. You can download the assignments of the semester in which you have enrolled from our website. Each course contains prescribed number of assignments that will be assessed by a counsellor at your study centre. All these assignments are to be submitted at your study centre within the stipulated time mentioned against last date of submission. In case a student needs the assignments of previous semesters, you can obtain a copy of the same from the KSOU website.

At your study centre, you will be able to avail yourself of the counselling for all the courses. It is not mandatory to attend the counselling session of theory courses but it is necessary to attend all lab sessions for laboratory courses. You are expected to pay the examination fee and the re-registration fee online. However, in exceptional cases, you can also submit the fee offline. It is to be noted that the fees that are mentioned in various forms/formats are as on date and is subject to revision from time to time. You are advised to check the website/study centre/regional centre for

any revision/modification. Some useful forms and formats (or the link to useful forms and formats) are also given at the end of this booklet. You may use the photocopies of those. The Programme Guide, forms and formats are also available on the website. Please confirm the fees with the Regional Centre / Study Centre / Website before you pay. As a distance learner, you may have several queries. You will find answers to many of them in this booklet. This booklet is a very important guide for you. Read it and preserve it until you successfully complete the B.Sc. programme. This Programme Guide contains the information related to the B.Sc. General

programme. However, during your studies, if you have any feedback, suggestions and comments, please write to us immediately. Learners are advised to be in touch with their study centres for advice, timely /day to-day information or visit the website with URL [www.ksoumysuru.ac.in](http://www.ksoumysuru.ac.in).

We wish you all the success in pursuing the B.Sc. Programme.

Programme Coordination Team

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## **1. ABOUT THE UNIVERSITY**

**The Karnataka State Open University is recognized by the University Grants Commission under (Open and Distance Learning & Online Learning) Regulation 2017.**

Karnataka State Open University was established in June 1996 with a vision 'Higher Education to Everyone, Everywhere'. The University blossomed in the era of globalization in which the economies of the world are being transformed from their original closed self-sustaining structure to the globalized context, where they can expose themselves to the competitive world. This transition forced the arena of knowledge emphasizing itself to more of its application than of accumulation of facts. The KSOU, in order to cope with the present global environment, is attempting to integrate interdisciplinary approaches in the dissemination of knowledge with the aim of achieving overall human personality development.

Mysuru is a historical centre possessing a rich cultural heritage with valiant historical events of different kingdoms and humane social setup of incomparable stature. The university has paved way for realizing the vision at the international arena leading to human welfare. It was started during the year 1996 as a separate entity to cater to the needs of thousands of young aspirants of higher education.

The KSOU is situated at the heart of Mysuru city, and operates in 50 Acre of land in a fully green ambience. The university is offering UG, PG and Ph.D. programs besides diploma and PG Certificate programs in various disciplines. The university is fully equipped with 28 academic departments controlled by the chairpersons and supported by other faculty and non-teaching staff. The KSOU is carved mainly with an intention of upbringing the unprivileged groups of the society, and hence the fees for all the courses at affordable rate.

### **1.1 SPECIAL FEATURES**

The ODL system is unique and challenging, because the learners hail from a diverse socio-economic and varied learning background. The present conventional university system could not meet the genuine needs of such students who could not pursue their studies in a conventional



university for various reasons. In order to give them an opportunity to pursue their studies in ODL, the KSOU has been established. The major objective of the university is to generate human resources of top quality with more emphasis laid on the following issues:

- (1) To transform guiding vision into action plan through various measures.
- (2) To generate high quality human resources through skill training.
- (3) To provide opportunity to those who discontinued their studies.
- (4) To provide opportunity to working class to acquire higher knowledge.
- (5) To provide opportunity to pursue higher education at their own places.
- (6) To provide transparent manner of admission.
- (7) To transfer restricted learning to a global-based learning.
- (8) To promote new concept and new direction to higher education.
- (9) To promote multiple imperatives to achieve national development.
- (10) To play critical role in addressing social imperatives.
- (11) To create adequate student-support services for innate capacity building.

## 2. OFFICERS OF THE UNIVERSITY

**Shri Thawar Chand Gehlot**

**Chancellor**

His Excellency, the Governor of Karnataka



**Dr. C. N. Ashwathnarayan**

**Pro Chancellor**

Hon'ble Minister for Higher Education, Govt. of Karnataka



**Prof. Vidyashankar S.**

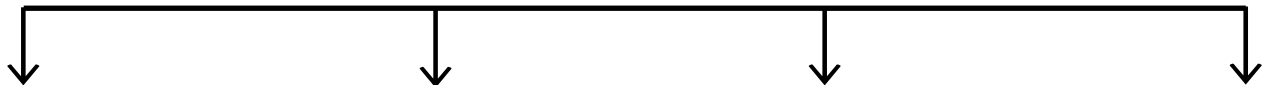
**Vice Chancellor**

Karnataka State Open University



**Prof. R Rajanna**

**Registrar**



**Prof. Kamble Ashok**

**Dr. Shanmukha**

**Dr. A. Khadar Pasha**

**Dean (Academic)**

**Dean (Study Centres)**

**Registrar (Evaluation)**

**Finance Officer**

### 3. FACULTY PROFILE

Faculty Profile						
Sl. No.	Name of the Faculty	Designation	Qualification	Specialization	Experience (Years)	Contact Nos.
Department of Studies and Research in Biochemistry						
01	Dr. Nataraju Angaswamy	Assistant Professor	M.Sc. Ph.D.	Biochemistry	8	9620697355
02	Smt. Rajeshwari	Assistant Professor (Guest Lecturer)	M.Sc	Biochemistry	-	-
Department of Studies and Research in Botany						
03	Dr. Krishna Murthy	Assistant Professor (Contract Basis)	M.Sc., M.Phil., Ph.D.	Pathology, ecology, and hydrobiology	09	9964488055
04	Dr. Ravindra K.N	Assistant Professor (Contract Basis)	M.Sc., M.Phil., Ph.D.	Plant tissue culture, plantmolecular biology, phytochemistry	05	9844101741
Department of Studies and Research in Chemistry						
06	Dr. M. Umashankara	Assistant Professor	M.Sc. Ph.D.	Organic Chemistry	7	9482510061
07	Dr. Krishna M.H	Assistant Professor (Contract Basis)	M.Sc. Ph.D	Organic Chemistry	08	9880858341
08	Dr. vasanth kumar. S	Assistant Professor	M.Sc. Ph.D	Physico-organic chemistry	02	8150984894

		(Contract Basis)				
09	Dr. Chaithanya S	Assistant Professor (Contract Basis)	M.Sc. Ph.D	General chemistry	08	9886684437
09	Dr. Shahini C.R	Assistant Professor (Contract Basis)	M.Sc. Ph.D	Organometallic chemistry	-	6363951836
10	Dr. Arjun H. A.	Assistant Professor (Contract Basis)	M.Sc. Ph.D	Bioorganic chemistry	-	9480468715
11	Dr. Kemparaje gowda	Assistant Professor (Contract Basis)	M.Sc. Ph.D, BEd.	Physical chemistry	05	6364278923
12	Dr. Obaiah G.O	Assistant Professor (Contract Basis)	M.Sc. Ph.D	Inorganic chemistry	03	9741913492
<b>Department of Studies in Computer Science</b>						
13	Smt. Suneetha	Assistant Professor and chairman	M.Sc.	Pattern recognition & Image Processing	16	9480326709
14	Dr. D.M. Mahesha	Assistant Professor	M.C.A., Ph.D.	Text Recognition	11	9901249102
15	Smt. D.N.Bhavya	Assistant Professor	M.Tech.	Bio Matrics	11	8722384750
16	Dr. Sumati Ramakrishna Gowda	Assistant Professor	M.Sc.IT, MPhil Ph.D.	Mobile Adhoc Networks	21	9743363293
17	Dr. Naveen Kumar C.G	Assistant Professor (Contract Basis)	M.Sc, MCA, MBA, MCSE, PhD.	Cloud computing, network security, computr networks.	12	9060091571

Department of Studies and Research in Environmental Science						
19	Dr.J.S.Chandrashekar	Assistant Professor	M.Sc. M.Phil Ph.D.	Ecology	10	9663061978
20	Dr. T. S. Harsha	Assistant Professor	M.Sc. Ph.D.	Environmental Microbiology	14	9449178802
21	Dr. H.R. MeenaKumari	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Environmental pollution	18	9900665328
22	Dr. Priyadarshini N.R	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Medical waste management	15	8970104120
23	Dr. Gireesha .J	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Environmental microbiology	09	9901308706
Department of Studies and Research in Food Science and Nutrition						
24	Dr. M.S. Hemalatha	Assistant Professor	M.Sc. Ph.D.	Food Science & Nutrition	8	9482566371
25	Dr. C. Anitha	Assistant Professor	M.Sc. Ph.D.	Nutrition and Dietetics	29	9148531967
26	Dr. Krishnaraj V	Assistant Professor (Contract Basis)	M.Sc, M.Phil., Ph.D.	Food Science & Nutrition	14	8722221499
Department of Studies and Research in Microbiology						
36	Dr. S. Niranjan Raj	Assistant Professor	M.Sc., M.Phil., Ph.D.	Mol. Plant Pathology	15	9886859350
37	Dr Syed Baker	Assistant Professor	M.Sc. Ph.D.	Microbiology, bionanotechnolog	07	9845542016

		(Contract Basis)		y		
38	Dr. Mahadeva Kumar S	Assistant Professor (Contract Basis)	M.Sc. Ph.D. PDF	Mycology, molecular plant pathology	05	9743217220
<b>Department of Studies in Physics</b>						
39	Sri. S.V. Niranjana	Assistant Professor	M.Sc.	Physics	8	9535284356
40	Dr. M.B. Nanda Prakash	Assistant Professor (Contract Basis)	M.Sc, M.Phil., Ph.D.	Solid state physics	20	9900356322
41	Dr. K.S. Pruthvi Rani	Assistant Professor (Contract Basis)	M.Sc. Ph.D	Nuclear physics, atmospheric physics	05	8951787130
<b>Department of Studies and Research in Zoology</b>						
45	Dr. Nandini G	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Molecular biology	4	9164967518
46	Deepthi S	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Aquatic miocrobial ecology	8	9738525445
47	Dr. M.K. Ramakrishna	Assistant Professor (Contract Basis)	M.Sc. Ph.D.	Genetics and molecular biology	6	9342151755
48	Dr. Chethan B.K	Assistant Professor (Contract Basis)	M.Sc. Ph.D, BEd.	Genetics and insect taxonomy	11	9611075414
<b>Department of Studies and Research in Mathematics</b>						
51	Dr. Pavithra M	Assistant Professor (Guest Lecturer)	M.Sc. Ph.D, BEd.	Graph theory	09	9739400079

52	Dr. Nandeesh K.C	Assistant Professor (Contract Basis)	M.Sc. Ph.D, BEd.	Spectral graph theory	05	9964685230
<b>Department of Studies and Research in Kannada</b>						
53	Dr. A. Rangaswamy	Professor	M.A. Ph.D	Chandassu	29	336
54	Dr. D. Naganna	Associate Professor	M.A. Ph.D	Sahitya Vimarshe	26	336
55	Dr. Kavitha Rai	Associate Professor	M.A. Ph.D	Kavya Mimamse	15	336
56	Dr. T.M. Geethanjali	Assistant Professor	M.A. Ph.D	Taulinika Sahitya	26	336
57	Dr. N.R. Chandre Gowda	Assistant Professor	M.A. Ph.D	Janapada mattu Vimarshe	24	336
58	Dr.P.Mani	Assistant Professor	M.A. Ph.D	Basha Sahitya	20	336
59	Dr. Jyothishankar	Assistant Professor	M.A. Ph.D	Pracheena Sahitya	17	336
<b>Department of Studies and Research in English</b>						
60	Dr. Nataraju .G	Assistant Professor	M.A. Ph.D	British Literature	12	389
61	Dr. Srikanth .S	Assistant Professor	M.A. M.Phil Ph.D.	European Classics	16	387
62	Dr. A.S. Madhura	Assistant Professor	M.A. M.Phil Ph.D.	Holocaust Literature	13	388
63	Dr John Peter S	Assistant Professor (Contract Basis)	M.A. BEd Ph.D.	-	8	9743707672
64	Dr Vinutha P Kunderi	Assistant Professor (Contract Basis)	M.A. M.Phil Ph.D.	-	5	9632469430
<b>Department of Studies and Research in Hindi</b>						
65	Dr. Kamble Ashok	Professor	M.A. Ph.D	Grammar	33	398
66	Dr. Prabhusena D	Assistant Professor	M.A. Ph.D	Modern Hindi Poetry, Comparative Study, Poetic Criticism	08	398

67	Dr. Veena	Assistant Professor (Contract Basis)	M.A. M.Phil Ph.D.	Poetic Criticism	11	9449785809
<b>Department of Studies and Research in Sanskrit</b>						
68	Dr. Shalva Pille Iyengar	Coordinator	M.A. Ph.D	Sanskrit	-	-
<b>Department of Studies and Research in Urdu</b>						
69	Dr. M. Ramanatham Naidu	Coordinator	M.A. Ph.D	urdu	18	395
70	Dr. Mohammed nasrulla khan	Assistant Professor (Contract Basis)	M.A. Ph.D	urdu	19	9845916982
71	Dr Syeda ishrath fathima	Assistant Professor (Contract Basis)	M.A, M.Phil, Ph.D	urdu	03	9663798365
<b>Department of Studies and Research in Telugu</b>						
72	Dr. M. Ramanatham Naidu	Associate Professor	M.A. Ph.D	Telugu	26	396
73	Dr. B. Nagashesu	Assistant Professor (ContractBasis)	M.A. Ph.D	Telugu	10	9985509053
74	Dr. B. chakravarthi	Assistant Professor (ContractBasis)	M.A. Ph.D, TPT	Telugu	09	9666454688
<b>Department of Studies and Research in Indian Constition</b>						
75	Dr. N. Ananda Gowda	Assistant Professor	M.A. Ph.D	Political Theory	11	445



## 4. ABOUT THE PROGRAMME

The University follows the credit system in all its B.Sc. programmes. One credit is equal to 30 hours of learner's study time which is equivalent to 15 lectures in conventional system. To earn a Bachelor's Degree, a learner has to earn 144 credits in minimum six semesters (three years) with 24 credits per semester. For earning 144 credits, a student has to opt from the following categories of courses:

- a) Discipline Specific Core Courses (DSC)
- b) Discipline Specific Electives (DSE)
- c) Ability Enhancement Compulsory Courses (AECC)
- d) Skill Enhancement Courses (SEC)

A learner can choose three disciplines as per his/her interest from the combination of optional subjects offered for completing B.Sc. (General) programme. The accessible disciplines are mentioned below:

1. Biochemistry
2. Botany
3. Chemistry
4. Computer Science
5. Environmental Science
6. Food Science and Nutrition
7. Mathematics
8. Microbiology
9. Physics
10. Zoology

A learner has to take Discipline Specific Core Courses and Discipline Specific Elective Courses from the above mentioned **three Disciplines ONLY** in all the subsequent semesters.

### **Explanation of terms used for categorization of courses:**

**1. Discipline Specific Core Courses (DSC):** A course, which should compulsorily be studied by a candidate as a core requirement is termed as a Core course.

**2. Elective Course (DE):** Generally, a course which can be chosen from a pool of courses and which may be very specific or specialized or advanced or supportive to the discipline/ subject of

study or which provides an extended scope or which enables an exposure to some other discipline/subject/domain or nurtures the candidate's proficiency/skill is called an Elective Course. The Elective course may be offered in following types:

**2.1 Discipline Specific Elective (DSE) Course:** Elective courses may be offered by the main discipline/subject of study is referred to as Discipline Specific Elective.

**2.2 Dissertation/Project:** An elective course designed to acquire special/advanced knowledge, such as supplement study/support study to a project work, and a candidate studies such a course on his own with an advisory support by a counsellor/faculty member is called dissertation/project.

**2.3 Generic Elective (GE) Course:** An elective course chosen generally from an unrelated discipline/subject, with an intention to seek exposure is called a Generic Elective. In B.Sc. programme presently we are not offering any such Course.

P.S.: A core course offered in a discipline/subject may be treated as an elective by other discipline/subject and vice versa and such electives may also be referred to as Generic Elective.

**3. Ability Enhancement Compulsory Courses (AECC):** AECC may be of two kinds:

Ability Enhancement Compulsory Courses (AECC) and Skill Enhancement Courses (SEC). "AECC" courses are the courses based upon the content that leads to knowledge enhancement; i. Environmental Science and ii. English/MIL Communication.

These are mandatory for all disciplines. SEC courses are value-based and/or skill-based and are aimed at providing hands-on-training, competencies and skills.

**3.1 Ability Enhancement Compulsory Courses (AECC):** Constitution of India and Environmental Science/Biodiversity.

**3.2 Skill Enhancement Courses (SEC):** These courses may be chosen from a pool of courses designed to provide value-based and/or skill-based knowledge.

## 4.1 OBJECTIVES

- To provide an advanced learning of core principles and specialized knowledge in the field specific.
- To pursue a well-organized and less expensive option abreast with latest knowledge.
- To impart skills to the learners that is required to diagnose the problems.

- To train the learners with professional fragrance who can assume the task in the domain subject.
- To improve the subject knowledge of the aspirants and to make them acquainted with necessary laboratory techniques.
- To produce trained learners with appropriate critical thinking and problem-solving skills and aptitude for taking up various job opportunities.

## 5. COMBINATION OF OPTIONAL SUBJECTS OFFERED

Sl. No.	Combination
1	<b>PCM:</b> Physics-Chemistry-Mathematics
2	<b>PMCs:</b> Physics-Mathematics-Computer Science
3	<b>BBZ:</b> Biochemistry-Botany-Zoology
4	<b>CBZ:</b> Chemistry-Botany-Zoology
5	<b>BBM:</b> Biochemistry-Botany-Microbiology
6	<b>CBM:</b> Chemistry-Botany-Microbiology
7	<b>BMF:</b> Biochemistry-Microbiology-Food Science and Nutrition
8	<b>CZEs:</b> Chemistry-Zoology-Environmental Science
9	<b>BZEs:</b> Biochemistry-Zoology-Environmental Science

## 6. DELIVERY MECHANISM

The delivery mechanism followed in the university is different from that of conventional universities. The Open University system is more learners-centric, and is geared to cater to the needs of motivated students assuming that the student is an active participant in the teaching-learning process. Instruction to the students is imparted through the following:

\*Printed Self-Learning Material (SLM).

\*Audio - visuals.

\* Counseling/PCP

**a. Printed SLM**

SLM takes the role of a teacher in distance education system. The study materials in English provided to you along with this programme guide are called self-learning materials as they facilitate learning on your own. The study material is exhaustive and easy to understand. The SLMs have been divided into blocks and units. Each block has one credit value which denote 30 hours of study for one block, be it studying, discussing with counselors, attending classes, writing assignment, and so on.

Objectives are given in the beginning of each unit which tells what is expected of you by learning the particular unit. Check your progress questions which are given under contents, so that you can measure your progress while studying the material. References are given at the end of each unit which gives you sources for furtherance of your study.

**b. Audio-visuals**

In an endeavor to impart education to reach the unreached, the university has a system to provide information by audio-visuals. The study material will be broadcasted by FM radio and other channels. The limited visuals are also pressed in to action to clarify many issues during the teaching-learning process.

**c. Counseling/ PCP**

The university delivers the instructions in English through counseling/PCP; counseling may be held during the weekends, while the PCP will be conducted for a period of 5 to 6 days at stretch. Well experienced teachers working in the department and from other universities will deliver lectures; thereby they clear many intricacies which may occur on the SLM. The academic counselors will help you to prepare yourself to face the examination with confidence, besides your career.

## 7. PROGRAMME STRUCTURE

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
I	Lang	L-A1	Language	2		80	20	-	-	100	3
	Lang	L-B1	Language	2		80	20	-	-	100	3
	AMC	AMC-1	Constitution of India	2		-	-	-	-	-	-
	DSC	DSC-A1	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-B1	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-C1	Optional	4	2	80	20	40	10	150	3
	Total			24		400	100	120	30	650	-

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
II	Lang	L-A2	Language	2		80	20	-	-	100	3
	Lang	L-B2	Language	2		80	20	-	-	100	3
	AMC	AMC-2	Environmental Science/Biodiversity	2		-	-	-	-	-	-
	DSC	DSC-A2	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-B2	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-C2	Optional	4	2	80	20	40	10	150	3
	Total			24		400	100	120	30	650	-

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
III	Lang	L-A3	Language	2		80	20	-	-	100	3
	Lang	L-B3	Language	2		80	20	-	-	100	3
	SEC	SEC-1	Computer networks/Cyber Security	2		40	10	-	-	50	1½
	DSC	DSC-A3	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-B3	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-C3	Optional	4	2	80	20	40	10	150	3
	Total			24		440	110	120	30	700	-

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
IV	Lang	L-A4	Language	2		80	20	-	-	100	3
	Lang	L-B4	Language	2		80	20	-	-	100	3
	SEC	SEC-2	Skill Enhancement Course	2		40	10	-	-	50	1½
	DSC	DSC-A4	Optional	4	2	80	20	40	10	150	3
	DSC	DSC-B4	Optional	4	2	80	20	40	10	150	3

	DSC	DSC-C4	Optional	4	2	80	20	40	10	150	3
	<b>Total</b>			<b>24</b>		<b>440</b>	<b>110</b>	<b>120</b>	<b>30</b>	<b>700</b>	<b>-</b>

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
V	*DSE	DSE-A1	Optional	3	2	80	20	40	10	250	3
		DSE-A2	Optional	3		80	20				3
		DSE-A3	Optional	3		80	20				3
	#DSE	DSE-B1	Optional	3	2	80	20	40	10	250	3
		DSE-B2	Optional	3		80	20				3
		DSE-B3	Optional	3		80	20				3
	\$DSE	DSE-C1	Optional	3	2	80	20	40	10	250	3
		DSE-C2	Optional	3		80	20				3
		DSE-C3	Optional	3		80	20				3
	Total				24	480	120	120	30	750	-

Sem	Course Nature	Course Code	Course Title	Credits		Theory Marks		Practical Marks		Total Marks	Duration of Exam
				Theory	Practical	Term end exam	Internal Assessment	Term end exam	Internal Assessment		
VI	**DSE	DSE-A1	Optional	3	2	80	20	40	10	250	3
		DSE-A2	Optional	3		80	20				3

		DSE-A3	Optional	3		80	20				3
	##DSE	DSE-B1	Optional	3	2	80	20	40	10	250	3
		DSE-B2	Optional	3		80	20				3
		DSE-B3	Optional	3		80	20				3
	\$\$DSE	DSE-C1	Optional	3	2	80	20	40	10	250	3
		DSE-C2	Optional	3		80	20				3
		DSE-C3	Optional	3		80	20				3
	<b>Total</b>			<b>24</b>		<b>480</b>	<b>120</b>	<b>120</b>	<b>30</b>	<b>750</b>	<b>-</b>

- **Lang** – Language; **AMC**- Additional Mandatory Courses; **SEC**- Skill Enhancement Courses; **DSC**-Discipline Specific Core; **DSE**- Discipline Specific Elective.

**Note:**

- List of languages offered:**Kannada, Hindi, English, Telugu, Sanskrit, Urdu.

In the first semester, the student has to choose any two languages from the above list and shall retain the same till the end of fourth semester.

- AMC-1:** Constitution of India;

- AMC-2:**Environmental Science (for all students except students who have opted for Environmental Science as one of the optional subjects) /Biodiversity (for students who have opted for Environmental Science as one of the optional subjects).

- In fifth and sixth semester

Student has to choose any two Courses among DSE-A1, DSE-A2 and DSE-A3.

# Student has to choose any two Courses among DSE-B1, DSE-B2 and DSE-B3.

\$ Student has to choose any two Courses among DSE-C1, DSE-C2 and DSE-C3

\*\*Student has to choose any two Courses among DSE-A4, DSE-A5 and DSE-A6.

## Student has to choose any two Courses among DSE-B4, DSE-B5 and DSE-B6.

\$\$ Student has to choose any two Courses among DSE-C4, DSE-C5 and DSE-C6

- SEC – 1** is a common paper for all students (Computer networks); **SEC – 2** is to be selected from one among the three subjects within the chosen combination only



## VI. OPTIONAL COMBINATIONS OPTIONS

Sl. No.	Combination
1	<b>PCM:</b> Physics-Chemistry-Mathematics
2	<b>PMCs:</b> Physics-Mathematics-Computer Science
3	<b>BBZ:</b> Biochemistry-Botany-Zoology
4	<b>CBZ:</b> Chemistry-Botany-Zoology
5	<b>BBM:</b> Biochemistry-Botany-Microbiology
6	<b>CBM:</b> Chemistry-Botany-Microbiology
7	<b>BMF:</b> Biochemistry-Microbiology-Food Science and Nutrition
8	<b>CZEs:</b> Chemistry-Zoology-Environmental Science
9	<b>BZEs:</b> Biochemistry-Zoology-Environmental Science

## 7. COURSE DETAILS FOR OPTIONALS

Sl. No.	Course	Semester	Course Code	Course Title
1	Biochemistry	I	BBCDSC-1	Introduction to Biochemistry
		II	BBCDSC-2	Bioorganic chemistry
		III	BBCDSC-3	Human physiology & Nutrition
		IV	BBCDSC-4	Biomolecules
		V	BBCDSE-1	Microbiology & Basic Immunology
			BBCDSE-2	Enzymology
			BBCDSE-3	Biochemical techniques
		VI	BBCDSE-4	Metabolism
			BBCDSE-5	Clinical biochemistry
			BBCDSE-6	Molecular biology and Genetic engineering
2	Botany	I	BBOTDSC-1	Phycology, Mycology and Microbiology
		II	BBOTDSC -2	Bryophytes, Pteridophytes, Gymnosperms
		III	BBOTDSC -3	Biomolecules and Cell Biology
		IV	BBOTDSC -4	Anatomy of Angiosperms
		V	BBOTDSE -1	Plant Physiology and Metabolism
			BBOTDSE-2	Cytogenetics
			BBOTDSE -3	Taxonomy of Flowering Plants

		VI	BBOTDSE -4	Plant Pathology and Biotechnology
			BBOTDSE -5	Plant Ecology and Phytogeography
			BBOTDSE -6	Economic Botany and Plant Resource Utilization
<b>3</b>	<b>Chemistry</b>	I	BCDSC-1	Chemistry - I
		II	BCDSC-2	Chemistry - II
		III	BCDSC-3	Chemistry - III
		IV	BCDSC-4	Chemistry - IV
		V	BCDSE-1	Chemistry -V
			BCDSE-2	Chemistry -VI
			BCDSE-3	Chemistry -VII
		VI	BCDSE-4	Chemistry -VIII
			BCDSE-5	Chemistry -IX
			BCDSE-6	Chemistry -X
<b>4</b>	<b>Computer Science</b>	I	BCSDSC-1	Basic concepts of computer & C programming
		II	BCSDSC-2	Data structure using C++
		III	BCSDSC-3	Python Programming
		IV	BCSDSC-4	Object oriented programming with java
		V	BCSDSE-1	DBMS
			BCSDSE-2	Operating system
			BCSDSE-3	Visual Technology
		VI	BCSDSE-4	Computer Networks
			BCSDSE-5	Web designing
			BCSDSE-6	Digital Image Processing
<b>5</b>	<b>Environmental Science</b>	I	BESDSC-1	Fundamentals of Environmental Science
		II	BESDSC-2	Ecology and Ecosystem Dynamics
		III	BESDSC-3	Environmental Pollution and Monitoring
		IV	BESDSC-4	Environmental conservation and Management
		V	BESDSE-1	Natural Resource Management
			BESDSE-2	Environmental Laws and Policies
			BESDSE-3	Human-Wildlife Conflict & Management
		VI	BESDSE-4	Climate Change - Mitigation and adaptation
			BESDSE-5	Eco Restoration and Sustainable Development
			BESDSE-6	Green Technologies
<b>6</b>	<b>Food Science and Nutrition</b>	I	BFSNDSC-1	Human Physiology
		II	BFSNDSC-2	Food Science
		III	BFSNDSC-3	Principles of Nutrition
		IV	BFSNDSC-4	Food Chemistry
		V	BFSNDSE-1	Community Nutrition
			BFSNDSE-2	Food Microbiology
			BFSNDSE-3	Clinical Nutrition
		VI	BFSNDSE-4	Dietetics
			BFSNDSE-5	Food Service Management
			BFSNDSE-6	Food Preservation and Quality control

<b>7</b>	<b>Mathematics</b>	I	BMDSC-1	Mathematics -I
		II	BMDSC-2	Mathematics -II
		III	BMDSC-3	Mathematics-III
		IV	BMDSC-4	Mathematics -IV
		V	BMDSE-1	Mathematics -V
			BMDSE-2	Mathematics-VI
			BMDSE-3	Mathematics -VII
		VI	BMDSE-4	Mathematics -VIII
			BMDSE-5	Mathematics -IX
			BMDSE-6	Mathematics -X
<b>8</b>	<b>Microbiology</b>	I	BMBDSC-1	General Microbiology
		II	BMBDSC-2	Structure and Classification of Microbes
		III	BMBDSC-3	Techniques in Microbiology
		IV	BMBDSC-4	Microbial Physiology and Genetics
		V	BMBDSE-1	Medical Microbiology and Immunology
			BMBDSE-2	Industrial Microbiology
			BMBDSE-3	Molecular Biology and Genetic Engineering
		VI	BMBDSE-4	Agriculture, Food and Dairy Microbiology
			BMBDSE-5	Environmental Microbiology and Microbial Ecology
			BMBDSE-6	Microbial Biotechnology
<b>9</b>	<b>Physics</b>	I	BPDSC-1	Mechanics
		II	BPDSC-2	Thermal Physics and Sound
		III	BPDSC-3	Electricity and Magnetism
		IV	BPDSC-4	Waves and Optics
		V	BPDSE-1	Fundamentals of Atomic and Molecular Physics
			BPDSE-2	Electronics
			BPDSE-3	Mathematical Methods of Physics
		VI	BPDSE-4	Classical Mechanics and Quantum Mechanics
			BPDSE-5	Elements of Modern Physics
			BPDSE-6	Solid State Physics
<b>10</b>	<b>Zoology</b>	I	BZDSC-1	Biology of Invertebrates
		II	BZDSC-2	Biology of Vertebrates
		III	BZDSC-3	Biochemistry and Physiology
		IV	BZDSC-4	Genetics
		V	BZDSE-1	Cell and Molecular Biology
			BZDSE-2	Ecology and Ethology
			BZDSE-3	Animal Physiology and Human anatomy
		VI	BZDSE-4	Reproductive Biology
			BZDSE-5	Embryology and Evolution
			BZDSE-6	Parasitic and non-parasitic Diseases
<b>11</b>	<b>Constitution of India</b>	I	AMC - 1	Indian constitution and human rights

<b>12</b>	<b>Environmental science</b>	II	AMC - 2	Environmental science
<b>13</b>	<b>SEC – I</b>	III	SEC – I	Computer networks
<b>14</b>	<b>SEC – II</b>	IV	SEC – II	(To be selected from one among the three subjects within the chosen combination only)

## 8. B.Sc. CREDITSTRUCTURE

SEMESTER	Lang-I	Lang-II	AMC - 1	AMC - 2	SEC-1	SEC-2	DSC/DSE				TOTAL CREDITS
							Course Nature	Course Code	Theory	Practicals	
I	2	2	2	-	-	-	DSC	DSC-A1	4	2	24
							DSC	DSC-B1	4	2	
							DSC	DSC-C1	4	2	
II	2	2	-	2	-	-	DSC	DSC-A2	4	2	24
							DSC	DSC-B2	4	2	
							DSC	DSC-C2	4	2	
III	2	2	-	-	2	-	DSC	DSC-A3	4	2	24
							DSC	DSC-B3	4	2	
							DSC	DSC-C3	4	2	
IV	2	2	-	-	-	2	DSC	DSC-A4	4	2	24
							DSC	DSC-B4	4	2	
							DSC	DSC-C4	4	2	
V	-	-	-	-	-	-	*DSE	DSE-A1	3	2	24

								DSE-A2	3			
								DSE-A3	3			
								#DSE	DSE-B1	3		2
									DSE-B2	3		
									DSE-B3	3		
								\$DSE	DSE-C1	3		2
							DSE-C2		3			
							DSE-C3		3			
							VI	-	-	-		-
DSE-A5	3											
DSE-A6	3											
##DSE	DSE-B4	3	2									
	DSE-B5	3										
	DSE-B6	3										
\$\$DSE	DSE-C4	3	2									
	DSE-C5	3										
	DSE-C6	3										
	8	8	2	2	2	2			84	36	144	

### SEC – II for fourth semester

Sl. No.	Subject	Title
1	Biochemistrty	Basics of diabetis and cancer
2	Botany	Nursery and gardening
3	Chemistry	Separation techniques
4	Computer science	Cyber security
5	Food science and nutrition	Food processing technology
6	Microbiology	Mushroom cultivation technology
7	Physics	Mathematical ability for competitive exams

Note: Students can not subject twice under any catergory

## 9. SYLLABUS

### 9.1 BIOCHEMISTRY

#### SEMESTER - I

##### BBCDSC-1: INTRODUCTION TO BIOCHEMISTRY

#### BIOPHYSICAL CHEMISTRY

**Overview of Biochemistry:** Definition, scope and significance of Biochemistry. Important discoveries in Biochemistry. An overview of elements, chemical reactions and biomolecules in living organisms.

**Concentration units:** Avagadro's number, mole, mole fraction, Molarity, Equivalent weight, Normality, Molality, percentage.

**Properties of Water:** Molecular structure of water, physical properties of water. Its effect on Biomolecules. Effect of non-polar compounds on water.

Colligative properties: Osmotic pressure and its measurements by Berkely and Hartley's method. Laws of osmotic pressure. Hypo, hyper and isotonic solutions. Effects of osmotic pressure on living cells. Donnan membrane equilibrium.

## **Physical properties of molecules**

**Adsorption:** Definition, Freundlich and Langmuir's adsorption isotherm. Applications of adsorption.

**Viscosity:** Definition, Determination of viscosity of liquids and solutions by Ostwald's viscometer (solutions of gum and protein to be taken as example).

**Distribution law:** Distribution law, partition coefficient. Applications of distribution law.

**Ionic Equilibria:** Lewis concept of acids and bases. Ionic product of water. pH scale, buffers, Henderson Hasselbach equation, buffer capacity, preparation of acidic and basic buffer solutions. Theory of acid base indicators. Choice of indicators. pH titration curves and isoelectric pH of amino acids. Electrodes (Hydrogen Electrode & Calomel electrode), Glass electrode. Conductometric titrations [Strong acid against strong base, weak acid (amino acid) against NaOH]. Determination of P<sub>ka</sub> value of amino acid by using pH meter.

**Photochemistry:** Laws of photochemistry, quantum efficiency, light absorption, Beer-lambert's law, spectrophotometer, colorimeter, fluorescence, phosphorescence, chemiluminescence, bioluminescence (Elementary treatment). Applications of UV-visible and fluorescence spectra. Principle of IR spectra and its applications.

## **BIOINORGANIC CHEMISTRY**

**Co-ordination compounds:** Transition metals, Properties (Colour, Oxidation States, Magnetic Properties). Co-ordinate bond, double and complex salts - differences with examples. Postulates of Werner's theory. Types of ligands - Uni, bi and polydentate with examples. Co-ordination number.

Porphyrin nucleus and classification. Important metallo porphyrins occurring in nature-structure and their biological importance (Hb, cytochrome, chlorophyll, Vit-B12). Bile pigments - Types, structure and chemical nature.

**Nitrogen:** Fixation of atmospheric nitrogen - symbiotic and non-symbiotic. Nitrogen cycle. Environmental pollution by nitrogen compounds.

**Phosphorous:** Importance of phosphorus compounds in biological system, phosphorous cycle.

**Oxygen:** Importance of oxygen in Biological System. Formation and role of ozone in maintenance of life on earth. Effects of Environmental pollutants on ozone layer.

**Sulphur and selenium:** Importance of compounds of sulphur and selenium in biological system. Effect of sulphur compounds on environmental pollution.

**Biochemical Toxicology:** Source, entry in to biological system and toxicity of Lead, Mercury, Cadmium and Arsenic.

**Radiochemistry:** Natural and artificial radioactivity, Characteristics of radioactive elements, units of radioactivity, disintegration constant, Half-life,  $\alpha$ ,  $\beta$  and  $\gamma$  radiation.



Detection of radioactivity by GM counter. Applications of radioisotopes- $^3\text{H}$ ,  $^{14}\text{C}$ ,  $^{131}\text{I}$ ,  $^{60}\text{Co}$  and  $^{32}\text{P}$ . Biological effects of radiations. Safety measure in handling radio isotopes.

**Reference textbooks:**

1. Barrow, G. M. (2007) *Physical Chemistry* Tata McGraw-Hill, India.
2. Castellan, G. W. (2004) *Physical Chemistry 4th Ed.* Narosa, India.
3. Kotz, J. C., Treichel, P. M. & Townsend, J. R. (2009) *General Chemistry* Cengage Learning India Pvt. Ltd.: New Delhi.
4. Mahan, B. H. (1998) *University Chemistry 3rd Ed.* Narosa, India.
5. J. D. Lee, *A new Concise Inorganic Chemistry*, E L. B. S.
6. F. A. Cotton & G. Wilkinson. *Basic Inorganic Chemistry*, John Wiley.
7. Douglas, McDaniel and Alexander: *Concepts and Models in Inorganic Chemistry*, John Wiley.
8. James E. Huheey, Ellen Keiter and Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Public
9. Pattabhi. V. and Gautham.N. (2002) *Biophysics*. Narosa Publishing House, India.
10. Puri, Pathan & Sharma - *Physical Chemistry*.

**PRACTICAL - I**

1. Use of analytical balance and weighting.
2. Calculation, preparation of normal, molar and percentage solutions.
3. Calibration of volumetric glasswares (Burette, pipette and measuring cylinder).
4. Preparation of standard Sodium carbonate solution, standardization of HCl (Methyl orange) and estimation of NaOH in the given solution. (Methyl orange or Phenolphthalein).
5. Preparation of standard Oxalic acid. Standardization of NaOH and estimation of  $\text{H}_2\text{SO}_4$  in the given solution (Phenolphthalein).
6. Preparation of standard Oxalic acid. Standardization of  $\text{KMnO}_4$  and estimation of  $\text{H}_2\text{O}_2$  in the given solution.
7. Preparation of standard  $\text{K}_2\text{Cr}_2\text{O}_7$ . Standardization of  $\text{Na}_2\text{S}_2\text{O}_3$  and estimation of  $\text{CuSO}_4$  in the given solution.
8. Preparation of  $\text{ZnSO}_4$ . Standardization of EDTA and estimation of total hardness of water using Eriochrome black-T indicator.
9. Preparation of standard potassium biphthalate. Standardization of NaOH and estimation of HCl in the given solution. (Phenolphthalein).
10. Determination of rate constant of decomposition of  $\text{H}_2\text{O}_2$  using  $\text{KMnO}_4$  by volumetric analysis method.

11. Demonstration: i) Determination of density and viscosity of the given liquid using specific gravity bottle and Ostwald's viscometer.
- ii) Determination of miscibility temperature by water-phenol system.

## **SEMESTER - II**

### **BBCDSC-2: BIOORGANIC CHEMISTRY - I**

**Introduction to Organic Chemistry:** Classification of organic compounds, unique characteristics, IUPAC nomenclature of organic compounds (including bifunctional) and biomolecules.

**Chemical Bonding:** Different types of bonds & bond characteristics. Ionic bonding, covalent bonding, co-ordinate bonding, Van der Waal's forces, ion-dipole, dipole-dipole interactions, London forces, Hydrophobic interaction, Hydrogen bonding. Effect of chemical forces on physical properties (Solubility, BP and MP).

**Reaction mechanisms:** Concept of inductive effect, resonance and hyperconjugation. Classification of organic reactions (substitution, addition, elimination and rearrangement), with two examples for each. Concepts of the following - carbanions, carbocations, free radicals, carbenes, nucleophiles and electrophiles (Formation and Stability).

**Aliphatic hydrocarbons:** Mechanism of Markownikoff and anti-markownikoff addition. Addition of HBr to propene. Dienes-types with examples, 1,3 butadiene-Preparation, stability and mechanism of addition of HBr. Diels-Alder reaction. Conformational analysis of ethane.

**Cycloalkanes:** Reactivities and relative stability. Bayer's strain theory. Sachse-Mohr theory. Boat and chair forms of cyclohexanes. Axial and equatorial bonds and their relation with biological activities of carbohydrates.

**Arenes:** Structure of benzene-by Resonance and molecular orbital theories. Aromaticity. Mechanism of Nitration and Friedel-craft reaction. Electronic interpretation of the orientating influence of substituents in the electrophilic substitution of toluene, chlorobenzene, nitrobenzene and phenol. Resonance structures of Naphthalene and Anthracene.

**Alkyl halides and organometallic compounds:** SN1 and SN2 reaction, Their mechanism with one example for each. Concept of elimination reactions (E1 and E2 with an example). Applications of organometallic compounds -organo lead, organo lithium, cis-platin.

**Alcohols:** Definition, Classification, monohydric alcohols-distinguishing reactions for Primary, Secondary and Tertiary alcohols.

**Dihydric alcohols:** Glycol, Preparation (any 2 methods) and uses.

**Trihydric alcohols:** Glycerol, Synthesis from propene, Properties, (reaction with conc.  $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ , Oxalic acid and HI).

**Phenols:** Acidity of phenols, effect of substituents on acidity.

**Stereochemistry:** Stereoisomerism, types, Fischer-projection formulae, Chiral carbon atom, Asymmetry and dissymmetry, chirality, conditions for optical isomerism ex: Glyceraldehyde, Lactic acid, Tartaric acid, Nomenclature of enantiomers, diastereomers. D and L notation, R and S system, Racemisation and resolution (Biochemical, chemical and physical methods). Geometrical isomerism.

**Reference textbooks:**

1. Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.
2. L. Finar: *Organic Chemistry (Vol. I & II)*, E. L. B. S.
3. R. T. Morrison & R. N. Boyd: *Organic Chemistry*, Prentice Hall.

**PRACTICAL - 2**

**I. Systematic qualitative analysis of the organic compounds:** Urea, Benzamide, Benzaldehyde, Aniline, Acetophenone, m-cresol, Nitrobenzene, Chlorobenzene, Naphthalene, p-Toluidine, Benzoic acid, Salicylic acid, Resorcinol, Benzyl alcohol and p-Dichloro benzene.

**II. Organic Preparations:**

- a) Aspirin from salicylic acid.
- b) Benzoic acid from benzaldehyde.
- c) para-Bromo acetanilide from acetanilide.
- d) meta-Dinitrobenzene from nitrobenzene.

**SEMESTER - III**

**BBCDSC-3: BIOORGANIC-II AND BIOCHEMICAL TECHNIQUES**

**BIOORGANIC-II**

**Hydroxy acids and dicarboxylic acids:** Structure & properties of Hydroxy Acids: Lactic acid, Citric acid and Isocitric acid, Dicarboxylic acid: Maleic and Fumaric acid. Ketoacids: Pyruvic,  $\alpha$ -Ketoglutaric, Oxalo acetic acid.

**Amines:** Classification, Properties, Amino functional group - Basicity of amines, acylation. Reaction with  $\text{HNO}_2$  & Schiff's base formation. Distinguishing reactions of primary, secondary and tertiary amines.

**Heterocyclic compounds:** Definition, classification with examples, structure and biological importance of Furan, Pyrrole, Thiophene, Pyridine, Pyran, Thiazole, Pyrimidine, Purine, Indole, Imidazole, Quinoline and Isoquinoline. Basicity of pyrrole and pyridine.

**Terpenes:** Definition, Isoprene rule, classification, isolation, structure and biological importance of menthol, camphor, farnesol, phytol, lanosterol, lycopene and dolichols.

**Steroids:** Basic ring structure in steroids. Structure and biological importance of cholesterol, Phytosterols, ergosterol, Cortisol,  $\beta$ -estradiol, testosterone and aldosterone. Bile acids (Mono, Di & Tri cholic acids).

**Alkaloids:** Definition, classification based on their structure and biological functions, Isolation of alkaloids, structure and physiological action of morphine, Nicotine & Atropine. Chemical Synthesis of nicotine and atropine.

**Vitamins:** Classification-Water soluble & Fat soluble. Structural formulae of vitamins and co-enzyme (B1, B2, B6 and Niacin). Vitamin C as redox reagent, Chemical synthesis of Vit-C. Structural formula of vitamin A, D, E and K.

**Biochemical techniques:** General Principles of chromatography- adsorption and partition.  $R_f$  values. Paper chromatography - Principle and procedure of ascending, descending, Circular and 2D- chromatography. TLC - Principle, procedure and applications.

Column chromatography - Principle, procedure and applications of Gel filtration, ion-Exchange, affinity chromatography, HPLC and GLC.

Electrophoresis- Principle of electrophoresis, Paper and gel electrophoresis (Agarose and SDS PAGE).

Centrifugation- Principle, procedure and applications of density gradient centrifugation, differential centrifugation and ultracentrifugation.

**Reference textbooks:**

1. *Biophysical Chemistry, Principles & Techniques* -Himalaya Publ. House.
2. *Principles & Techniques of Practical Biochemistry* - Wilson, Walker- Cambridge Univ. Press.
3. *G. Abbott - Chromatography.*
4. *Friefelder D. WH Freeman and Company. Physical Biochemistry- Application to*
5. *Biochemistry and Molecular Biology*
6. *Arun Bahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand.*
7. *L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.*

**PRACTICAL -3**

PART-A:Extraction of Biomolecules:

- \*Starch from potato.\*Casein from milk.
- \*Caffeine from tea leaves.\*Oil from oil seeds.
- \*Glycogen from liver.\*Cellulose from plant material.

## PART-B (BIOCHEMICAL TECHNIQUES)

- \*Identification of amino acid by circular paper chromatography.
- \*Ascending paper chromatography of amino acids.
- \*Separation of plant pigments by column chromatography using silica gel-G.
- \*Demonstration on polyacrylamide gel electrophoresis[PAGE] of proteins.
- \*Demonstration of separation of lipids by TLC.
- \*Demonstration of two-dimensional chromatography of amino acids.

## SEMESTER - IV

### BBCDSC-4: BIOMOLECULES

**Carbohydrates:** Definition, empirical formulae, classification, biological importance. Monosaccharides: Configuration relationship of D-aldoses, D-ketoses. General properties of aldoses and ketoses. Oxidation, reduction, reducing property, formation of glycosides, acylation, methylation, condensation - phenyl hydrazine, addition -HCN. Interconversion of aldoses and ketoses by chemical method. Ascending and descending the series by chemical methods. Stereochemistry of monosaccharides, (+) and (-), D and L, epimers, anomers and diastereoisomers.

**Glucose:** Elucidation of open chain structure and ring structure of glucose. Conformation of glucose (only structures), mutarotation. Structure of galactose, mannose, ribose and fructose. Structure and biological importance of amino sugars, deoxy sugars, sugar acids, neuraminic and muramic acid.

**Disaccharides:** Establishment of structures of Sucrose and Lactose, Biological importance and structure of Isomaltose, Trehalose and Maltose.

**Polysaccharides:** Partial structure, occurrence and importance of Starch, Glycogen, Inulin, Cellulose, Chitin, and Pectin.

**Glycosaminoglycans:** Occurrence, importance and the structure of the repeating units of Heparin, Hyaluronic acid, Teichoic acid and Chondroitin sulphate Bacterial cell wall polysaccharide, peptidoglycans.

Qualitative tests - Molisch, Benedicts/Fehling's, Picric acid, Barfoed's, Bial's, Seliwanoff's, Osazone tests.

**Amino acids:** Structure and classification of amino acids based on polarity. Reactions of the amino groups with  $\text{HNO}_2$ ,  $\text{LiAlH}_4$ . Ninhydrin, Phenyl isothiocyanate, DANSYL Chloride, Fluorodinitro benzene. Zwitterionic properties.  $\text{pK}_a$  values. Reaction of carboxyl group - Hydrazine. Any method for the chemical synthesis of amino acids D & L notation.

**Peptides:** Peptide bond, structure and biological importance of Glutathione, Valinomycin. Leu-enkephalin, Synthetic peptides- polyglutamic acid, polylysine. Chemical synthesis of di-peptides.

**Proteins:** Isolation, methods of purification-dialysis salting out, pH precipitation and solvent precipitation. Classification of proteins based on solubility, structure and functions with examples. Colour reactions of proteins - Biuret, Xanthoproteic, Millon's.

Primary Structure of proteins, methods of determining N- and C-terminal amino acids, amino acid composition. Sequencing by Edman's degradation method. Secondary Structure -  $\alpha$  Helix.  $\beta$ -sheet,  $\beta$ -bend.

Tertiary of myoglobin and quaternary structure of Hemoglobin, Denaturation and renaturation of proteins. Anfinsen's experiment.

**Lipids:** Classification and biological role, Fatty acids- Nomenclature of saturated and unsaturated fatty acids. Physiological properties of fatty acids.

**Acylglycerols:** Mono, di and triglycerols. Saponification, Saponification value, Iodine value, Acid value and significance.

**Phosphoglycerides:** Structure and biological importance of phosphatidyl choline, phosphatidyl ethanolamine, Phosphatidyl inositol, Plasmalogens, and Cardiolipin.

**Sphingolipids:** Structure and importance of Sphingomyelin.

**Glycosphingo lipids:** Structure and importance of Gangliosides and Cerebrosides.

**Eicosanoids:** Biological role of Prostaglandins, prostacyclins, Thromboxanes and leukotrienes. Structure of PGE<sub>2</sub>, PGF<sub>2</sub> Alpha and TXA<sub>2</sub>.

**Plasma lipoproteins:** Types - Chylomicrons, VLDL, LDL and HDL and their significance.

**Biological Membrane:** Composition of membrane, micelles and liposomes. Fluid Mosaic Model, functions of the plasma membrane. Endocytosis and phagocytosis. Membrane receptors and their functions.

**Nucleic acids:** Isolation of DNA and RNA. Composition of DNA. Nucleosides and Nucleotides. Chargaff's rule. Watson and Crick model of DNA. Melting of DNA ( $T_m$ ).

**RNA:** Composition, types (mRNA, tRNA and rRNA), Secondary structures of tRNA - Clover leaf model. Chemical reactions of RNA and DNA with acid and alkali, colour reactions of DNA and RNA.

### **Reference textbooks:**

1. A.L., Lehninger, *PRINCIPLES OF BIOCHEMISTRY* (1982), Worth Publishers, Inc. New York.
2. E.E. Conn and P.K. Stumpf. *OUTLINES OF BIOCHEMISTRY* (1976) Wiley Eastern, New Delhi.
3. L. Stryer *BIOCHEMISTRY* (1995) W.H. Freeman Press, San Francisco, USA.
4. Voet, D. and Voet, J.G. (2004). *Biochemistry*, 3rd Edition, John Wiley & Sons, Inc. USA.
5. *Biochemistry U. Sathyanarayana Books and Allied (P) Ltd. Kolokatta*
6. ISBN 0-87893- 214-3.
7. J.L Jain. *Text book of biochemistry*.
8. Ramakrishnan - *Medical Biochemistry*.
9. D.M. Vasudevan - *Text Book of Biochemistry*.
10. A.C. Deb - *Text Book of Biochemistry*.

### **PRACTICAL - 4**

Qualitative analysis of Biomolecules

1. Carbohydrate - Glucose, Fructose, Lactose, Maltose and Sucrose.
2. Proteins - Precipitation reactions of proteins, Colour reactions of proteins, Colour reactions of amino acids like tryptophan, tyrosine, cysteine, methionine, arginine, proline and histidine.
3. Lipids- solubility, acrolein test, Salkowski test, Lieberman-Burchard test.
4. Qualitative tests for nucleic acid.

## **SEMESTER-V**

### **BBCDSC-5: ENZYMOLOGY, CLINICAL BIOCHEMISTRY AND NUTRITION**

#### **ENZYMOLOGY**

**48 Hrs**

#### **ENZYMES:12hrs**

Definition, historical perspective, General characteristics, Co-factors - coenzymes and metal ions. Classification of enzymes based on IUB with examples. Unit of enzyme activity - definition of IU, enzyme turn over number and nature of non- enzymatic and enzymatic catalysis. Specific activity. Enzyme specificity. Concept of active site.

Theories of enzyme catalysis - Lock and key model, Koshland's induced fit theory.  
Enzyme kinetics: Factors affecting rate of enzyme catalyzed reactions.

Effect of enzyme concentration, substrate concentration, pH and temperature.

Michaelis - Menten equation (Derivation not required). Lineweaver - Burk (L-B) plot. Determination of  $V_{max}$  &  $K_m$  from L-B plot and their significance. Enzyme inhibition - competitive, non-competitive and uncompetitive.

Graphical representation by L-B plot. Evaluation of  $K_m$ ,  $K_i$  and  $V_{max}$  in presence of inhibitor.

Allosteric enzyme-Sigmoidal curve, positive and negative modulators, with phosphofructokinase as an example.

Iso enzymes - Detection, nature, importance. LDH as an example.

Multi enzyme complex - Pyruvate dehydrogenase complex. - Composition, subunits, assembly, enzymatic reaction functions.

RNA as an enzyme. (Ribozymes).

Industrial and medical application of enzymes.



## **CLINICAL BIOCHEMISTRY12hrs**

**Urine:** Normal composition of urine - Volume, pH, colour, specific gravity. Constituents- urea, uric acid, creatinine, pigment. Abnormal constituents - glucose, albumin, ketone bodies, variations in urea, creatinine, pigments and their clinical significance in brief.

**Blood:** Normal constituents of blood and their variation in pathological conditions - urea, uric acid, creatinine, glucose, bilirubin, total protein, albumin/globulin ratio. Lipid profile - cholesterol, Triglycerides, lipoproteins - HDL and LDL.

### **Liver function tests:**

Alkaline phosphatase, SGOT and SGPT.  
Cardiac injury profile CPK and LDH.

### **Inborn errors of Metabolism:**

Sickle cell anaemia, phenyl ketonuria, Neimann- Pick disease, Type III glycogen storage disease (Cori's disease).

## **NUTRITION24hrs**

### **Introduction**

**3hrs.**

Concept of Nutrition, calorific value of foods and its determination (Bomb calorimeter) different components of energy expenditure, respiratory quotient, Basal Metabolic Rate (BMR), determination of BMR, factors affecting BMR. Specific dynamic action of foods.

### **Carbohydrates: 1hr.**

Dietary Sources, dietary fibres and protein sparing action.

### **Protein 3hrs.**

Dietary sources, nutritional classification, Nutritional value of proteins - PER, NPU and Biological value of proteins (BV). Essential amino acids. Nitrogen balance, mutual supplementation of proteins, Malnutrition- Kwashiorkor and marasmus.

### **Fats: 1hrs.**

Dietary sources of fats, invisible fat, essential fatty acids and their biological importance.

### **Vitamins: 6hrs.**

Dietary sources, requirements, deficiency symptoms and biological role of water-soluble vitamins Thiamine, Riboflavin, Niacin, Pantothenic acid, Pyridoxine, Biotin, Folic acid, Vit B<sub>12</sub> and Vit-C.

Fat soluble vitamins: Vitamin A, D, E and K.  
Hypervitaminosis.

## **Minerals:3hrs.**

Mineral metabolism of Ca, P, Fe, Cu

**Water Metabolism: 1hr.** Distribution of water in body fluids, Regulation of water metabolism.

## **Antinutritional factors: 1hr.**

Sources and harmful effects of anti-vitamins (eg. avidin, dicoumarol), Natural toxicants (eg. Lathyrus sativa) and adulterants (eg. butter yellow, lead chromate, malachite green).

Digestion, absorption and transport of carbohydrates proteins and fats, GI tract, secretions, composition and function of - saliva, gastric, bile, pancreatic and intestinal juices. Appetite, gastrointestinal hormones. **5hrs.**

## **Reference textbooks:**

1. R.K. Murray, D.K. Granner, P.A. Mayes and V.W. Rodwell, *HARPER'S BIOCHEMISTRY*, 22nd edn. (1990), Prentice-Hall, International, USA.
2. P.K. Stumpf, *OUTLINES OF BIOCHEMISTRY*, 4th edn. (1994), Wiley Eastern, New Delhi, (Chapters 7 & 8).
3. Nelson and Cox, *LEHNINGER's PRINCIPLES OF BIOCHEMISTRY*, (2000), Kalyani Publishers, Ludhiana/Worth Publishers, Inc., New York.
4. L. Stryer *BIOCHEMISTRY* 4th Ed. (1995) W.H. Freeman Co., San Francisco, USA
5. G.L. Zubay *BIOCHEMISTRY* 4th Ed. (1998) W.C. Brown Publishers, USA.
6. Voet, D and Voet, J.G, (2009) *Biochemistry*, John Wiley and Sons, N.Y. USA.
7. Garret, R.H. and Grisham, C.M. (2005) *Biochemistry*, 3rd Edition. Thomson Learning INC.
8. MS Swaminathan - *Nutritional Biochemistry*.
9. Davidson S and Pasmor J.R *Nutrition and dietetics*.
10. B. Sreelakshmi. *Food science*.
11. Sakunthala Manay, Sadhakshara Swami. *Food facts and principles*.
12. T.M. Delvin (editor), *Text book of biochemistry with clinical correlation*, (1982), John Wiley & Sons Inc. USA.

## **SEMESTER-V**

### **BBCDSC-5: METABOLISM AND HUMAN PHYSIOLOGY 48hrs**

#### **METABOLISM 24Hrs**

**Metabolism:** Anabolism and catabolism, compartmentalization of metabolic pathways. **1Hr**

**Bio Energetics:** Laws of Thermodynamics - first and second law. Concept of enthalpy, entropy and free energy. Standard free energy. Endergonic and exergonic reactions. Coupled reactions. High energy compounds - structural features of ATP and its free energy change during hydrolysis, other high energy compounds.

**4Hrs**

**Biological oxidation:** Ultrastructure of mitochondrion, electron transport chain. Electron transport complexes Complex I, II, III and IV. Uncouplers and inhibitors of respiration (Rotenone, Antimycin, Cyanide and 2,4 DNP) Oxidative phosphorylation, P/O ratio. Formation of ATP - Outline of Mitchell's hypothesis. Substrate level phosphorylation with examples.

**5Hrs**

**Metabolism of Carbohydrates:** Glycogen metabolism- glycogenolysis, glycogen synthesis. Glycolysis, energetic of glycolysis. Entry of other carbohydrates into glycolytic pathway. Fates of pyruvate - conversion of pyruvate to lactate, alcohol and acetyl Co-A. Citric acid cycle and its energetic. Amphibolic integrating roles of TCA cycle. Anaplerotic reactions. Pentose phosphate pathway and its significance. Cori cycle. Gluconeogenesis. **8Hrs**

**Metabolism of Lipid:** Oxidation of fatty acid -  $\alpha$ ,  $\beta$  and  $\omega$  types,  $\beta$ -oxidation of even number saturated fatty acids. Energetics of  $\beta$ -oxidation. Schematic representation of biosynthesis of even number saturated fatty acids and cholesterol biosynthesis. Formation of ketone bodies.

**4Hrs**

**Metabolism of Amino acids:** General reaction of amino acid degradation - Transamination, deamination and decarboxylation. Ketogenic and glucogenic amino acids. Urea cycle and its significance.

**2Hrs**

#### **HUMAN PHYSIOLOGY 24hrs**

Types of neurons, generalized structure of multipolar neuron. Resting membrane potential, Action potential, Transmission of nerve impulse along an axon and across a synapse. Excitatory and inhibitory neurotransmitters.

**Muscle: 3hrs.**

Types of muscles and their structure. Ultrastructure of skeletal muscle. Contractile and regulatory proteins of muscle. Sliding filament model of skeletal muscle contraction.

**Bone: 3hrs.**

Composition and structure of long bone, growth and remodelling of long bone. Factors affecting its growth.

**Excretory system:2hrs.**

Structure of the Nephron, formation of urine - Glomerular filtration, tubular reabsorption and secretions. Role of kidney in acid-base balance.

**Body fluids:5hrs.**

Blood volume, composition and functions, RBC, WBC and platelets, their structure and functions. Mechanism of blood coagulation. Biochemical events in transport of CO<sub>2</sub> and O<sub>2</sub> in blood. Cerebrospinal fluid, Lymph and its function. Blood brain Barrier. Blood buffers.

**Endocrine system:6hrs.**

Endocrine organs, classification of hormones. Hierarchy, interplay and dynamic balance and regulation of hormone secretions. Functions of the hormones of Hypothalamus, Pituitary, adrenal, Thyroid, Pancreas and Gonads.

General mechanism of steroid hormone action. Mechanism of hormone action. concept of messengers. Eg: cAMP, DAG, IP<sub>3</sub>, G-protein.

**Liver:** Structure of a liver lobule. Role of liver in metabolic, storage and detoxification.

**Reference textbooks:**

1. *Human Physiology, Vol. I & II*, - C. C. Chatterjee - Medical Allied Agency - Calcutta.
2. *Concise Medical Physiology* - Choudhary - New Central Book Agency - Calcutta.
3. *Text Book of Medical Physiology* - Guyton - Prism Books Pvt.Ltd. - Bangalore.
4. *Harper's Biochemistry* - Murray, Granner, Mayes, and Rodwell - Prentice
5. *Hall International Inc.*
6. *Textbook of medical physiology: A. C. Gyton, and J. E Hall.*
7. *Saunders Elsevier Publications, A division of Reed Elsevier India Pvt. Ltd. New Delhi ISBN 81-8147-084-2.*
8. *Human physiology: Chatterjee, Medical Allied Agency.*
9. *Principles of anatomy and physiology: 13<sup>th</sup> edition, Gerard J Totor, Bryan Derrickson.*
10. *Human physiology, international edition, ninth edition, Eric P Widmaier, Hershel Raff and Kevin T Strang.*
11. *L. Stryer BIOCHEMISTRY (1995) W.H. Freeman Press, San Francisco, USA.*
12. *10.A.L., Lehninger, PRINCIPLES OF BIOCHEMISTRY (1982), Worth*
13. *Publishers, Inc. New York.*
14. *G.L. Zubay BIOCHEMISTRY 4th Ed. (1998) W.C. Brown Publishers, USA*

## **PRACTICAL - 5.1**

**Marks=50**

### **Practical Proper-40Internal Assessment -10**

#### **I Biochemical analysis of urine sample:**

- \*Qualitative analysis of urine - detection of urea, uric acid and creatinine.
- \* Qualitative analysis of abnormal constituents in urine - glucose, albumin, bile pigments, bile salts and ketone bodies.

#### **II Colorimetric estimation of**

- \*Glucose by DNS method.
- \*Protein by Biuret method.
- \*Protein by Lowry's method.
- \*Uric acid.
- \*Urea by DAMO method.
- \*Creatinine by Jaffe's method.
- \*Phosphorous by Fiske and Subbarow's method.
- \*Ironby       Wong's       methods

## **PRACTICAL - 5.2- Marks=50**

### **Practical Proper-40Internal Assessment -10**

#### **Enzyme Assays:**

- \*Isolation of Urease and demonstration of its activity.
- \*Isolation of Acid phosphatase and demonstration of its activity.
- \*Salivary amylase
- \*Determination of specific activity of salivary amylase by DNS.
- \*Determination of pH optimum of salivary amylase.
- \*Determination of  $K_m$  and  $V_{max}$  of salivary amylase.
- \* Determination of initial velocity (time kinetics) of salivary amylase.
- \*Determination of optimum temperature of salivary amylase.
- \*Effect of sodium chloride on amylase.

## **SEMESTER-VI**

### **BBCDSC--6 MOLECULAR BIOLOGY AND GENETIC ENGINEERING CLASS DURATION-03 HOURS PER WEEK**

#### **MARKS-Theory-80+Internal Assessment-20=10048hrs MOLECULAR BIOLOGY30Hrs Basic concepts of Genetic Information:2hrs**

Nucleic acids as genetic information carriers, experimental evidences e.g. bacterial genetic transformation, Hershey Chase experiment. Central dogma of molecular biology and its modification.

#### **Degradation of Nucleic acid:4hrs.**

Degradation of nucleic acids by Nucleases-DNase, RNase and phosphodiesterases.

Schematic pathway for degradation of purine nucleotides and pyrimidine nucleotides. Recycling of purine bases by salvage pathway using PRPP.

#### **Replication of DNA:4hrs.**

DNA replication in prokaryotes- conservative, semi conservative and dispersive types. Mechanism of Semiconservative replication. DNA polymerases, other enzymes and protein factors involved in replication. Meselson and Stahl experiment. Mechanism of Replication in prokaryotes.

#### **Prokaryotic RNA Synthesis:4hrs.**

Role of RNA polymerase. Initiation, elongation and termination, Reverse transcription.

**Genetic code:** General features, Wobble hypothesis

**1 hr**

**Prokaryotic Protein biosynthesis:4hrs.**

Activation of Amino acids, amino acyl tRNA synthesis. Initiation, elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post translational modifications.

**Mutations:4hrs.**

Concept of mutation and mutagens - effect of HNO<sub>2</sub>, alkylating agents, intercalating agents and UV-radiation. Concept of missense, nonsense, Point mutation and frameshift mutation.

**Repair of DNA:** DNA damage and their repair. Types of damages, repair by direct reversal of damage, excision repair, recombination repair, SOS repair. **3hrs**

**Concept of gene:4hrs.**

\*Gene expression in prokaryotes - concept of Lac-Operon and Trp operon.

\*Functional units in a typical eukaryotic gene - promoter, introns and exons.

**GENETIC ENGINEERING**

**18hrs**

Historical development, aim and scope of genetic engineering. **1hr.** Isolation of DNA, Cutting of DNA by restriction endonucleases - Types, staggered cut and blunt end.

**2hrs**

Outline of Techniques of genetic engineering. **9hrs**

Cutting genomic DNA, Separation of fragments by agarose gel electrophoresis. Vectors-plasmid (pBR 322), Bacteriophage, viruses, cosmids, phagemid and plant vectors. Insertion of foreign DNA into Vectors- Use of linkers and adapters. Homopolymer tailing. Transfections of vectors into host cells. cDNA. Principle of polymerase chain reaction and applications.

### **Blotting techniques:3hrs**

Principle and procedure of Southern, Northern and Western blotting. Dot blot. DNA finger printing.

### **Applications of Genetic engineering3hrs**

\*Transgenic plants, transgenic animals and gene therapy.

\*Human genome project.

### **Reference textbooks:**

1. *Nelson and Cox, Lehninger's Principles of Biochemistry (2000), Worth Publish., Inc. New York.*
2. *L. Stryer. BIOCHEMISTRY, 4th Edn., (1995), W.H. Freeman Press, San Francisco, USA.*
3. *E.J. Gardner and D.P. Snustad. PRINCIPAL OF GENETICS (1984), John Wiley & Sons, New York.*
4. *Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., 2008*
5. *Molecular Biology of the Gene 6th edition. Cold Spring Harbour Lab. Press, Pearson Pub.*
6. *Freifelder - Molecular Biology.*

## **SEMESTER-VI**

### **PAPER 6.2 MICROBIOLOGY AND IMMUNOLOGY 48hrs**

#### **MICROBIOLOGY19hrs**

**Study of micro-organisms:2hr.**

**Staining micro-organisms** - principle and procedure of gram stain and acid-fast staining.



**Microbial nutrition:5hrs.**

Growth of micro-organisms, measurement of growth, factors influencing growth - Nutrition, carbon source, Nitrogen source, Temperature, pH and oxygen. Batch and continuous culture. Growth curve, phases of growth curve. Concept of synchronous cultures. Instrumentation in bioreactors.

**Industrial Microbiology:4hrs.**

Production and importance - Alcoholic beverages (Beer and Wine), Fermented products of milk cheese, antibiotic production - penicillin, single cell protein - Spirulina. Fermentors- types and components.

**Antibiotics:3hrs.**

Definition, Mechanism of action of penicillin, streptomycin and chloramphenicol, antibiotic resistance in brief.

**Viruses:2hrs.**

Classification based on genetic material with examples. Plant viruses-TMV, morphology, general characteristics and its replication.

**Bacteriophages:3hrs.**

Morphology, general characteristics, life cycle (lysogeny and lytic cycle) of T-even Bacteriophage.

## **IMMUNOLOGY**

**29hrs**

### **IMMUNITY: 6hrs.**

Role of immunologically important organs and cells - bone marrow, thymus, spleen and lymphocytes. Haematopoiesis. Formation and functions of T & B Lymphocytes. Helper T-cells and killer T-cells. Macrophages. Cellular and humoral immunity.

**Types of immunity:** Innate and Adaptive immunity. Passive and active immunity. **4 hrs.**

**Antigens: 3hrs.** Definition, types, chemical nature and antigenicity. Epitopes, paratopes and Haptens,

Adjuvants.

### **Antibodies: 4hrs**

Definition, types and structure of a typical immunoglobulin (IgG - Light chain, heavy chain, hypervariable region, constant domains, Fab and Fc). Polyclonal and monoclonal antibodies. Production and applications of monoclonal antibodies.

### **Antigen -antibody reaction in Vitro: 4hrs.**

Formation of Antigen-Antibody complex. Agglutination and precipitation. Principle, procedure and applications of Immuno-diffusion, RIA, ELISA.

### **Immunization: 2hrs.**

Vaccination -vaccines and their preparations, Primary and secondary immune response

**Hypersensitivity:** Immediate and Delayed hypersensitivity. Type I hypersensitivity reaction (Anaphylaxis). **2hrs**

**Immunological disorders: 2hrs**

Autoimmune disorder- systemic lupus erythematosus and rheumatoid arthritis.

Immunodeficiency diseases- AIDS.

**Reference textbooks:**

1. M. Pelczar, E.C.S. Chan and M.R. Krieg, *MICROBIOLOGY*, McGraw Hill Inc., Singapore (1997).
2. Powar, Daginawala- Himalaya Publishing House. *General Microbiology*, Vol. I
3. & II.
4. \*Stanier, Adelberg, Ingraham- The Macmillan Press- London. *General*
5. *Microbiology*.
6. Nandini Shetty. *Introduction to Immunology*.
7. Janis Kuby. - W. H. Freeman and Co. *Immunology*.
8. I.M. Riott, J. Brostoff, D. Male "Immunology" 3rd edn. W.H. Freeman and Pub.
9. Company, USA.
10. J. Kuby "Immunology" 3rd edn., Mosby Year Book Co., England

**SEMESTER-IV**

Note: - The students may be taken for the visit to scientific institution in the country relevant to Biochemistry and a report to be submitted. The report is valued for 5 marks and these marks to be considered for IA Practical - VIII instead of class test.

**Practical Duration - 04 Hours per week**

**Two practical examinations. Each examination is of 03 hrs duration**

**PRACTICAL - 6.1 Marks=50**

**Practical Proper-40 Internal Assessment - 10**

\* Moisture content of fodds

\*Adultrants in food

\*Calcium in ragi

\*Iron in drumsticks.

\*Estimation of vitamin-C in lemon and gooseberries.

- \*Gravimetric estimation of sulphate as barium sulphate.
- \*Estimation of amino acid by formal titration.
- \*Estimation of reducing sugars by Hedgedon and Jensen method.
- \*Determination of saponification value of oil or fat.
- \*Determination of iodine value of oil or fat.
- \*Determination of Molar extinction coefficient of a given solution.
- \*Determination of absorption maxima of proteins and nucleic acid.
- \*Ouchterlony immunodiffusion.

### **PRACTICAL - 6.2 Marks=50**

#### **Practical Proper-40, Internal Assessment -Record-05+Class Test-05 =10**

- \*Conductometric titration of strong acid against strong base.
- \* Conductometric titration of weak acid (amino acid) against strong base.
- \*Preparation of acidic and basic buffers and determination of pH using pH meter.
- \*Determination of Pka value of amino acid by using pH meter.
- \*Gram staining.
- \*Demonstration of western blot
- \* Extraction and estimation of DNA from coconut endosperm.
- \* Extraction and estimation of RNA from spinach leaves.

#### **Visit to scientific institution in the country:**

- \*CFTRI, DFRL Mysuru.
- \*JSS Institute of Higher education and Medical services, Mysuru.
- \*Bangalore: IISC, JNCASR, NIMHANS, UAS-NCBS, Biocon.
- \*Bombay: TIFR, Cancer Research Institute, BARC, IIT.
- \*Hyderabad -CCMB, NIN, Raddy's lab, Indian drug research lab, International crop research institute for semiarid Tropics (ICRISAT).
- \*Kasargod: Coconut Research Institute.

\*Trivendrom- Rajiv Gandhi institute of Biological science.

\*Mangalore - Fisheries college

\*Manipal Centre for Higher Education, Plant biotechnology lab - St. Allcious college.

\*Hassan: Coffee estate, MCF.

\*Ooty: Potato research station.

\*Coonoor: TATA tea process centre, vaccine institute

\*Madras: IIT

\*RSIC- Regional Sophisticated Instrumentation Centre.

\*University of Poona

\* National Institute of Virology, National Chemical Laboratory, National center for cell science.

\*Goa: National Institute of occanography (NIO)

\*Cochin - Sri Chitra Tirunal Institute of medical science.

\*Kasargod: Coconut Research Institute.

\*Trivendrom- Rajiv Gandhi institute of Biological science.

\*Mangalore - Fisheries college

\*Manipal Centre for Higher Education, Plant biotechnology lab - St. Allcious college.

\*Hassan: Coffee estate, MCF.

\*Ooty: Potato research station.

\*Coonoor: TATA tea process centre, vaccine institute

\*Madras: IIT

\*RSIC- Regional Sophisticated Instrumentation Centre.

## **9.2BOTANY**

### **BOT-1- DSC:SEMESTER- I**

#### **Phycology, Mycology and Microbiology**

**Algae, Cyanophyta and Xanthophyta:** Life histories of algae, commonly found algae of India, Classification (by Fritsch), Algal cultivation methods, Algal cell structure, Phylogenetic ctomycorr of red, brown and green algae, Dinoflagellates, Diatoms, Cryptomonads and other unicellular algae, Algal evolution, Algal bioprospecting. Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and reproduction of Spirulina and Nostoc. Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and life-cycle of Vaucheria

**Chlorophyta and Phaeophyta and Rhodophyta:** General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Volvox, Trebouxia, Ulva, Oedogonium and Chara. Red tides and other algal adaptations. Commercial cultivation and economic importance of green algae. General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of Ectocarpus, Fucus and red algae (Porphyra and Polysiphonia). Commercial cultivation and economic importance of brown and red algae.

**Introduction to fungi and classification:** General characteristics; Affinities with plants and animals; Thallus organization; Cell wall composition; Nutrition; Classification. Chytridiomycota and Zygomycota: Characteristic features; Ecology and significance; Thallus ctomycorhi; Reproduction; Life cycle with reference to Synchytrium, Rhizopus. Ascomycota: General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle, Heterokaryosis and parasexuality; Life cycle and classification with reference to Saccharomyces, Aspergillus, Penicillium, Alternaria, Neurospora and Peziza.

**Basidiomycota, Allied fungi and Oomycota:** General characteristics; Ecology; Life cycle and Classification with reference to black stem rust on wheat Puccinia (Physiological Specialization), loose and covered smut (symptoms only), Agaricus; Bioluminescence, Fairy Rings and Mushroom Cultivation. Allied fungi: General characteristics; Status of Slimemolds, Classification; Occurrence; Types of plasmodia; Types of fruiting bodies. Oomycota: General characteristics; Ecology; Life cycle and classification with reference to Phytophthora, Albugo.

**Symbiotic associations and applied Mycology:** 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. Role of fungi in biotechnology; Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Mycoproteins); Secondary metabolites (Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides, Myconematicides); Medical mycology

## **Introduction to microbial world:**

Microbial nutrition, nutritional types, growth and metabolism. Economic importance of viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of plant diseases. Economic importance of bacteria with reference to their role in agriculture and industry (fermentation and medicine).

**Viruses and Bacteria:** General characteristics; classification (Baltimore), structure and replication of DNA virus (T4 and  $\lambda$ ), lytic and lysogenic cycle; RNA virus (TMV), viroids and prions. General characteristics; Archaeobacteria, Eubacteria, wall-less forms (mycoplasmas); Cell structure; Reproduction and recombination (conjugation, transformation and transduction). Binary fission and endospore.

## **Practical -1**

### **Phycology**

1. Study of phototactic isolation of zooids of *Ulva* through chart.
2. Microscopic observation of vegetative and reproductive structures of *Nostoc*, *Chlamydomonas*, *Volvox*, *Oedogonium*, *Coleochaete*, *Chara*, *Vaucheria*, *Sargassum*/ *Ectocarpus*, *Fucus* and *Polysiphonia*, *Prochloron* through temporary preparations and permanent slides.

### **Mycology**

1. *Rhizopus*: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. *Aspergillus* and *Penicillium*: study of asexual stage from temporary mounts. Study of Sexual stage from permanent slides/photographs.
3. *Peziza*: sectioning through ascocarp.
4. *Alternaria*: Specimens/photographs and temporary mounts.
5. *Puccinia*: Herbarium specimens of Black Stem Rust of Wheat and infected Barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
6. *Agaricus*: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*, fairy rings and bioluminescent mushrooms to be shown.
7. Study of *Phaneroplasmodium* from actual specimens and /or photograph. Study of *Stemonitis* sporangia.
8. *Albugo*: Study of symptoms of plants infected with *Albugo*; asexual phase study through section/temporary mounts and sexual structures through permanent slides.
9. Lichens: Study of growth forms of lichens (crustose, foliose and fruticose) on different substrates. Study of thallus and reproductive structures (soredia and apothecium) through permanent slides. Mycorrhizae: ectomycorrhizae and endomycorrhiza (Photographs).

## Microbiology

1. Electron micrographs/Models of viruses-T4 and TMV, Lined drawings/ Photographs of Lytic and Lysogenic Cycle.
2. Types of Bacteria from temporary/permanent slides/photographs. Waterbloom. Electron micrographs or charts of bacteria, binary fission, endospore, conjugation.
3. Gram-staining of root nodule and curd.
4. Micrometry and counting of cells by Haemocytometer

### Reference textbooks:

1. Agrios, G.N. (1997). *Plant Pathology*, 4<sup>th</sup> edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). *Introductory Mycology*. 4<sup>th</sup> edition. John Wiley & Sons (Asia) Singapore.
3. Campbell, N.A., Reece, J.B., Urry, L.A., Cain, M.L., Wasserman, S.A., Minorsky P.V. and Jackson, R.B. (2008). *Biology*, 8<sup>th</sup> edition. Pearson Benjamin Cummings, USA..
4. Lee, R.E. (2008). *Phycology*, Cambridge University Press, Cambridge. 4<sup>th</sup> edition.
5. Pelczar, M.J. (2001). *Microbiology*, 5<sup>th</sup> edition, Tata McGraw-Hill Co, New Delhi.
6. Sahoo, D. (2000). *Farming the ocean: seaweeds cultivation and utilization*. Aravali International, New Delhi.
7. Sethi, I.K. and Walia, S.K. (2011). *Text book of Fungi and Their Allies*, Macmillan Publishers India Ltd. 5. Sharma, P.D. (2011). *Plant Pathology*, Rastogi Publication, Meerut, India.
8. Sharma T.A., Dubey, R.C. and Maheshwari, D.K. (1999). *A Text Book of Microbiology*. S Chand and Co, New Delhi.
9. Vashishta B.R., Sinha A.K. and Singh V. P. (2008). *Botany for Degree Students. Algae*. S Chand and Co, New Delhi.
10. Webster, J. and Weber, R. (2007). *Introduction to Fungi*. 3<sup>rd</sup> edition. Cambridge University Press, Cambridge.
11. Wiley, J.M, Sherwood, L.M. and Woolverton, C.J. (2013). *Prescott's Microbiology*. 9<sup>th</sup> Edition. McGraw Hill International.

## **BOT-2-DSC: SEMESTER -II**

### **Bryophytes, Pteridophytes, Gymnosperms**

**Introduction:** Unifying features of archegoniates; Transition to land habit; Alternation of generations.

**Bryophytes and type of bryophytes:** General characteristics; Adaptations to land habit; Classification (up to family); Range of thallus organization. Morphology, anatomy, reproduction and evolutionary trends in Riccia, Marchantia, Anthoceros, Sphagnum and Funaria; Common



mosses of India, Ecological and economic importance of bryophytes with special reference to Sphagnum.

**Pteridophytes:** General characteristics; Classification (up to family); General account of early land plants. Morphology, anatomy and reproduction of Psilotum, Selaginella, Equisetum and Pteris (Developmental details not to be included). Apogamy and apospory, heterospory and seed habit, telome theory, stellar evolution; Common ferns of India, Ecological and economic importance.

**Gymnosperms:** General characteristics, classification (up to family), morphology, anatomy and reproduction of Cycas, Pinus and Gnetum (excluding developmental details); Cycas and Pinus of India, Ecological and economic importance.

## **Practical -2**

1. Riccia - Morphology of thallus.
2. Marchantia- Morphology of thallus, whole mount of rhizoids and Scales, vertical section of thallus through Gemma cup (all temporary slides), vertical section of Antheridiophore, Archegoniophore, longitudinal section of Sporophyte (all permanent slides).
3. Anthoceros- Morphology of thallus, dissection of sporophyte (to show stomata, spores, pseudoelaters, columella) (temporary slide), vertical section of thallus (permanent slide).
4. Sphagnum- Morphology of plant, whole mount of leaf (permanent slide only).
5. Funaria- Morphology, whole mount of leaf, rhizoids, operculum, peristome, annulus, spores (temporary slides); permanent slides showing antheridial and archegonial heads, longitudinal section of capsule; whole mount of protonema.
6. Psilotum- Study of specimen, transverse section of synangium (permanent slide).
7. Selaginella- Morphology, whole mount of leaf with ligule, transverse section of stem, whole mount of strobilus, whole mount of microsporophyll and megasporophyll (temporary slides), longitudinal section of strobilus (permanent slide).
8. Equisetum- Morphology, transverse section of internode, longitudinal section of strobilus, whole mount of sporangiophore, whole mount of spores (temporary slide), transverse section of rhizome (permanent slide).
9. Pteris- Morphology, transverse section of rachis, vertical section of sporophyll, whole mount of sporangium, whole mount of spores (temporary slides), transverse section of rhizome, whole mount of prothallus with sex organs and young sporophyte (permanent slide).
10. Cycas- Morphology (coralloid roots, leaf), whole mount of microsporophyll, transverse section of coralloid root, transverse section of rachis, vertical section of leaflet, vertical section of microsporophyll, whole mount of spores (temporary slides), longitudinal section of ovule, transverse section of root (permanent slide).

11. Pinus- Morphology (long and dwarf shoots, whole mount of dwarf shoot, male and female cones), transverse section of needle, transverse section of stem, longitudinal section of / transverse section of male cone, whole mount of microsporophyll, whole mount of Microspores (temporary slides), longitudinal section of female cone, tangential longitudinal section and radial longitudinal section of stem (permanent slide).
12. Gnetum- Morphology (stem, male and female cones), transverse section of stem, vertical section of ovule (permanent slide)
13. Botanical excursion.

**Reference textbooks:**

1. Vashistha, P.C., Sinha, A.K., Kumar, A. (2010). *Pteridophyta*. S. Chand. Delhi, India.
2. Bhatnagar, S.P. and Moitra, A. (1996). *Gymnosperms*. New Age International Publishers, New Delhi, India.
3. Parihar, N.S. (1991). *An introduction to Embryophyta: Vol. I. Bryophyta*. Central Book Depot, Allahabad.
4. Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). *Biology*. Tata McGraw Hill, New Delhi.
5. Vanderpoorten, A. and Goffinet, B. (2009). *Introduction to Bryophytes*. Cambridge University Press, Cambridge

**BOT-3-DSC: SEMESTER -III**

**Biomolecules and Cell Biology**

**Bioenergetics:** Laws of thermodynamics, concept of free energy, endergonic and exergonic reactions, coupled reactions, redox reactions. ATP: structure, its role as an energy currency molecule. Types and significance of chemical bonds; Structure and properties of water; significance of pH and buffers.

**Biomolecules:** Carbohydrates: Nomenclature and classification and isomeric form; Monosaccharides; Disaccharides; Oligosaccharides and polysaccharides. Lipids: Definition and major classes of storage and structural lipids; Fatty acids structure and functions; Essential fatty acids; Triacylglycerols structure, functions and properties; Phosphoglycerides. Proteins: Structure of amino acids; Levels of protein structure-primary, secondary, tertiary and quaternary; Protein denaturation and biological roles of proteins. 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.

**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, Lineweaver-Burk equation, enzyme inhibition and factors affecting enzyme activity.

**Cell Biology and Signal transduction:** Cell as a unit of structure and function; Characteristics of prokaryotic and eukaryotic cells; Plant and animal cells; Origin of eukaryotic cell (Endosymbiotic theory). 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. Nucleus: Structure-nuclear envelope, nuclear pore complex, nuclear lamina, molecular organization of chromatin; nucleolus.

**Cytoskeleton:** Role and structure of microtubules, microfilaments and intermediary filament; Intracellular trafficking. Chloroplast, mitochondria and peroxisomes: Structural organization; Function; Semiautonomous nature of mitochondria and chloroplast. Lysosomes and Vacuoles. Endomembrane system: Endoplasmic Reticulum - Types and Structure. Golgi Apparatus - organization, protein glycosylation, protein sorting and export from Golgi Apparatus; Phases of eukaryotic cell cycle, mitosis and meiosis; Regulation of cell cycle - checkpoints and regulation; role of protein kinases.

**Signal Transduction:** Receptors and primary and secondary signal transduction

### **BOT-SEC1: Nursery and Gardening**

Nursery: definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.

Seed: Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion - Seed production technology - seed testing and certification.

Vegetative propagation: air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse.

Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping

Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.

Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.

### **Reference textbooks:**

1. Bose T.K. & Mukherjee, D. (1972). *Gardening in India*, Oxford & IBH Publishing Co., New Delhi.
2. Sandhu, M.K. (1989) *Plant Propagation*, Wile Eastern Ltd., Bengaluru.
3. Kumar, N. (1997) *Introduction to Horticulture*, Rajalakshmi Publications, Nagercoil.

4. Edmond Musser & Andres, *Fundamentals of Horticulture*, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K.(1993). *Hand Book of Seed Technology*, Dept.ofAgricultureand Cooperation, National Seed Corporation Ltd., New Delhi.
6. Janick Jules (1979). *Horticultural Science*. (3rdEd.),W.H. FreemanandCo., SanFrancisco, USA.

### **Practical -3**

1. Study of plant cell structure with the help of epidermal peel mount of Onion/ Rhoeo/ Crinum.
2. Demonstration of the phenomenon of protoplasmic streaming in Hydrilla leaf.
3. Measurement of cell size by the technique of micrometry.
4. Counting the cells per unit volume with the help of haemocytometer. (Yeast/pollen grains).
5. Study of cell and its organelles with the help of electron micrographs.
6. Cytochemical staining of: DNA- Feulgen and cell wall in the epidermal peel of onion using Periodic Schiff's (PAS) staining technique.
7. Study the phenomenon of plasmolysis and deplasmolysis.
8. Study the effect of organic solvent and temperature on membrane permeability.
9. Study different stages of mitosis and meiosis.
10. Acid/AlkalinephosphataseorAmylase:Enzymecharacteristics:pH/temperature/ kinetics
11. Immobilization of whole cell and isolated organelle.
12. Separation of protein by SDS-PAGE(only demonstration to class by the instructor.

### **Reference textbooks:**

1. G.M.Cooper.(2015). *The cell:AMolecularApproach*. 7<sup>th</sup> Edition. Sinauer Associates.
2. Alberts, B.,Johnson, A.D., Lewis, J.,Morgan,D., Raff, M., Roberts, K.,Walter, P. (2014). *Molecular Biology of Cell*. 6<sup>th</sup> Edition. WW. Norton & Co.
3. Campbell, M.K. (2012) *Biochemistry*, 7<sup>th</sup> ed., Published by Cengage Learning.
4. Campbell, P.N. and Smith, A.D. (2011). *Biochemistry Illustrated*, 4<sup>th</sup> ed., Published by Churchill Livingstone
5. Tymoczko, J.L., Berg, J.M.and Stryer,L.(2012). *Biochemistry:A short course*, 2<sup>nd</sup>ed., W.H.Freeman.
6. Berg, J.M., Tymoczko, J.L. and Stryer, L. (2011) *Biochemistry*, W.H.Freeman and Company
7. Nelson,D.L.andCox,M.M.(2008). *LehningerPrinciplesofBiochemistry*, 5<sup>th</sup> Edition., W.H. Freeman and Company.

8. Karp, G. (2010). *Cell Biology*, John Wiley & Sons, U.S.A. 6<sup>th</sup> edition.
9. Hardin, J., Becker, G., Skliensmith, L.J. (2012). *Becker's World of the Cell*. 8<sup>th</sup> edition. Pearson Education Inc. U.S.A.
10. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. 5<sup>th</sup> edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
11. Becker, W.M., Kleinsmith, L.J., Hardin, J. and Bertoni, G. P. (2009). *The World of the Cell*. 7<sup>th</sup> edition. Pearson Benjamin Cummings Publishing, San Francisco.

## **BOT-4- DSC: SEMESTER - IV**

### **Anatomy of Angiosperms**

**Adaptive and Protective Systems:** Introduction to Epidermal tissue system, cuticle, trichomes, stomata (structure, function and classification); Adcrustation and incrustation; Anatomical adaptations of xerophytes, mesophytes and hydrophytes. Applications in systematics, forensics and pharmacognosy.

**Introduction to plant anatomy and plant body:** Internal organization of plant body; tissue system, types of cells and tissues. Classification of tissues; Simple and complex tissues, cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Wall ingrowths and transfer cells, Ergastic substances. Hydathodes, cavities, lithocysts and laticifers.

**Apical meristems:** Evolution of concept of organization of shoot apex (Apical cell theory, Histogen theory, Tunica Corpus theory, continuing meristematic residue, cyto-histological zonation); Types of vascular bundles; Structure of dicot and monocot stem. Structure of dicot and monocot leaf, Kranz anatomy. Organization of root apex (Apical cell theory, Histogen theory, Korper- Kappe theory); Quiescent centre; Root cap; Structure of dicot and monocot root; Endodermis, exodermis and origin of lateral root.

<b>Vascular</b>	<b>Cambium</b>	<b>and</b>
<b>Wood:</b> Structure, function and seasonal activity of cambium; Secondary growth in root and stem. Anomalous secondary growth; Sapwood and heartwood; Ring and diffuse porous wood; Early and late wood, tyloses; Dendrochronology. Development and composition of periderm, rhytidome and lenticels.		

### **BOT-SEC2: Medicinal Plants**

History and Traditional Systems of Medicine: History, Scope and Importance of Medicinal Plants; Traditional systems of medicine; 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 and Augmentation: Conservation of 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. 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 Medicine: 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.

Brief description of selected plants and derived drugs, namely Guggul (*Commiphora*) for hypercholesterolemia, Boswellia for inflammatory disorders, Arjuna (*Terminalia arjuna*) for cardioprotection, turmeric (*Curcuma longa*) for wound healing, antioxidant and anticancer properties, Kutaki (*Picrorhiza kurroa*) for hepatoprotection, Opium Poppy for analgesic and antitussive, Salix for analgesic, Cinchona and Artemisia for Malaria, Rauwolfia as tranquilizer, Belladonna as anticholinergic, Digitalis as cardiotoxic, Podophyllum as antitumor. Practical Demonstration and practice of cultural practices for seed / vegetative / clonally propagated medicinal plants (*Mentha arvensis*, Satavar, Artemisia, Aloe vera, Stevia, Ashwagandha).

1. Harvesting, drying, storage (Stevia, Kalmegh and Satavar)
2. Harvesting and distillation of Mints, Basil
3. Extraction of alkaloids / Withanoloids (Belladonna, Ashwagandha)
4. Additional Practical may be added depending on the local habitats and available facilities

### **Reference textbooks:**

1. Akerele, O., Heywood, V. and Syngé, H. (1991). *The Conservation of Medicinal Plants*. Cambridge University Press.
2. AYUSH ([www.indianmedicine.nic.in](http://www.indianmedicine.nic.in)). *About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy*. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
3. CSIR-Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya: *Handbook of Medicinal and Aromatic Plant Cultivation*.
4. Dev, S. (1997). *Ethnotherapeutics and modern drug development: The potential of Ayurveda*. *Current Science* 73:909-928.
5. Evans, W.C. (2009). *Trease and Evans Pharmacognosy*, 16th edn. Philadelphia, PA: Elsevier Saunders Ltd.

6. Jain, S.K. and Jain, Vartika. (eds.) (2017). *Methods and Approaches in Ethnobotany: Concepts, Practices and Prospects*. Deep Publications, Delhi
7. Kapoor, L. D. (2001). *Handbook of Ayurvedic medicinal plants*. Boca Raton, FL: CRC Press.
8. Saroya, A.S. (2017). *Ethnobotany*. ICAR publication.
9. Sharma, R. (2003). *Medicinal Plants of India - An Encyclopaedia*. Delhi: Daya Publishing House.
10. Sharma, R. (2013). *Agro Techniques of Medicinal Plants*. Daya Publishing House, Delhi.
11. Thakur, R.S., H. S. Puri, and Husain, A. (1989). *Major medicinal plants of India*. Central Institute of Medicinal and Aromatic Plants, Lucknow, India.

#### **Practical -4**

1. Study of stomata through peel method and replica method.
2. Simple microtomy - hand sections and/or using microtome - hand held or rotary microtome
3. Staining techniques
4. Apical meristem of root, shoot and vascular cambium.
5. Distribution and types of parenchyma, collenchyma and sclerenchyma.
6. Xylem: Tracheary elements - tracheids, vessel elements; thickenings; perforation plates; xylem fibres.
7. Wood: ring porous; diffuse porous; tyloses; heart- and sapwood.
8. Phloem: Sieve tubes - sieve plates; companion cells; phloem fibres.
9. Epidermal system: cell types, stomata types; trichomes: non-glandular and glandular.
10. Root: monocot, dicot, secondary growth.
11. Stem: monocot, dicot - primary and secondary growth; anomalous secondary growth in *Achyranthes*, *Boerhaavia* and *Dracaena*; periderm; lenticels.
12. Leaf: isobilateral, dorsiventral, C<sub>4</sub> leaves (Kranz anatomy).
13. Adaptive Anatomy: xerophytes, hydrophytes.
14. Secretory tissues: cavities, lithocysts and laticifers.

#### **Reference textbooks:**

1. Dickison, W.C. (2000). *Integrative Plant Anatomy*. Harcourt Academic Press, USA.
2. Fahn, A. (1974). *Plant Anatomy*. Pergamon Press, USA.
3. Mauseth, J.D. (1988). *Plant Anatomy*. The Benjamin/Cummings Publisher, USA.

4. Evert, R.F. (2006) *Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development*. John Wiley and Sons, Inc.
5. Any local/state/regional flora published by BSI or any other agency

## **BOT-5 DSESEMESTER - V**

### **Plant Physiology and Metabolism**

#### **Water Potential and Other Potential Physiological Aspect of Plant:**

Water relation of plants, unique physicochemical properties of water; water absorption, uptake and bulk movement of water, stomatal regulation of transpiration, anti transpirants; Inorganic nutrition, (macro and micro), deficiency symptoms, hydroponic studies; mineral absorption, translocation and assimilation. (including explanation on active passive uptake, Channels, carriers and pumps).

**Nitrogen Nutrition:** Metabolism: Nitrogen nutrition, organic nitrogen, nitrogen fixation in microbes/legumes, nif  
genes and NOD factors, nitrate and ammonia assimilation, interrelationship between  
photosynthesis and nitrogen metabolism. (Emphasis on various enzymes especially nitrogenase).

**Photosynthesis and Photorespiration:** Photosynthesis: Importance of photosynthesis for food security and environment. (a) Light  
reaction: Radiant energy, photosynthetic apparatus, pigments and their biosynthesis; light  
harvesting complex; light absorption and composition and characteristics of two photosystems,  
photosynthetic electron transport, (b) Dark reaction: Carbon dioxide fixation  
in C<sub>3</sub>, C<sub>4</sub> and CAM plants, photorespiration and its significance, environmental factors  
affecting photosynthesis. (Explain RUBISCO). Respiration: Aerobic and anaerobic respiration;  
cyanide independent respiration; fermentation; cytochrome system; carbohydrate and lipid  
metabolism; high energy compounds and factors affecting respiration.

#### **Phytochrome, Phytohormone and Plant**

**Cycle:** Growth and development (a) Phytochromes and light control, role of phytochrome in  
tropism, flowering and fruiting. (b) Phytohormones: Auxin; cytokinin; Gibberellins; ethylene; ABA.  
Synthesis, distribution and physiological effects. Application of hormones in agriculture and  
horticulture. Polyamines, brassinosteroids and their functions. Seed dormancy and germination,  
senescence, circadian rhythms in plants (exogenous factors and physiological mechanism).

**Concept of Metabolism:** Introduction, anabolic and catabolic pathways,  
regulation of metabolism, role of regulatory enzymes (allosteric, covalent modulation and  
Isozymes). Historical background, role of photosynthetic pigments (chlorophylls and accessory  
pigments), antenna molecules and reaction centres,

**Carbon Assimilation, Metabolism and Oxidation:** Photochemical reactions, photosynthetic  
electron transport, PSI, PSII, Q cycle, CO<sub>2</sub> reduction/ Carbon assimilation: C<sub>3</sub> and C<sub>4</sub> pathways;  
photorespiration; Crassulacean acid metabolism; Factors affecting CO<sub>2</sub> reduction. Synthesis and  
hydrolysis of sucrose and starch. Glycolysis and its regulation of glycolysis, oxidative pentose  
phosphate pathway, oxidative decarboxylation of pyruvate, regulation of PDH, NADH shuttle;



TCA cycle, amphibolic role, anaplerotic reactions, regulation of the cycle, mitochondrial electron transport, oxidative phosphorylation, cyanide-resistant respiration, factors affecting respiration.

**ATP-Synthesis:** Mechanism of ATP synthesis, substrate level phosphorylation, chemiosmotic mechanism (oxidative and photophosphorylation), ATP synthase, Boyer's conformational model, Racker's experiment, Jagendorf's experiment; role of uncouplers.

**Lipid and Nitrogen Metabolism, Mechanism of Signal Transduction:** Synthesis and breakdown of triglycerides,  $\beta$ -oxidation, glyoxylate cycle, gluconeogenesis and its role in mobilisation of lipids during seed germination,  $\alpha$  oxidation. Biological nitrogen fixation (examples of legumes and non-legumes); Physiology and biochemistry of nitrogen fixation; Nitrate and Ammonia assimilation; Transaminase reactions. Receptor-ligand interactions; Secondary messengers concept, Calcium-calmodulin, MAP kinase cascade.

**Reference textbooks:**

1. Buchanan, B.B. and Gruissem, W. (2015). *Biochemistry and molecular biology of plants*. Wiley Blackwell ASPB USA.
2. Campbell, M.K. and Farrell, S.O. (2007). *Biochemistry*. Thomson Brooks/cole, USA.
3. Dey, P.M. and Harborne, J.B. (2000). *Plant biochemistry*. Academic Press, UK.
4. Goodwin, T.W. and Mercer, E.I. (2003). *Introduction to plant biochemistry*. CBS Publishers & Distributors, New Delhi, India.
5. Ross and Salisbury. (2009). *Plant Physiology*. Cengage Learning (Thompson), New Delhi, India.
6. Segel, I.H. and Segel, E. (1993). *Enzyme kinetics: Behavior and analysis of rapid equilibrium and steady-state enzyme systems*. Wiley-Interscience, USA.
7. Taiz, L., Zeiger, E., Moller, I.M. and Murphy, A. (2015). *Plant physiology and Development* 6th edition. Sinauer Associates Inc., USA.
8. Hopkins, W.G. and Huner, A. (2008). *Introduction to Plant Physiology*. 4th edition. John Wiley and Sons. U.S.A.
9. Harborne, J.B. (1973). *Phytochemical Methods*. John Wiley & Sons. New York.
10. H.W. Heldt and B. Piechulla. (2019). *Plant Biochemistry*. 4th Edition. Paperback. Academic Press.

**BOT-6-DSC Genetics and Cytogenetics (Soft Core-1)**

**Principles of genetics and Biology of Inheritance:** Mendelism: History; Mendel's Laws of inheritance; Chromosome theory of inheritance and linkage; Incomplete dominance and codominance; Interaction of Genes; Multiple alleles, Lethal alleles, Epistasis, Pleiotropy, Recessive and Dominant traits, Penetrance and Expressivity, Mendelian segregation and gene interaction: Numericals; Polygenic inheritance; Mitosis and Meiosis in plants, animal and human; Cell cycle and cell division.

**Extra-nuclear Inheritance, Linkage, crossing over and chromosome mapping:** Determining non-Mendelian inheritance; Maternal effects and cytoplasmic 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. Linkage and crossing over; Cytological basis of crossing over; Recombination frequency, two factor and three factor crosses; Interference and coincidence; Linkage and Gene mapping, and numericals based on gene mapping.

**Variation in Chromosome Number and Structure, Mutations:** Chromosome morphology and Karyotype concept, Deletion, Duplication, Inversion, Translocation, Position effect; Euploidy, Aneuploidy and Amphiploidy and their implications, FISH and GISH in chromosome and genome identification. Types of mutations; Molecular basis of Mutations; Induction of mutations and Mutagens - physical and chemical (Base analogs, deaminating, alkylating and intercalating agents); Detection of mutations: ClB method. Role of Transposons in mutation. DNA repair mechanisms.

**Fine Structure of Gene, Gene Interaction, Population and Evolutionary Genetics:** Evolution of Gene Concept - Classical vs molecular concepts of gene: One gene one character; One gene-one enzyme, one gene-one polypeptide hypothesis and beyond; Cis- trans complementation test for functional allelism and gene as unit of function, mutation and recombination, non-coding RNA. Concept of sex determination and Sex chromosomes; Patterns of Sex determination in plants and animals (human, Drosophila and other animals) ; Sex-linked, sex-limited and sex-influenced characters; Dosage compensation. Allele frequencies, Genotype frequencies, Hardy-Weinberg Law, role of natural selection, mutation, genetic drift. Genetic variation and Speciation.

**Reference textbooks:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (1991). *Principles of Genetics*. 8th edition. John Wiley & sons, India.
2. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. (2010). *Introduction to Genetic Analysis*. 10th edition. W. H. Freeman and Co., U.S.A.
3. Gupta, P.K. (2018) *Genetics*. 5th Edition, Rastogi Publications, Meerut.
4. Hartl, D.L. and Jones, E.W. (1999). *Essential Genetics*, 2nd Edition, Jones and Barlett Publishers, Boston.
5. Jain, H.K. (1999). *Genetics: Principles, Concepts and Implications*. Science Pub Inc.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). *Concepts of Genetics*. 9th edition. Benjamin Cummings, U.S.A.
7. Singh, R. J. (2016). *Plant Cytogenetics*, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
8. Singh, R.J. (2017). *Practical Manual on Plant Cytogenetics*. CRC Press, Boca Raton, Florida, USA.
9. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*. 5th edition. John Wiley & Sons Inc., India.
10. Strickberger, M.W. (1985) *Genetics*, 3rd Edition. Pearson Printice Hall (printed in India by Anand Sons).

**BOT-7 DSE Taxonomy of Flowering Plants (Soft Core-2)**

## **Significance of Plant systematics and Taxonomic hierarchy:**

Introduction to systematics; Plant identification, Classification, Nomenclature. Evidence from palynology, embryology, cytology, phytochemistry and molecular data. Field inventory; Importance of Herbarium; Important herbaria and botanical gardens of the world and India; Virtual herbarium; E-flora; Documentation: Flora, Monographs, Journals; Keys: intended (yolked) and bracketed keys. Phenetics vs. Cladistics, Taxonomic Hierarchy: Concept of taxa (family, genus, species); Categories and taxonomic hierarchy; Species concepts (biological, morphological, evolutionary). Modes of speciation. Problems with species concepts. Rankless system of phylogenetic systematics

**Botanical Nomenclature and System of Classification:** Principles and rules (ICN); Ranks and names; Typification, author citation, valid publication, rejection of names, principle of priority and its limitations; Names of hybrids. System of classification: Natural system of classification (Bentham and Hooker), Takhtajan classification of Angiosperms, Principles of Angiosperm Phylogeny Group (APG IV) classification.

**Biometrics, Numerical Taxonomy and Cladistics:** Characters; Variations; OTUs, character weighting and coding; Cluster analysis; Phenograms, cladograms (definitions and differences).

**Phylogenetic Systematics:** Terms and concepts (primitive and advanced, homology and analogy, parallelism and convergence, monophyly, Paraphyly, polyphyly, clades, synapomorphy, symplesiomorphy, apomorphy, lineage sorting, serial homology etc). Origin and evolution of angiosperms; Co-evolution of angiosperms and animals; Methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).

### **Reference textbooks:**

1. Singh, (2012). *Plant Systematics: Theory and Practice* Oxford & IBH Pvt. Ltd., New Delhi. 3rd edition.
2. Jeffrey, C. (1982). *An Introduction to Plant Taxonomy*. Cambridge University Press, Cambridge.
3. Judd, W.S., Campbell, C.S., Kellogg, E.A., Stevens, P.F. (2002). *Plant Systematics-A Phylogenetic Approach*. Sinauer Associates Inc., U.S.A. 2nd edition.
4. Radford, A.E. (1986). *Fundamentals of Plant Systematics*. Harper and Row, New York.
5. Sambamurthy, A.V.S.S. (2005). *Taxonomy of Angiosperms*. I.K. International Pvt. Ltd., New Delhi.
6. Singh, V., Pande, P.C. & Jain, D.K. (2008). *Taxonomy and Economic Botany*. Rastogi Publications, Meerut.
7. Pandey, B. P. (2009). *A Textbook of Botany Angiosperms*. S. Chand and Company Ltd., New Delhi.
8. Hall, B.G. (2011). *Phylogenetic Trees Made Easy: A How-To Manual*. Sinauer Associates, Inc. USA
8. Any local/state/regional flora published by BSI or any other agency

## **Practical-5 Plant Physiology**

1. Analysis of plant tissue for water, organic and inorganic contentdetermination of a few macronutrient (K/Na) by Flame photometer
2. Quantitative and qualitative estimation of sugars
3. Qualitative and quantitative determination of amino acids
4. Quantitative estimation of protein
5. Determination of ascorbic acid content of tissue (DCIP red)
6. Pigmentsextraction,separationthroughsolventpartitioningandchromatographic techniques
7. Spectrophotometric estimation of chlorophyll
8. Enzyme activity with respect to temperature, pH and substrate concentration.
9. Effect of inorganic nutrients on plant growth
10. Assayofphotosyntheticelectrontransportactivityfromisolatedchloroplast/Algae using DCIP reduction
11. AssayofrespiratoryelectrontransportactivityfrompotatousingDDCPdye oxidation.
12. Estimation of nitrate/nitrite reductase activity in leaves/algae
13. Seed viability -TTC test
14. Estimation of transpiration through different simple methods.

### **Plant Metabolism**

1. Solvent partitioning of photosynthetic pigments.
2. Experimental demonstration of Hill's reaction.
3. To study the effect of light intensity on the rate of photosynthesis.
4. Effect of carbon dioxide on the rate of photosynthesis.
5. To compare the rate of respiration in different parts of a plant.
6. To demonstrate activity of Nitrate reductase in germinating leaves of different plant sources.
7. To study the activity of lipases in germinating oilseeds and demonstrate mobilization of lipids during germination.
8. Demonstration of fluorescence by isolated chlorophyll pigments.
9. Demonstration of absorption spectrum of photosynthetic pigments.
10. Blood Typing: ABO groups & Rh factor.

## **Genetics**

1. Mitosis, and study of chromosome morphology through squash preparation, including effect of chemicals on mitosis.
2. Meiosis and study of chiasma frequency through temporary squash preparation.
3. Laws through seed ratios. Laboratory exercises in probability and chi-square.
4. Chromosome mapping using point test cross data.
5. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
8. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes.
9. Photographs/Permanent Slides showing Translocation Ring, Laggards and Inversion Bridge.
10. Study of human genetic traits: Sickle cell anemia, Xeroderma Pigmentosum, Albinism, red-green Color blindness, Widow's peak, Rolling of tongue, Hitchhiker's thumb and Attached earlobe.
11. To test PTC tasting ability in a random sample and calculate gene frequencies for the taster and non-taster alleles.
12. Identification of inactivated X chromosome as Barr body and drumstick.

## **Taxonomy**

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): Ranunculaceae - Ranunculus, Delphinium Brassicaceae - Alyssum / Iberis Papaveraceae - Argemone Myrtaceae - Eucalyptus, Callistemon Umbelliferae - Coriandrum / Anethum / Foeniculum Asteraceae - Sonchus/Launaea, Vernonia/Ageratum, Eclipta/Tridax Solanaceae - Solanum nigrum/Physalis Lamiaceae - Salvia/Ocimum Euphorbiaceae - Euphorbia hirta/ Jatropha, Croton Liliaceae - Asphodelus/Lilium/Allium Poaceae - Triticum/Hordeum/Avena
2. Field visit (local or outside depending on situation) -
3. Mounting of a properly dried and pressed specimen of any 20 wild plant with Herbarium label (to be submitted in the record book).
4. Construction of plant phylogenetic trees using various loci (rbcL, ITS, trnL etc) with various phylogenetic methods (Neighbour Joining, Maximum Likelihood etc)

## **BOT-9 DSE SEMESTER - VI**

### **Plant Pathology and Biotechnology**

**History:** Milestones in phytopathology with particular reference to India. Major epidemics and their social impacts. Historical developments of chemicals, cultural and biological protection measures. Altered metabolism of plants under biotic and abiotic stresses. Koch's Postulates, Epidemiology and forecasting of plant diseases

**Principles of Plant pathology:** i. Principles of plant pathology-Importance, nature, classification and general symptoms of plant diseases. ii. Pathogenicity of microorganisms and pathogenesis. iii. Host parasite relationship and Interaction; Signal transduction.

**Defence mechanism in host plants against pathogens** -morphological or structural defence mechanism; Biochemical defence mechanisms - role of phenolic compounds, enzymes and toxins

**Principles and methods of plant disease control** -cultural methods, chemical methods, Biological control, transgenic approach for plant disease control, integrated pest management (IPM), Biopesticides.

A Detailed study of the Diseases of the following crops caused by fungal pathogens with effective control measures.

**Diseases of Cereals:** Seedling blight of cereals, Smut of wheat, Foot rot of wheat, Covered smut of Barley, False smut of rice, Downey mildew of jowar, Green ear disease of Bajra, Ergot of Bajra, Downey mildew of maize.

**Diseases of Vegetable crops** with special reference to the important diseases of the following: Chilli, Brinjal, Tomato, Onion, Bhindi. General knowledge of post harvest diseases of fruits and vegetables and their control.

**Diseases of Oil Seed Crops** viz. Linum, Sesamum, Groundnut, Mustard and Sunflower

**Diseases of Fruit Trees**-With special reference to important diseases of the following Citrus, Apple, Mango, Banana and Grapes.

**Bacterial diseases of plants** - Bacterial blight of rice, Tundu disease of wheat, Angular leaf spot of cotton, stalk rot of maize, Fire blight of Apple, Bacterial soft rot of fruits and Vegetables.

**Viral Diseases of Plant:** Bunchy top of Banana, Leaf curl of Papaya, Yellow vein mosaic of Bhindi. Mosaic of Cucurbits, Viral diseases of Tobacco, Potato and Tomato.

**Mycoplasma/Phytoplasma (PPLO) Diseases of Plants:** Citrus greening, Rice yellow dwarf: Little leaf of Brinjal, Sandal Spike.

**Nematode Diseases of Plants:** General knowledge of plant parasitic nematodes and important nematode diseases viz. Root knot of Vegetables, Ear cockle of wheat. .

**Plant Tissue Culture:** Historical perspective; Formulation of nutrient media; Sterilization, role of vitamins and hormones; Totipotency; Organogenesis; Embryogenesis (somatic and zygotic); Organ culture, Embryo culture, Anther and triploid culture, Callus culture, Protoplast isolation, culture and fusion; Tissue culture applications including micropropagation, androgenesis, production of virus free plants, secondary metabolite

production, haploids, triploids and hybrids and germplasm conservation, Cryopreservation and usages.

**Enzymes and Vectors for Genetic Manipulations:** Restriction Endonucleases (History, Types I-IV and subtypes of II, Structures, biological role, Mechanism, and usages in cloning); Restriction Mapping (Linear and Circular); Ligases enzymes, Cloning Vectors: History, basic sequences of any vector, types of bacterial vectors (pUC18 and pUC19, pBR322, Ti plasmid, BAC); Yeast vector, viral vectors including Lambda phage, M13 phagemid, Cosmid, Shuttle vector; Eukaryotic Vectors (YAC).

**Gene Cloning and Methods of Gene Transfer:** Basic concept of Gene cloning, advantages of gene cloning, Bacterial Transformation methods and selection of recombinant clones using various strategies, PCR-mediated gene cloning; Gene Construct; Plant transformation vector, T-DNA and viral vector, Agrobacterium-mediated Transformation protocols, molecular mechanism of T-DNA transfer, direct gene transfer method by Electroporation, Microinjection, Microprojectile bombardment; Selection of transgenics - selectable marker and reporter genes (Luciferase, GUS, GFP), chloroplast transformation, transgene analysis, Mutant formation, Marker-free and novel selection strategies.

**Major Concerns and Applications of Transgenic Technology:** Transgenic technology and sustainable agriculture, Biosafety concerns with transgenic technology, History of transgenic development across the world, Major concerns with implementation of transgenic technology in India. Applications as Pest resistant (Bt-cotton); herbicide resistant plants (RoundUp Ready soybean); Transgenic crops with improved quality traits in major crops (FlavrSavr tomato, Golden rice); Improved horticultural varieties (Moon dust carnations); Role of transgenics in bioremediation (Superbug)

### **Reference textbooks:**

1. Bhojwani, S.S. and Razdan, M.K., (1996). *Plant Tissue Culture: Theory and Practice*. Elsevier Science Amsterdam. The Netherlands.
2. Glick, B.R., Pasternak, J.J. (2003). *Molecular Biotechnology-Principles and Applications of recombinant DNA*. ASM Press, Washington.
3. A. Slater, N.W. Scott and M.R. Fowler (2008). *Plant Biotechnology. Second Edition*. Oxford.
4. Snustad, D.P. and Simmons, M.J. (2010). *Principles of Genetics*. John Wiley and Sons, U.K.
5. Stewart, C.N. Jr. (2008). *Plant Biotechnology & Genetics: Principles, Techniques and Applications*. John Wiley & Sons Inc. U.S.A.
6. Chrispeels, M.J. and Sadava, D.E. (1994). *Plants, Genes and Agriculture*. Jones & Bartlett Publishers.
7. N. Santosh and A. Madhavi. (2010). *Practical Book of Biotechnology and Plant Tissue Culture*. S. Chand & Co.
8. Agrios, G.N. (1997). *Plant Pathology, 4th edition*, Academic Press, U.K.
9. Sharma, P.D. (2011). *Plant Pathology*, Rastogi Publication, Meerut, India.

## **BOT-10 DSE Plant Ecology and Phytogeography (Soft Core-1)**

**Introduction, soil and water:** Basic concepts; Levels of organization. Abiotic and biotic Components and their interrelationships and dynamism, homeostasis. Soil: Origin; Types and Formation; Composition; Physical, Chemical and Biological components; Soil profile. Types of soils in India. Water: States of water in the environment; Precipitation types (rain, fog, snow, hail, dew); Hydrological Cycle; Atmospheric moisture; Water in soil; Ground water table. Water resources of India

**Ecological adaptations, Population ecology:** Variations in adaptation of plants in relation to light, temperature, water, wind and fire. Biotic interactions: Competition: Inter- and intraspecific competition; Ammensalism, heterotrophy; mutualism, commensalism, parasitism; herbivory, carnivory, proto cooperation, Population ecology: Characteristics and population growth, population regulation, life history strategies; r and k selection. Ecological Speciation.

**Plant Communities and Ecosystem:** Community characteristics: analytical and synthetic; Concept of ecological amplitude; Habitat and niche; Ecotone and edge effect; Succession: processes, types; climax concept. Primary vs Secondary succession. Ecosystem: Structure; Processes; Trophic organization; Food chains and Food webs; Ecological pyramids. Ecosystems of India.

**Functional Aspects of Ecosystem and Phytogeography:** Principles and models of energy flow; Production and productivity; Ecological efficiencies; Biogeochemical cycles of carbon, nitrogen and phosphorus. Phytogeography: Principles; Continental drift; Theory of tolerance; Endemism; Brief description of major terrestrial biomes (one each from tropical, temperate & tundra); Phyto-geographical division of India; Local Vegetation.

### **Reference textbooks:**

1. Odum, E.P. (2005). *Fundamentals of ecology*. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). *Ecology Environment and Resource Conservation*. Anamaya Publications, New Delhi, India.
3. Sharma, P.D. (2010). *Ecology and Environment*. Rastogi Publications, Meerut, India. 8th edition.
4. Wilkinson, D.M. (2007). *Fundamental Processes in Ecology: An Earth Systems Approach*. Oxford University Press. U.S.A.
5. Kormondy, E.J. (1996). *Concepts of ecology*. PHI Learning Pvt. Ltd., Delhi, India. 4th edition.

## **BOT-11 DSE Botany and Plant Resource Utilization (Soft Core-2)**

**Origin and conservation of Cultivated Plants:** Origin, Importance and domestication: Origin of Agriculture and ancient economic botany, Vavilov's Centres of Origin and diversity of crop plants, domestication, evaluation, bioprospection, Major plant introductions; Crop domestication and loss of genetic diversity;



Germplasm augmentation and conservation: History and importance of germplasm collection; Overview of: Ecogeographical distribution of diversity, General account of: Biotechnology in plant germplasm acquisition, plant tissue culture in disease elimination, in vitro conservation and exchange, cryopreservation, transgenics - exchange and biosafety issues, Plant Quarantine: Principles, objectives and relevance of plant quarantine; Introductory regulations and plant quarantine set up in India; economic significance of seed borne pests, pathogens and weeds; detection and post entry quarantine operations.

**Botany, Utilization of Plant Wealth (Cereals and Millets, Pulses and Legumes, Sources of Sugars and Starches):** Origin, evolution and biosystematics, morphology, and uses of some selected crops: Cereals: Wheat, Rice, maize, sorghum, pearl millet and minor millets. Pulses: Origin, morphology, uses, Importance to man and ecosystem of pulses (Pigeon pea, Chickpea, Black gram, Green gram, Cowpea, Soyabean, Pea, Lentil, Horsegram), and Legumes (lab-lab bean, ricebean, winged bean, French bean, limabean, sword bean). Morphology and processing of sugarcane, products and by-products. Morphology, propagation & uses of Sugarbeet, Sugarcane and sweet sorghum. Potato, Sweet Potato and Tapioca.

**Botany, Utilization of Plant Wealth (Spices, Beverages, Oil seeds fats and Essential oils):** Spices: Listing of important spices (Saffron, Cloves, Cardamom, Cinnamon, Tejpatta, Nutmeg and Mace, Anise, Cumin, Celery, Tamrind, Vanilla, Asafoetida, Dill, Fenugreek, Fennel, Coriander), their botanical name, family and part used. Origin, distribution, ecology, botany, cultivation practices, processing of economic plant part / product, main chemical constituents, and economic Importance of the Major spices, namely Turmeric, Ginger, Capsicum, Black Pepper, Coriander. Beverages: Tea and Coffee: History, origin, growing countries, Botany, cultivation practices, common diseases and pests, major chemical constituents, processing and quality control of economic product, Oil seeds and fats: General description, classification, extraction and uses of groundnut, coconut, linseed, soybean, mustard. Essential Oils: General description, uses extraction / distillation of essential oil, chemical constituents of major essential oil yielding aromatic plants, namely Rose, Geranium, Lemongrass / Palmarosa / Citronella, Vetiver, Menthol mint, Basil, Lavender, Eucalyptus, Clove, Camphor and Sandal wood.

**Botany, Utilization and Processing of Plant Wealth (Aromatic Plants, Drug-yielding and Medicinal plants, Timber plants):** Drug-yielding and Medicinal plants: Fumitories and Masticatories: Processing, therapeutic uses, and health hazards of habit-forming drugs, Botany and cultivation / regulatory practices of such drug yielding plants with special reference to Papaver, Cannabis and Tobacco. Major Medicinal Plants: Botany, Uses, Cultivation and Processing of major medicinal plants, namely: Ashwagandha, Kalmegh, Satavar, Ghrit Kumari (Aloe vera), Quinghao (Artemisia annua), Isabgol, Senna, Bhui Amla (Phyllanthus), Stevia, Sarpagandha, Atropa, Digitalis, Licorice, Gilloi (Tinospora), Natural Rubber: Para-rubber: tapping, processing and uses. Timber plants and Fibres: General account and Botany of the Tree, wood structure and quality characteristics, and timber processing with special reference to, Saal (Shorea robusta), Teak and Pine. General account of the Fiber yielding plants, Classification based on the origin of fibers, Extraction, processing, morphology and uses of fibers, with special reference to Cotton, Sunhemp, flax, Coir, Jute. Seaweeds: Economically important seaweed resources of India, Production of carrageenan, algin, agar and agarose, seaweeds as fertilizers, edible seaweeds,

seaweeds as fodder, drugs from algae, cosmetics and nutraceuticals from algae, algae based biofuel.

**Reference textbooks:**

1. Chrispeels, M.J. and Sadava, D.E. (1994) *Plants, Genes and Agriculture*. Jones & Bartlett Publishers.
2. CSIR- Central Institute of Medicinal and Aromatic Plants, Lucknow (2016). Aush Gyanya: *Handbook of Medicinal and Aromatic Plant Cultivation*.
3. Kochhar, S.L. (2016). *Economic Botany: A Comprehensive Study*. 5th Edition. Cambridge
4. Samba Murty, AVSS and Subrahmanyam, N.S. (1989). *A textbook of Economic Botany*. Wiley Eastern Ltd., New Delhi
5. Sambamurty, AVSS and Subrahmanyam, N.S. (2008). *A Textbook of Modern Economic Botany*. 1st Edition, Paperback. CBS Publishers & Distributors Pvt. Ltd.; 1st edition (4 September 2008)
6. Wickens, G.E. (2001). *Economic Botany: Principles & Practices*. Kluwer Academic Publishers, The Netherlands.
7. Any local/state/regional flora published by BSI or any other agency.

**Practical-6**

**Plant Pathology**

1. Herbarium specimens of bacterial diseases; Citrus Canker; Angular leaf spot of cotton, Viral diseases: TMV, Vein clearing, Fungal diseases: Early blight of potato, Black stem rust of wheat and White rust of crucifers.

**Plant Biotechnology**

1. (a) Preparation of liquid and solid MS medium.  
(b) Demonstration of in vitro sterilization of seeds and germination in MS media containing petri plates.  
(c) in vitro selection and inoculation methods using leaf and nodal explants of tobacco, Datura, Brassica etc.
2. Callus formation in tobacco and rice using MS medium containing phytohormones.
3. Study of anther, embryo and endosperm culture, micropropagation, somatic embryogenesis & artificial seeds through photographs.
4. Isolation of protoplasts and protoplast culture using photographs
5. Construction of restriction map of circular and linear DNA from the data provided.
6. Study of methods of gene transfer through photographs: Agrobacterium-mediated, direct gene transfer by electroporation, microinjection, microprojectile bombardment.

7. Study of steps of genetic engineering for production of Bt cotton, Golden rice, FlavrSavr tomato through photographs.
8. Isolation of plasmid DNA.
9. Restriction digestion and gel electrophoresis of plasmid DNA.

### **Ecology**

1. Study of instruments used to measure microclimatic variables: Soil thermometer, maximum and minimum thermometer, anemometer, psychrometer/hygrometer, rain gauge and lux meter.
2. Determination of pH of various soil and water samples (with pHmeter, universal indicator/Lovibond comparator and/or pH paper strip)
3. Analysis for carbonates, chlorides, nitrates, sulphates, organic matter and base deficiency from two soil samples by rapid field tests.
4. Determination of organic matter of different soil samples by Walkley & Black rapid titration method.
5. Comparison of bulk density, porosity and rate of infiltration of water in soils of three habitats.
6. Determination of dissolved oxygen of water samples from polluted and unpolluted sources.
7. Study of morphological adaptations of hydrophytes and xerophytes (four each).
8. Study of biotic interactions of the following: Stem parasite (Cuscuta), Root parasite (Orobanchae), Epiphytes, Predation (Insectivorous plants).
9. Determination of minimal quadrat size for the study of herbaceous vegetation in the college campus, by species area curve method (species to be listed).
10. Quantitative analysis of herbaceous vegetation in the college campus for frequency and comparison with Raunkiaer's frequency distribution law.
11. Quantitative analysis of herbaceous vegetation for density and abundance in the college campus.
12. Field visit to familiarise students with ecology of different sites.

### **Economic Botany**

1. Cereals: Wheat (habit sketch, L.S./T.S. grain, starch grains, micro-chemical tests) Rice (habit sketch, study of paddy and grain, starch grains, micro-chemical tests).
2. Legumes: Soybean, Groundnut, (habit, fruit, seed structure, micro-chemical tests).
3. Sources of sugars and 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, Curcuma and Clove (habit and sections).

5. Beverages: Tea (plant specimen, tea leaves), Coffee (plant specimen, beans).
6. Sources of oils and fats: Coconut- T.S. nut, Mustard-plant specimen, seeds; tests for fats in crushed seeds.
7. Essential oil-yielding plants: Habits sketch of Rosa, Vetiveria, Santalum and Cymbopogon spp., Mint, Basil, Eucalyptus (specimens/photographs).
8. Rubber: specimen, photograph/model of tapping, samples of rubber products.
9. Drug-yielding plants: Specimens of Ashwagandha, Artemisia, Kalmegh, Phyllanthus, Satavar, Gillo, Digitalis, Papaver and Cannabis.
10. Tobacco: specimen and products of Tobacco.
11. Woods: Tectona, Pinus: Specimen, Section of young stem.
12. Fiber-yielding plants: Cotton (specimen, whole mount of seed to show lint and fuzz; whole mount of fiber and test for cellulose), Jute (specimen, transverse section of stem, test for lignin on transverse section of stem and fiber).

### **9.3 CHEMISTRY**

#### **SEMESTER - I; PAPER - I**

##### **BLOCK-1: Inorganic Chemistry**

**Unit-1:** Rutherford model of atom, Bohr's theory of Hydrogen atom, line spectra of atom, Zeeman effect, Quantum theory, Quantum numbers and their significance, Shapes of s, p and d orbitals, Effective nuclear charge, screening effect-based on Slater's rules (problems to be worked out), Pauli's exclusion principle.

**Unit-2:** General energy level diagram of multi electron atom (up to  $n=4$ ), Aufbau principle Hund's rule,  $(n+1)$  rule, Electronic configuration of elements (up to At. No. 40), stability of completely filled and half-filled orbitals based on the concepts of pairing energy.

**Unit-3:** Periodic Table and Periodicity: Classification of elements, cause of periodicity, Detailed discussion of the Atomic, Covalent, ionic, Vanderwaal's and crystal radii, Additive nature of covalent radii, Determination of ionic radii by Lande's method, Variation of covalent radii in a group and in a period, explanation for the observed trends, Comparison of the size of the atoms with the corresponding anions and cations, Variation of ionic radii in isoelectronic ions.

**Unit-4:** Ionization enthalpy, Successive ionization enthalpy, factors affecting ionization enthalpy, applications of ionization enthalpy. Variation in a group and in a period, explanation for the observed trends.

Electron gain enthalpy, Successive electron gain enthalpy variation of electron gain enthalpy in period and in a group, explanation for the observed trends.

Electronegativity, Variation of electronegativity in a group and in a period, explanation for the observed trends, Factors determining electro negativity (charge on the atom and hybridization). Pauling, Mulliken and Allred-Rochow scale of electronegativity.

## **BLOCK - 2: Physical Chemistry**

**Unit-5:** Gases: Maxwell-Boltzmann distribution of molecular velocities, Effect of temperature on distribution of molecular velocities using distribution curve (graph). Boltzmann factor (significance and equation), Energy distribution as a function of temperature, Types of molecular velocities - average ( $U_{av}$ ) - root mean square velocity ( $U_{rms}$ ) - most probable velocity ( $U_{mp}$ ) - their definition and equations, Relation between  $U_{av}$ ,  $U_{rms}$  and  $U_{mp}$  velocities of molecules and their calculations (based on temperature dependence)

**Unit-6:** The critical phenomena - Andrew's experiments on  $CO_2$ , critical constants -  $T_c$ ,  $P_c$  and  $V_c$ , definitions experimental determination of Critical temperature and Critical pressure by using Cagniard del Tour's apparatus, critical volume by Cailletes and Mathias method - Vander Waal's equation - relation between Vander Waal's Constants 'a' and 'b' and critical constants  $T_c$ ,  $P_c$  and  $V_c$  to be derived using isotherms of  $CO_2$ .

**Unit-7:** Law of corresponding states and reduced equation of state (to be derived) Liquefaction of gases: Principle underlying liquefaction of gases: Joule Thomson effect, Joule Thomson experiment: Show that Joule Thomson effect is an isoenthalpic process ( $\Delta H = 0$ ). Joule Thomson coefficient, Inversion temperature, definitions and its relation between Vander Waal's constants ('a' and 'b').

**Unit-8:** Indicator: Definitions, types (acid-base, redox, adsorption indicators), examples for each type. Theory of indicators: Oswald's theory and Quinonoid theory: indicator constant: action of phenolphthalein and methyl orange in acid-base solutions: pH titration curves for strong acid vs strong base, weak acid vs strong base, weak base vs strong acid, choice of indicators in these types of titrations: color change and pH range, Universal indicator: definition.

## **BLOCK: 3: Organic Chemistry**

**Unit-9:** Definition and importance of organic compounds, classification of organic compounds, Tetravalency of carbon,  $sp^3$ ,  $sp^2$  and  $sp$ : hybridization (in brief). Bond length, bond angle, bond energy, localized and delocalized chemical bonds: resonance and hyperconjugation effects, isomerism and their different types

**Unit-10:** Alkanes: General formula and IUPAC nomenclature, properties, Preparation by Corey-House reaction, conversion of alkanes to aromatic compounds via alkenes and alkynes- aromatization and pyrolysis, reactions of alkanes.

Alkenes: General formula, and IUPAC nomenclature, geometrical isomerism in alkenes, Preparation of alkenes by Witting's reaction, Hoffmann's elimination, reactions of alkenes: electrophilic addition, oxymercuration, reduction, hydroboration: oxidation and epoxidation reactions and their mechanisms, oxidation with  $\text{KMnO}_4$  and  $\text{OsO}_4$ , ozonolysis, industrial applications of ethane and propene.

**Unit-11:**Dienes: Types, relative stabilities of dienes, conjugated dienes: 1,3 butadiene-structure, 1,2 and 1,4- addition reactions with  $\text{H}_2$  and halogens, Diels-Alder reaction with an example.

Alkynes: General formula, and IUPAC nomenclature, acidity of acetylenic proton, Methods of preparation: dehydrohalogenation from vicinal and geminal dihalides, reactions of alkynes:Electrophilic additions with  $\text{HCN}$ ,  $\text{CH}_3\text{COOH}$  and  $\text{H}_2\text{O}$ , polymerization.

**Unit-12:**Cycloalkanes: General formula, Definition, synthesis, relative stability Bayer's strain theory and its limitations, Sachse-Mohr's theory of strainless rings, Chair and boat conformations of cyclohexane and their stability, structure and stability of higher cycloalkanes (up to ring size 10)

## **SEMESTER: II; PAPER: II**

### **BLOCK: 2.1 Inorganic Chemistry**

**Unit-1:**Ionic bond- Introduction, Factors that favor the formation of ionic bonds, Lattice energy, Born-Landé's equation (no derivation), Born-Haber cycle, setting up of Born-Haber cycle for 1:1 ionic solids, Numerical calculations of LE and EA based on Born-Haber cycle for 1:1 ionic solids, uses of Born-Haber cycle, Role of lattice energy and hydration energy and their importance in the context of stability and solubility of ionic solids.

**Unit-2:**Covalent bond- Introduction, Factors favoring the formation of covalent bond (ionization energy, electron affinity, electronegativity, nuclear charge, inter nuclear distance and number of valence electrons). Valence bond approach: explanation with examples ( $\text{H}_2$ ,  $\text{F}_2$ ,  $\text{HF}$ ,  $\text{O}_2$  and  $\text{N}_2$ ) to illustrate valence bond approach. Sigma and Pi bonds: explanation by taking  $\text{H}_2$ ,  $\text{O}_2$  and  $\text{N}_2$  as examples.

**Unit-3:**Fajan's rules of polarization and their explanation. Bond length, bond order, bond energy and their significance, polarity of covalent bonds, polar and non-polar molecules, Dipole moment and polarity of molecules to be explained by taking  $\text{HCl}$ ,  $\text{CO}_2$ ,  $\text{CCl}_4$  and  $\text{H}_2\text{O}$  as examples.

**Unit-4:** Hybridization-directional property and geometry of  $sp$ ,  $sp^2$ ,  $sp^3$ ,  $sp^3d$  and  $sp^3d^2$  hybrid orbitals taking  $BeCl_2$ ,  $BF_3$ ,  $SiCl_4$ ,  $PCl_5$  and  $SF_6$  as examples respectively. VSEPR theory with  $SO_2$ ,  $NH_3$ ,  $H_2O$ ,  $SF_4$  and  $ClF_3$  as examples.

## **BLOCK: 2 Physical Chemistry**

**Unit-5:** Adsorption- Introduction, principle involved, Sorption, absorption and adsorption (statement, differences and examples) physical and chemical adsorption: definition and differences, Adsorption of gases on solids: factors which influence, Adsorption isotherms (definition): mathematical expression for Freundlich's and

Langmuir's adsorption isotherms, Applications of adsorption.

**Unit-6:** Liquid mixtures: Classification of binary mixtures: partially miscible, completely miscible and completely immiscible pairs of liquids (explanation with examples for each type). Raoult's law, definition of ideal and non-ideal solutions based on Raoult's law.

Partially miscible liquids: Critical solution temperature (CST): types: phenol-water system, triethylamine-water system, nicotine-water system (mutual solubility temperature (MST) vs composition curves to be drawn). Effect of addition of non-volatile solute on CST. Binary mixtures of completely miscible liquids.

**Unit-7:** Vapour pressure: definition, vapor pressure: composition diagrams and boiling point: composite diagrams. Classification into the types: obeying Raoult's law (type I), showing positive deviation from Raoult's Law (type II) and showing negative deviation from Raoult's Law (type III): examples for each type.

Principles of fractional distillation: Fractional distillation of type I, type II and type III liquid mixtures (with examples). Azeotropic mixtures (definition).

Binary mixtures of completely immiscible liquids (with examples), weight fraction of distillates, principle of distillation, applications (numerical problem on weight fractions of components).

**Unit-8:** Polymers: Introduction, monomer, repeating units, types (linear, branches and network) with examples, degree of polymerization, classification (arrangement and shape) with examples, polymerization reaction (addition and condensation), molar masses of polymers: types (number average and mass average), determination of molar mass (viscosity and osmotic pressure method) (Numerical problems).

## **BLOCK: 3 Organic Chemistry**

**Unit-9:** Aromatic hydrocarbons: Nomenclature of benzene derivatives, Resonating structures of benzene, naphthalene and anthracene. Huckel's rule with respect to benzenoids, (benzene, naphthalene, anthracene and phenanthracene) Aromatic electrophilic substitution: General mechanism, electronic interpretation of orientating influence of electron donating groups ( $-\text{CH}_3$ ,  $-\text{Cl}$ ,  $-\text{NH}_2$  and  $-\text{OH}$  groups) and electron withdrawing groups ( $-\text{NO}_2$ ,  $-\text{CHO}$ ,  $-\text{COOH}$  and  $-\text{SO}_3\text{H}$  groups) on electrophilic substitution reactions.

**Unit-10:** Non-benzenoid compounds, Huckel's rule with respect to non-benzenoid compounds (cyclopentadienyl anion, cycloheptadienyl cation) anti-aromaticity.

Hydrogenation of aromatic compounds: Birch reduction, side chain oxidation of toluene to benzaldehyde and benzoic acid. Diels-Alder reactions of anthracene with maleic anhydride. Biphenyls: Preparation: Ullmann reaction.

Alkenyl Benzenes: Cis and Trans stilbene and their preparation (any one method).

**Unit-11:** Alcohols: Definition and classification, IUPAC nomenclature, Monohydric alcohols: Preparation of alcohols from alkene, carbonyl compounds, and carboxylic acids, Distinction tests between  $1^\circ$ ,  $2^\circ$ , and  $3^\circ$  alcohols by Victor Meyer oxidation method. Conversion of  $1^\circ$  to  $2^\circ$ ,  $2^\circ$  to  $3^\circ$  and  $1^\circ$  to  $3^\circ$  alcohols. Dehydration of  $1^\circ$ ,  $2^\circ$ ,  $3^\circ$  alcohols and comparison of their rates, Reactions: With sodium,  $\text{HX}$  (Lucas test), esterification, oxidation (with PCC, alk.  $\text{KMnO}_4$ , acidic dichromate, conc.  $\text{HNO}_3$ ), Oppenauer oxidation.

**Unit-12:** Dihydric alcohols: Glycol: preparation from vicinal dihalides and uses. Pinacoles: synthesis, mechanism of pinacol-pinacolone rearrangement.

Trihydric alcohols: Glycerol, synthesis from propene, reactions with  $\text{HNO}_3$ ,  $\text{H}_2\text{SO}_4$ , oxalic acid and  $\text{HI}$ . Uses of glycerol.

Ethers: IUPAC Nomenclature, synthesis, reactions: cleavage and auto-oxidation-Ziesel's method. Epoxides: Synthesis by Darzen's method. Acid and base catalyzed opening of epoxides. Crown ethers: Introduction with examples

Phenols: Definition, classification with examples, acidity of phenols, effect of substituents on acidity of phenols. Mechanism of Reimer-Tiemann reaction and Kolbe reaction, Houben-Hoesch Condensation, Schotten-Baumann Reaction.

## **BLOCK: 3.1 Inorganic Chemistry**



**Unit-1:**Molecular Orbital Theory: An elementary account of MOT, linear combination of atomic orbitals (no mathematical approach). Bonding and antibonding molecular orbitals, conditions for the combination, energy levels of molecular orbitals, Molecular orbital structures and bond orders of species like  $H_2$ ,  $He_2$ ,  $He_2^+$ ,  $N_2$ ,  $O_2$ ,  $HF$ ,  $LiH$ , and  $CO$ , Prediction of magnetic properties of these species.

**Unit-2:**Metallic bond: Definition, factors favouring the formation of metallic bond, Band theory, explanation of electrical conductance of metals, semiconductors (n- and p-type), Insulators and Superconductors (explanation and applications with suitable examples).

Hydrogen bonding: Types of hydrogen bonding, conditions for the formation of H-bond. Hydrogen bonding in  $HF$ ,  $H_2O$ ,  $NH_3$ , alcohols, carboxylic acids and nitrophenols. Appropriate anomalous properties like physical state, boiling point and solubility. Structure of ice. Theories (or nature) of hydrogen bond(electrostatic approach, VBT and MOT treatments)

**Unit-3:**Noble gases: Isolation from air by Rayleigh's method, preparation, separation of Noble gases-Dewar's method. Preparation, Structure and applications of compounds of Xenon and Krypton ( $XeF_2$ ,  $XeOF_2$ ,  $XeO_3$ ,  $KrF_2$ ,  $KrF_4$ ,  $KrO_3XH_2O$ -one method of preparation for each), Clathrates (explanation with suitable examples, essential conditions for the formation and uses).

**Unit-4:**s-block elements: alkali and alkaline earth metal, occurrence and abundance, electronic structure, general physical properties: size of atoms, and ions, density, ionization energy, electronegativity and bond type, melting and boiling points, flame colour and spectra, structures of the metals, hardness and cohesive energy, chemical properties, reactions with air, water, dinitrogen, oxides, hydroxides, peroxides and superoxides, anomalous properties of Lithium and Beryllium.

### **BLOCK: 3.2 Physical Chemistry**

**Unit-5:**Colligative Properties: Concept of vapour pressure, variation of vapour pressure with temperature. Definition of boiling point and freezing point, effect of dissolution of solute on the vapour pressure of the solvent. Lowering of vapour pressure. Raoult's law: relation between relative lowering of vapour pressure and molar mass (to be derived). Determination of relative molar mass of solute by dynamic method. Elevation of boiling point and its relation to lowering of vapour pressure and molar mass (to be derived). Ebullioscopic constant of the solvent and its relation to the boiling point (only equation). Determination of molar mass of the solute by Walker-Lumsden method.

**Unit-6:**Depression in freezing point and its relation to lowering of vapour pressure and molar mass (to be derived). Cryoscopic constant and its relation to the melting point (equation).

Determination of molar mass of a non-volatile solute by Beckmann's method (problems to be worked out). Definition of osmosis, osmotic pressure (mention application), determination of osmotic pressure by Berkley-Hartley's method, laws of osmotic pressure analogy with gas laws, determination of molar mass from osmotic pressure measurements (relation to be derived), isotonic solutions, Semi permeable membrane: natural and artificial, preparation of copper ferrocyanide membrane by Morse- Frazer method, plasmolysis.

**Unit-7:** Distribution Law: Nernst distribution law in liquid-liquid systems, distribution coefficient, statement of Nernst distribution law: verification of distribution law taking distribution of I<sub>2</sub> in H<sub>2</sub>O and CCl<sub>4</sub>: limitations of the law, conditions for the validity of distribution law, association of the solute in one of the solvents, dissociation of the solute in one of the solvents, application of distribution law with respect to solvent extraction process (numerical problems)

**Unit-8:** Physical Properties and chemical constitution: Additive and constitutive properties, properties of liquids: viscosity, definition of coefficient of viscosity, factors affecting viscosity: temperature, size, weight, shape of molecules, intermolecular forces, determination of viscosity of liquids by Ostwald's method.

Surface tension: Definition, effect of temperature on surface tension, effect of solute on surface tension, determination of surface tension of liquids using stalgmometer.

Parachor: Definition: Sugden equation, calculation of parachor and its application with respect to structural elucidation of benzene and quinone, numerical problems based on surface tension, viscosity and parachor applications

### **BLOCK: 3.3 Organic Chemistry**

**Unit-9:** Alkyl Halides: IUPAC Nomenclature, Preparation: from alkenes and alcohols, Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation, Elimination vs substitution, Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides,

Aryl Halides: Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions, Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by: OH group) and effect of nitro substituent. Benzyne Mechanism: KNH<sub>2</sub>/NH<sub>3</sub> (or NaNH<sub>2</sub>/NH<sub>3</sub>).

**Unit-10:** Carbonyl Compounds: Distinction between aldehydes and ketones, structure of carbonyl group, reactivity trend, IUPAC Nomenclature, acidity of  $\alpha$ -hydrogen atom, synthesis of carbonyl compounds by oxidation and reduction method, Reactions of carbonyl compounds:

Addition of alcohols- formation of hemiacetal and acetal, Condensation with  $\text{NH}_2\text{OH}$  and 2,4-DNP. Perkins reaction, Cannizzaro reaction, Claisen condensation, Knoevenagel reaction, Wittig reaction, Benzoin condensation. Clemmensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf-Verley reduction.

**Unit-11:** Reactions of carbonyl compounds: Aldol condensation, Mechanism of aldol condensation, Synthesis of  $\beta$ -Hydroxy Carbonyls and  $\alpha,\beta$ -Unsaturated Carbonyls, The Mixed Aldol Reaction and Regiocontrol Involving Enolates, Enolate Reactions: Synthesis of 1,3-Dicarbonyls, 1,5-Dicarbonyls, and Cyclohexenones, Synthesis of Aromatic Ketones (Friedel-Crafts Acylation) Synthesis of Aromatic Aldehydes (Formylation Reactions), Iodoform reaction, Addition of organomagnesium, organozinc and organocopper reagents to carbonyl group.

**Unit-12:** Carboxylic acids (aliphatic and aromatic), IUPAC nomenclature, Preparation: Acidic and Alkaline hydrolysis of esters. Nitrile, amides, oxidation of alcohols and carbonyl compounds, acidity of carboxylic acid group, Reactions: Hell-Vohlhard - Zelinsky Reaction, Reformatsky Reaction, Perkin condensation,  $\alpha$ -halogenation, decarboxylation,

Derivatives of carboxylic acids: synthesis of Acid chlorides, Anhydrides, Esters, Lactams and Amides and their reactions.

Hydroxy acids: Synthesis of lactic, citric and tartaric acids. One method each and their importance. Effect of heat on  $\alpha$ ,  $\beta$ ,  $\gamma$ -hydroxy acids.

## **BLOCK: 4.1            Inorganic Chemistry**

**Unit-1:** Boron: Boron hydrides: diborane, preparation, structure and uses.

Carbon: allotropy of carbon, Fullerenes: production, structure of  $\text{C}_{60}$  and  $\text{C}_{70}$ , Diamond, graphite: properties and structure.

Silicon: Structure of silica. Silicates: types and structure with one example for each type.

Nitrogen: Preparation, properties, structure and applications of hydrazine, hydroxyl amine and nitrogen trichloride.

**Unit-2:** Sulphur: Preparation, properties, structures and applications of thionyl chloride, sulphuryl chloride and  $\text{SF}_6$ .

Halogens: Bleaching powder: preparation, properties and structure.

Pseudo halogens: Preparation, properties and structure of cyanogen and thiocyanogen (any one method of preparation and any three properties to be discussed).

**Unit-3:**Chemistry of transition elements: Position in the periodic table, electronic configuration, general characteristics- atomic and ionic radii, ionization energy, variable oxidation states, spectral properties, redox potentials, colour and magnetic properties, catalytic activity, complex formation and interstitial compounds formation (3d, 4d and 5d series).

**Unit-4:**Chemistry of inner transition elements: Electronic configuration and position in the periodic table, oxidation states, spectral properties, colour and magnetic properties, complex formation and ionic radii, lanthanide contraction: cause and its consequences. General survey of actinides: comparison with lanthanides, transuranic elements.

## **BLOCK: 4.2                      Physical Chemistry**

**Unit-5:**Ionic equilibria: Ionic equilibria in aqueous solutions, strong and weak electrolytes: definition and examples. Ostwald's dilution law (to be derived) and its limitations (numerical problems). Activity and activity coefficients: definition and their relation. Mean ionic activity coefficients: ionic strength:determination and its calculation. Debye-Huckel theory of strong electrolytes (relaxation time effect, electrophoretic effect and viscous effect).

**Unit-6:**Debye-Huckel-Onsagar equation, Debye-Huckel Limiting equation for activity coefficients, Solvent system concept of acids and bases. Role of solvents in altering strengths of acids and bases, Hydrolysis of salts: derivation of hydrolysis constant and degree of hydrolysis of the salt of weak acid and weak base (ammonium acetate), effect of temperature on degree of hydrolysis.

**Unit-7:**Thermodynamics: Introduction, First Law of Thermodynamics and its limitations of: need for II Law of thermodynamics, spontaneous, non-spontaneous and equilibrium processes (definitions and examples for each), different ways of stating II Law, heat engine (example) Carnot cycle, efficiency of Carnot cycle(derivation), concept of entropy: definition and physical significances of entropy: criteria of spontaneity in terms of entropy change, statements of II law in terms of entropy (numerical problems to be worked out on entropy and efficiency of Carnot engine).

**Unit-8:**Free energy: Helmholtz and Gibb's free energy: their definitions and their relationship, Gibb's:Helmholtz equation at constant pressure and volume (derivations), thermodynamic criteria of equilibrium and spontaneity, variation of free energy with temperature and pressure, Claussius:Clappeyron equation(differential form to be derived), integrated form of Claussius:Clappeyron equation (to be assumed) and its applications (enthalpy of vapourization,

boiling point and freezing point at different temperatures), (numerical problems on these applications), Van't Hoff's reaction isotherms and isochore equations (to be derived).

### **BLOCK: 4.3                      Organic Chemistry**

**Unit-9:**Amines: Definition, classification with example. Separation of amine mixture by Hinsberg's method using toluene sulphonyl chloride. Distinction tests for 1°, 2°, 3° amines (acetylation and Hoffmann's exhaustive methylation. Action of nitric acid on different amines. Both aliphatic and aromatic 1°, 2°, 3° amines, basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Hoffmann-Martius rearrangement.

Diazonium Compounds: preparation, mechanism of preparation and synthetic applications of benzene diazonium chloride. Conversion to phenol, halobenzene, phenyl hydrazine and coupling reaction.

**Unit-10:**Stereochemistry: Introduction, definition, elements of symmetry (plane, centre, simple axes and alternative axes), asymmetry and dissymmetry, Chirality, designation of configuration: R-S notation. Optical activity: explanation: cause of optical activity (non-super impossibility). Enantiomers and diastereomers optical isomerism in tartaric acid and biphenyls, racemisation, resolution, methods of resolution (Chemical and biochemical methods).

**Unit-11:**Geometrical isomerism: Definition with example, designation of cis-trans and E-Z notations with examples. Geometrical isomerization of aldoximes and ketoximes, Beckmann rearrangement, cis-trans conformations in disubstituted cyclohexanone.

Conformational analysis of acyclic molecule: ethane, propane and butane and bicyclic molecule: Decalins and substituted decalines.

**Unit-12:**Active methylene compounds: Definition, ethyl acetoacetate, preparation and keto-enol tautomerism in ethyl acetoacetate- its evidence.

Synthetic applications: Acid hydrolysis, ketonic hydrolysis, mono carboxylic acids, dicarboxylic acid succinic acid, adipic acid, antipyrine, uracil, acetyl acetone, crotonic acid and cinnamic acid.

### **PAPER:VA**

#### **Block-5A.1      Inorganic Chemistry**

**Unit-1:**Nuclear chemistry: Fundamental particles of nucleus- nucleons, isotopes, isobars and isotones (definition with suitable examples), Nuclear forces (brief explanation), nuclear stability- n/p ratio, Mass defect, Binding energy, Inner structure of nucleus- Liquid drop model, Nuclear fission- (definition with suitable examples), Calculation of energy release in nuclear fission, modes of release of fission energy (uncontrolled and controlled), Plutonium as a fissionable material (Plutonium bomb),

**Unit-2:**Nuclear fusion and its advantages over nuclear fission reactions, hydrogen bomb, nuclear transmutation-artificial radioactivity. Detection and measurement of radioactivity: G. M. counter. Cyclotron, Nuclear reactor, Breeder reactor, Q values of nuclear reactions. Uses of radio isotopes: tracer technique, agriculture, medicine, food preservation and dating (explanation). Separation of uranium isotopes: Laser irradiation method (atomic and molecular routes).

**Unit-3:**Fuels: Definition, classification with examples: characteristics, calorific value, determination of calorific value of a solid or liquid fuel. Applications of gaseous fuels. Compressed natural gas, water gas, producer gas and LPG: their production, composition and applications Propellants: Definition, characteristics, classification and applications.

**Unit-4:**Abrasives: Definition, classification with examples: hardness, manufacture and applications of carborundum, alundum and tungsten carbide.

Refractories: Definition, properties, classification with examples. Different steps involved in the manufacture of refractories. Applications of refractories. Explosives: Definition, classification with examples, characteristics of explosives. Preparation and uses of dynamite, cordite and RDX.

## **BLOCK-5A.2      Physical Chemistry**

**Unit-5:**Crystallography: Elements of symmetry: plane, axis and center, elements of symmetry in cubic crystals, law of rational indices: Weiss and Miller indices, lattice planes in cubic crystals. Crystal lattice and unit cell, types of Lattice: Bravais lattices.

**Unit-6:**X-Ray diffraction and Bragg's Law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg's spectrometer, application of X-ray studies: distance between lattice planes, density of crystals, determination of Avogadro Number (numerical problems on applications).

**Unit-7:**Liquid Crystals: Definition, classification of thermotropic liquid crystals into smectic and nematic with examples-molecular arrangement of these and their uses.

**Unit-8:**Nanotechnology: Definition, uses and nature of nanotechnology, Nanomaterials- definition, properties and applications, Carbon nanotubes- definition, types, methods of

preparation (mention), properties and industrial applications of carbon nanotubes, Nanowires- definition, types, production of crystalline nanowires by vapour- liquid-solid synthesis method, applications of nanowires.

### **BLOCK-5A.3**                      **Organic Chemistry**

**Unit-9:** Organometallic compounds: Definition with example, organo zinc compounds: preparation of diethyl zinc and its applications. Organo magnesium compounds (Grignard reagent)- preparation and applications Organolithium Compounds- Preparation and synthetic applications. Organocopper reagents- Preparation and synthetic applications.

**Unit-10:** Active methylene compounds: Definition, ethyl acetoacetate, preparation and keto-enol tautomerism in ethyl acetoacetate- its evidence.

Synthetic applications: Acid hydrolysis, ketonic hydrolysis, mono carboxylic acids, dicarboxylic acid succinic acid, adipic acid, antipyrine, uracil, acetyl acetone, crotonic acid and cinnamic acid.

**Unit-11:** Amines: Definition, classification with example. Separation of amine mixture by Hinsberg's method using toluene sulphonyl chloride. Distinction tests for 1°, 2°, 3° amines (acetylation and Hoffmann's exhaustive methylation. Action of nitric acid on different amines. Both aliphatic and aromatic 1°, 2°, 3° amines, basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Hoffmann-Martius rearrangement.

**Unit-12:** Diazonium Compounds: preparation, Sandmeyer reaction, mechanism of preparation and synthetic applications of benzene diazonium chloride. Conversion to phenol, halobenzene, phenyl hydrazine and coupling reaction, Nitro and nitroso compounds- preparations and synthetic applications.

### **PAPER:VB**

### **BLOCK:5B.1**                      **Inorganic Chemistry**

**Unit-1:** Coordination Chemistry: Ligands, classification of ligands and chelation, nomenclature of co-ordination compounds, physical methods in the study of complexes: change in conductance, colour and pH. Stability of complexes: stability constant, a brief outline of thermodynamic stability of metal complexes, factors affecting the stability of complexes. Polynuclear complexes, inner metallic complexes.

**Unit-2:** Isomerism in co-ordination complexes: Stereo-isomerism: Geometrical and optical isomerism exhibited by co-ordination compounds of co-ordination number 4 and 6.

### **Unit-3:** Metal-ligand bonding in transition metal complexes:

Valence bond theory: Salient features, formation of octahedral complexes on the basis of VBT, outer and inner orbital octahedral complexes-  $[\text{Fe}(\text{CN})_6]^{4-}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$ ,  $[\text{Co}(\text{CN})_6]^{3-}$ ,  $[\text{CoF}_6]^{3-}$ ,  $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$  and  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$ . Formation of tetrahedral and square planar complexes on the basis of VBT:  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Cu}(\text{NH}_3)]^{2+}$ ,  $[\text{Zn}(\text{NH}_3)_4]^{2+}$  and  $[\text{Ni}(\text{CO})_4]$ , limitations of VBT.

**Unit-4:** Crystal field theory: Important features of crystal field theory, crystal field splitting of d-orbitals in tetrahedral, octahedral and square planar complexes, crystal field stabilization energy (CFSE), factors affecting the magnitude of  $\Delta_o$ , (nature of ligand, oxidation state of the metal ion, size of the orbitals, geometry of the complex) high spin (HS) and low spin (LS) complexes, magnetic properties of metal complexes based on crystal field theory- $[\text{Co}(\text{NH}_3)_6]^{3+}$ ,  $[\text{CoF}_6]^{3-}$ ,  $[\text{Fe}(\text{CN})_6]^{4-}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$  and  $[\text{Ni}(\text{CN})_4]^{2-}$ . Magnetic susceptibility, measurement of magnetic moment by Gouy's method. Limitations of CFT

## **BLOCK-5B.2                      Physical Chemistry**

**Unit-1:** Electrochemistry-I: Introduction, conductance: specific conductance, equivalent conductance and molar conductance: their definitions and SI units. Conductance cell and cell constant. Determination of equivalent conductance by meter: bridge method, ionic mobility, ionic conductance, Kohlrausch's law and its significance: determination of equivalent conductance at infinite dilution for weak electrolyte.

**Unit-2:** Transport number: Definition and explanation, anomalous transport number: explanation with examples, relationship between ionic conductance and transport number (to be derived), determination of transport number by moving boundary method: transport number of  $\text{H}^+$  using  $\text{CdCl}_2$  as supporting electrolyte (numerical problems on equivalent conductance, transport numbers and Kohlrausch's law).

**Unit-3:** Application of conductance measurements: (a) solubility and solubility product of sparingly soluble salt, (b) ionic product of water, (c) degree of ionization of weak electrolyte. Numerical problems for the applications of a, b and c to be worked out. Conductometric titration: strong acid vs strong base, weak acid vs strong base, strong acid vs weak base, weak acid vs weak base, with suitable examples for each.

**Unit-4:** Phase equilibria: Gibb's phase rule: definition of the terms with examples, application to one component system (water system), reduced phase rule: statement, reduced systems, two component system: simple eutectic type KI-water system, freezing mixtures, Pb-Ag system (desilverization of argentiferous lead)



### **BLOCK-5B.3**

### **Organic Chemistry**

**Unit-5:** Heterocyclic Compounds: Definition, classification with examples, synthesis of furan, thiophene, pyrrole, pyridine, indole (Fischer method) quinoline (Skrap's synthesis with mechanism), isoquinoline, pyrimidine (one method each), aromaticity and basicity of pyrrole and pyridine. Electrophilic substitution reactions of pyrrole and pyridine.

**Unit-6:** Carbohydrates: Definition and importance, classification based on composition with examples-reducing and non-reducing sugars.

Monosaccharides: Glucose: reactions of glucose (with  $\text{H}_2\text{N}-\text{OH}$ ,  $\text{HCN}$ ,  $\text{C}_6\text{H}_5\text{NHNH}_2$ ,  $\text{Br}_2$  water, Conc.  $\text{HNO}_3$ , reductions with  $\text{HI/red P}$ , methanols, (dry  $\text{HCl}$ ), acetic anhydride and reduction reactions.

Structural elucidation of glucose: Open chain structure, configuration, drawbacks of open chain structure, ring structure.

**Unit-7:** Fischer and Haworth structure. Determination of ring size by methylation method. Fischer and Haworth structures of fructose, galactose and mannose.

Conversion reactions: 1. Ascending (Kiliani's synthesis) 2. Descending (Wohl's degradation) 3. Aldose to ketose 4. Ketose to Aldose 5. Epimerisation

Disaccharides: Structural elucidation of sucrose, structural formulae of maltose and lactose (Haworth structure).

Polysaccharides: Partial structural formulae of starch, cellulose, glycogen and their uses.

**Unit-8:** Alkaloids: Definition, classification based on heterocyclic rings- isolation, synthesis and structural elucidation of nicotine and morphine, physiological importance of alkaloids.

Uric acid: Elucidation of structure and synthesis by Fischer's method, conversion of uric acid to purine and caffeine.

### **PAPER:VC**

### **BLOCK-5C.1**

### **Inorganic Chemistry**

**Unit-1:** Non-aqueous solvents: Liquid ammonia-reasons for the solvent properties, typical reactions- solubility of alkali metals; acid-base, precipitation, ammonolysis, Ionization of weak acids, advantages and disadvantages.

Liquid  $\text{SO}_2$ -reasons for the solvent properties, typical reactions-acid-base, solvolysis, precipitation, amphoteric and redox

HSAB: Classification of acids and bases as Hard and Soft. Pearson's HSAB concept, acid-base strength, hardness and softness, symbiosis.

**Unit-2:** Metal carbonyls: Definition, classification with examples, nature of M-CO bonding in carbonyls. Preparation, properties and structures of mono nuclear and binuclear metal carbonyls-  $\text{Ni}(\text{CO})_4$ ,  $\text{Cr}(\text{CO})_6$ ,  $\text{Fe}(\text{CO})_5$ ,  $\text{Mn}_2(\text{CO})_{10}$ ,  $\text{Co}_2(\text{CO})_8$ . Applications of EAN rule to mononuclear metalcarbonyls.

**Unit-3:** Metallurgy: Types of metallurgy: Pyrometallurgy: Extraction of Nickel from sulphide ore: general metallurgy followed by Mond's process (purification), manganese from oxide ores: reduction by the Aluminothermite process: refining by electrolytic process.

Hydrometallurgy: Extraction of gold from native ore by cyanide process and refining by quartation process.

**Unit-4:** Nanotechnology: Definition, uses and nature of nanotechnology, Nanomaterials- definition, properties and applications, Carbon nanotubes- definition, types, methods of preparation (mention), properties and industrial applications of carbon nanotubes, Nanowires- definition, types, production of crystalline nanowires by vapour- liquid-solid synthesis method, applications of nanowires.

## **BLOCK-5C.1            Physical Chemistry**

**Unit-5:**        Electromotive force-I: Electrolytic and electrochemical cells, electrode reaction of Daniel cell, single electrode potential, sign of electrode potential-convention (reduction potential to be adopted), convention of representing a cell, EMF and standard EMF of a cell, cell reaction, reversible and irreversible cells, Nernst equation (to be derived) and calculation of electrode potential.

**Unit-6:**        Standard hydrogen gas electrode, reference electrodes-calomel and Ag-AgCl electrode-construction and working. Electrochemical series and its significance, equilibrium constant and free energy of cell reaction, spontaneity of a cell reaction, Concentration cells. EMF of concentration cells- Definition, explanation: with transference and without transference.

**Unit-7:**        Liquid junction potential and salt bridge. (Numerical problems on Nernst equation and EMF calculations). Fuel cells: Working of  $\text{H}_2$ - $\text{O}_2$  fuel cell and its importance.

**Unit-8:**Electromotive force-II: Application of EMF measurements: (a) Determination of pH of a solution using quinhydrone electrode and glass electrode (using dip type Calomel electrode): Explanation with principle and procedure. (b) Potentiometric titration: principle, location of end points in - (1) Neutralization reactions [NaOH Vs HCl] (2) Oxidation-reduction reactions [K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> Vs FAS] (3) Precipitation reaction [KCl Vs AgNO<sub>3</sub>] and (4) Complexometric reactions (ZnSO<sub>4</sub> Vs K<sub>3</sub>[Fe(CN)<sub>6</sub>])

### **BLOCK-5C.3            Organic Chemistry**

**Unit-9:**Chromatography: Paper: introduction to ascending, descending and circular, R<sub>f</sub> value and it's applications

TLC: Introduction and applications

Column Chromatography: Introduction, principle and experimental details and applications

Gas Chromatography: Introduction, apparatus, programmed temperature gas chromatography, quantitative analysis of GLC

HPLC: Introduction, schematic diagram of instrumentation and application.

**Unit-10:**Amino acids: Structure of  $\alpha$ -amino acids, peptide bond, protecting groups-Boc, Z, Fmoc groups, use of HOBt and HOAt.

Vitamins: Definition, classification, structural elucidation and synthesis of Vit-A, Synthesis of Vit-C, structural formulae of Vit B1, B2, B6, calciferol, E and K and their importance.

**Unit-11:**Terpenes: Definition, isoprene rule, classification, isolation (solvent extraction and steam distillation) structural elucidation of citral and its synthesis, structural formulae of  $\alpha$ -terpeniols, camphor and menthol.

Natural Pigments: Introduction to anthocyanines, structural formulae and their importance of antho cyanins,  $\beta$ -carotene and haemoglobin.

**Unit-12:**Special techniques in organic synthesis:

a) Polymer supported reagents: introduction, properties of polymer support-advantages of polymer support reagents, choice of polymers, types and applications.

b) Phase transfer catalysis: introduction, definition, types, preparation, mechanism and advantages.

c) Microwave induced organic synthesis: introduction, reaction vessel, reaction medium, advantages, limitations, precaution and applications.

d) Sonochemistry: use of ultra sound in organic synthesis, introduction, instrumentation, physical aspects, types and applications.

## **PAPER-6A**

### **BLOCK-6A.1            Inorganic Chemistry**

**Unit-1:**Inorganic polymers: Definition: examples, general properties, comparison with organic polymers, glass transition temperature

Silicones: Definition, nomenclature, preparation (linear, cross- linked and cyclic). Factors affecting the nature of silicon polymers, properties (chemical and thermal stabilities, chemical properties) uses of silicon polymers, silicon fluids/oils: uses, silicon elastomers: rubbers, silicon resins (preparation and uses)

**Unit-2:**Phosphazenes: Definition, types, structures, preparation, properties and uses. Crystalline polymetaphosphates:Maddrell's and Kuroll's salts: properties and uses. Nature of bonding in phosphazenes.

Fluorocarbons: Definition, examples, preparation, properties and uses of Freon-12, Freon-22, PTFE and poly per fluorovinyl chloride

**Unit-3:**Paints: Constituents and their functions, manufacture of lithopone and titanium dioxide.

Fertilizers: Definition and classification, manufacture of nitrogeous fertilizers: CAN and urea. Phosphatic fertilizers: calcium dihydrogen phosphate, NPK type fertilizers.

**Unit-4:**Fuels: Definition, classification with examples: characteristics, calorific value, determination of calorific value of a solid or liquid fuel. Applications of gaseous fuels. Compressed natural gas, water gas, producer gas and LPG: their production, composition and applications.

Propellants: Definition, characteristics, classification and applications.

### **BLOCK-6A.2            Physical Chemistry**

**Unit-5:**Crystallography: Elements of symmetry: plane, axis and centre, elements of symmetry in cubic crystals, law of rational indices: Weiss and Miller indices, lattice planes in cubic crystals. Crystal lattice and unit cell, types of Lattice: Bravais lattices, X-Ray diffraction and Bragg's Law (to be derived), determination of crystal structure of rock salt by rotating crystal method using Bragg's spectrometer,

**Unit-6:**Application of X-ray studies: distance between lattice planes, density of crystals, determination of Avogadro Number (numerical problems on applications).

Liquid Crystals: Definition, classification of thermotropic liquid crystals into smectic and nematic with examples-molecular arrangement of these and their uses.

**Unit-7:**Spectrophotometry and photochemistry: Lambert: Beer's law: statement and mathematical form (to be derived). Molar extinction coefficient: definition: spectrophotometer: construction and working, its application.

Laws of photochemistry:Grotthus-Draper law of photochemical activation and Einstein's law of photochemical equivalence, quantum efficiency, reasons for low quantum yield (HBr formation as example) and high quantum yield (HCl formation as example), actinometry: Uranyl oxalate actinometer.

**Unit-8:**Photophysical processes: Definition with examples: photosensitization (eg. photosynthesis in plants), photo inhibition, fluorescence, phosphorescence, chemiluminescence and bioluminescence with examples. Determination of absorbed intensity: schematic diagram of apparatus used. Detectors: thermopile,photoelectric cell and actinometer (Uranyl oxalate).

### **BLOCK-6A.3      Organic Chemistry**

**Unit-9:**UV-visible spectroscopy: Introduction, chromophores and auxochrome, blue shift and red shift, graphical representation of spectra of 1,3-butadiene, benzene and lycopene. Influence of conjugation on UV absorption-comparison of UV spectra of acetone and methylvinyl ketone

**Unit-10:**IR-Spectroscopy: Introduction, stretching frequency of:OH (free and H-bonded), alkyl:C-H, C=C, C=C, C-C, C=O and C-O groups (by taking suitable examples). Graphical representation of IR spectra of benzoic acid and methyl benzoate

**Unit-11:**NMR Spectroscopy: Basic principles of proton magnetic resonance , nuclear magnetic spin quantum number I, influence of the magnetic field on the spin of nuclei, spin population, saturation using radio frequency, nuclear magnetic resonance-chemical shift (  $\delta$  value), uses of TMS reference, nuclear shielding effects, equivalent and non-equivalent protons, spin-spin splitting and coupling.

**Unit-12:**Applications of NMR spectroscopy to simple organic molecules (like ethyl alcohol, ethane, propane, ethylene, methylamine, aniline, benzene, toluene, acetone, acetophenone, methyl cyanide and other simple molecules.

## **PAPER-6B**

### **BLOCK-6B.1            Inorganic Chemistry**

**Unit-1:**Gravimetry: Introduction to gravimetric analysis: precipitation methods (various steps involved to be discussed), advantages of gravimetric analysis, purity of the precipitates, co-precipitation and post precipitation, conditions of precipitation, precipitation from homogeneous solution (hydroxides and sulphates), washing and ignition of precipitate (general discussion only). Electro-gravimetric analysis estimation of copper. Organic precipitants: Advantages of organic precipitants over inorganic precipitants, DMG, 8-hydroxy quinoline (Oxine), 1,10-phenanthroline and EDTA. Structure of  $\text{Ni}^{2+}$ -DMG and  $\text{Mg}^{2+}$ -oxine complexes

**Unit-2:**Glasses, Ceramics and composite: Glasses, Ceramics Composites and Nano-materials: Glassy state, glass formers and GlassModifiers. Glasses, Ceramics, Clay products, Refractories with reference to: preparation, Properties and applications. Microscopic composites, dispersion, strengthened and particlereinforced, fibre reinforced Composites, microscopic composites, nanocrystalline phase, preparation procedure, special properties and applications,

Ores: Composition and analysis of the followings ores- Bauxite, Pyrolusite, Dolomite, Chromite.

Portland cement: Composition, raw material, manufacturing processes, characteristics, analysis

**Unit-3:**Analysis of alloys: Definition of alloy, Phase diagrams of Fe-C, Pb-Sn, Pb-Ag systems and their applications. Types of steel: hypoeutectic, hypereutectic steels, mild steel, and stainless steel. Uses of steel. Composition and uses of brass, bronze and soldering alloy. Analysis of iron, nickel, chromium and manganese in steel. Analysis of copper and zinc in brass, lead and tin in soldering alloy. Industrial applications of alloys.

**Unit-4:**Analysis of petroleum and petroleum products: Introduction, determination of flash and fire point, Pensky Marten's apparatus, cloud and pour point, aniline point, drop point, viscosity and viscosity index, Redwood and Saybolt viscometer, API specific gravity, water and sulphur in petroleum products, carbon residue, corrosion stability, decomposition stability, emulsification, neutralization and saponification number.

### **BLOCK-6B.2            Physical Chemistry**

**Unit-5:**Chemical Kinetics: Introduction: differential and integrated rate equations for second order kinetics, derivation of second order rate equation when  $a=b$  and  $a \neq b$ , unit of rate constant, half- life period, experimental verification of second order reactions: study of kinetics of saponification of an ester, determination of the order of reaction: differential, time for half-change method and isolation method.

Experimental methods of chemical kinetics, conductometric: example - saponification of esters.

**Unit-6:**Potentiometric - example: kinetics of bromination of N,N-di-methyl aniline and spectrophotometric: example: colorimetric study of kinetics of oxidation of Indigocarmine by chloramine-T.

Application of kinetic studies: Arriving at the mechanism of urea formation from ammonium cyanate.

**Unit-7:**Phase equilibria: Gibb's phase rule: definition of the terms with examples, application to one component system (water system), reduced phase rule: statement, reduced systems, two component system: simple eutectic type KI-water system, freezing mixtures, Pb-Ag system (desilverization of argentiferous lead)

**Unit-8:**Radiation Chemistry: Definition, primary and secondary stages in radiochemical reactions, ionic yield, energy yield, comparison with photochemistry, units of radiation: rad, gray and roentgen, Dosimeter: Fricke dosimeter, theories of radiolysis: Lind's and EHT theories. Radiolysis of water vapour, benzene and acetic acid

### **BLOCK-6B.3            Organic Chemistry**

**Unit-9:**Substitution reactions: Nucleophilic substitution reaction, SN1 and SN2 with energy profile diagram. Stereochemistry and mechanism of SN1 and SN2 reaction, Walden inversion, Factors affecting the rate of SN1 and SN2 reactions- nature of alkyl groups, nature of leaving groups, nucleophiles and solvents.

**Unit-10:**Elimination reactions: E1 and E2 reactions, mechanisms of E1 and E2 reactions, Stereochemistry of elimination reactions- Anti and Syn, Factors affecting the rate of E1 and E2 reactions- nature of alkyl groups, nature of leaving groups, nucleophiles and solvents, Substitution v/s Elimination reactions. E1CB reactions,

**Unit-11:**Addition reactions: Additions to Alkenes and Alkynes, Syn Additions, Anti Additions, Additions to Carbonyls- Diastereoselectivity in Acyclic Systems: Cram's Rule, Felkin:Anh Model, Chelation Control by Neighboring Groups, Addition to Cyclohexanones, Additions to Enolates- Formation of (E) and (Z) Enolates.

**Unit-12:** Synthesis of cyclic compounds: Synthesis of Cyclopropanes, Synthesis of Cyclobutanes, Synthesis of Five-Membered Rings (Radical Cyclization Reactions), Baldwin's Rules, Synthesis of Six-Membered Rings (Diels:Alder Reaction)- The Dienophile (E+), The Diene (Nu:) Regiochemistry of the Diels:Alder: 1,2-Disubstituted Product Is Preferred Over 1,3, 1,4-Disubstituted Product Is Preferred Over 1,3. Robinson annulation.

## **PAPER- 6C**

### **BLOCK-6C.1      Inorganic Chemistry**

**Unit-1:** Introduction, Components of Environment, Biosphere, Lithosphere, Hydrosphere and Atmosphere, Ecological principles- aspects of ecology, classification, types of ecosystems. Environmental Pollution and Environmental Pollutants, Some Commonly used terms in Environmental Pollution, Types of Pollution, Smog, Greenhouse Effect and Global Warming, Ozone Layer and its Depletion (Stratospheric Pollution), Soil or Land Pollution, Strategies to Control Environmental Pollution, Green Chemistry as an Alternative Tool for Reducing Pollution

**Unit-2:** Water pollution and analysis: Sources of water pollution, composition of potable water, importance of water analysis, sampling and sample preservation, physico-chemical analysis of water. Mineral analysis (temperature, pH, conductivity, turbidity, solids, alkalinity, chloride, fluoride, sulphates, hardness), Demand analysis (DO, BOD, COD, TOC), nutrients (nitrogen-total, nitrate, nitrite, phosphate) and heavy metals (As, Cd, Cr, Hg and Pb). A brief idea of coagulation and flocculation. Water treatment plants: Sand filters and other types of filters.

**Unit-3:** Air pollution and analysis: Air pollution and analysis-classification of air pollutants, sources of air pollution and methods of control, sampling of aerosols and gaseous pollutants and their effects, SO<sub>2</sub>, NO<sub>2</sub>, CO, CO<sub>2</sub>, particulates-SPM, RSPM, High Volume Sampler, Fabric Filters, Cyclones (direct and Reverse), ESP,

Thermal pollution—sources, harmful effects and prevention of thermal pollution.

Noise pollution --- sources, effects and control of noise pollution

**Unit-4:** Bio-inorganic chemistry: Essential and trace elements in biological process, metalloporphyrins with special reference to haemoglobin and myoglobin, oxygen uptake, structure and functions of haemoglobin, myoglobin, Oxygenation and deoxygenation, biological role of alkali and alkaline earth metal ions with respect to Na<sup>+</sup> and Ca<sup>2+</sup> ions, Photosynthesis and nitrogen fixation reactions.



## **BLOCK-6C.2 Physical Chemistry**

**Unit-5:** Molecular Spectroscopy: Regions of spectra, types of spectra, microwave spectra: rotational spectra of diatomic molecules, moment of inertia (expression to be derived). Expression for rotational energy, selection rule and transition, calculation of bond length, Isotopic effect.

**Unit-6:** IR Spectra: vibrational spectra of diatomic molecules: force constant (no derivation), expression for vibrational energy, zero point energy. Selection rule and transitions. Vibrational modes of polyatomic molecules taking H<sub>2</sub>O and CO<sub>2</sub> molecules as examples. Applications of IR spectroscopy (mention).

**Unit-7:** Raman Spectra: Concept of polarizability, pure rotation, vibration (qualitative study) Stokes's and anti-Stokes's lines, selection rule, applications (mention)

Electronic Spectra: Potential energy curves for bonding and antibonding molecular orbitals, band theory, electronic transitions, qualitative description of non-bonding orbitals and transition between them. Selection rule and Franck Condon principle.

**Unit-8:** Lattice Defects: Perfect & Imperfect crystals, point defects, Interstitial, Schottky defect, Frenkel defect, line defect & other entities, thermodynamics of Schottky & Frenkel defects. Dissociation, theory of dislocation, plane defects- Line boundary, grain boundary, stacking fault, 3D defects, Defects & their concentrations, ionic conductivity in solids, Non stoichiometric compounds.

Electronic properties of Non-stoichiometric oxides.

## **BLOCK-6C.3 Organic Chemistry**

**Unit-9:** Green Chemistry: Purpose, principles to be followed for green chemistry. Synthesis of acetamide, ibuprofen, benzoin, benzoic acid and para-bromo acetanilide.

Natural Pigments: Introduction to anthocyanins, structural formulae and their importance of anthocyanins,  $\beta$ -carotene and haemoglobin.

**Unit-10:** Organic Polymers: Monomer and repeating units, Condensation polymers, addition polymers, natural polymer- rubber, vulcanization of rubber, silk, hair, synthetic polymer- polystyrene, PVC, PEG, polyethylene, Nylon 66, terylene, synthesis and their applications, glass transition temperature.

**Unit-11:** Dyes: Colour and constitution, chromophore - auxochrome theory, classification of dyes based on applications with examples, synthesis of indigo and malachite green, structural elucidation of alizarin and its synthesis.

Terpenes: Definition, isoprene rule, classification, isolation (solvent extraction and steam distillation) structural elucidation of citral and its synthesis, structural formulae of  $\alpha$ -terpeniols, camphor and menthol.

**Unit-12: Drugs:** Chemotherapy and chemotherapeutic agents, definition of drugs, types of drugs, antipyretics, analgesics, anesthetics, sedatives, narcotics, antiseptics, antibacterials, antibiotics, antimalarials and sulpha drugs with examples. Synthesis of paracetamol, sulphanilamide, sulphaguanidine

## **Chemistry Syllabus for B.Sc. Practical Course**

**Note:** Students should be trained to use electronic balances      72hr per semester

### **Semester-I: Practical-I**

1. Calibration of: (i) Pipette (ii) Burette (iii) Volumetric flask
2. Preparation of 2N solutions of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ ,  $\text{HNO}_3$ ,  $\text{CH}_3\text{COOH}$  and  $\text{NH}_3$
3. Preparation of standard sodium carbonate solution and standardization of hydrochloric acid solution (methyl orange indicator). Estimation of sodium hydroxide present in the solution using phenolphthalein indicator.
4. Preparation of standard oxalic acid solution and standardization of sodium hydroxide solution. Estimation of sulphuric acid present in the solution
5. Preparation of standard potassium biphthalate solution and standardization of sodium hydroxide solution. Estimation of oxalic acid present in the solution.
6. Preparation of standard oxalic acid solution and standardization of potassium permanganate solution. Estimation of ferrous ammonium sulphate present in the solution
7. Preparation of standard oxalic acid solution and standardization of potassium permanganate solution. Estimation of hydrogen peroxide present in the solution.
8. Estimation of sulphuric acid and oxalic acid in a mixture using standard sodium hydroxide and standard potassium permanganate solutions.
9. Determination of the percentage of available chlorine in the given sample of bleaching powder.
10. Estimation of ferrous and ferric iron in a given mixture using standard potassium dichromate solution.

11. Preparation of standard zinc sulphate solution and standardization of EDTA. Estimation of total hardness of water.

12. Estimation of ammonium chloride using standard sodium hydroxide and standard hydrochloric acid solutions (back titration).

### **Semester-II: Practical-II**

Part 1: Qualitative analysis of mono functional organic compounds through functional group analysis. Determination of physical constant and preparation of suitable derivative of the following class

1. Acids
2. Alcohols
3. Aldehydes
4. Amides
5. Amines
6. Halogenated hydrocarbons
7. Hydrocarbons
8. Ketones
9. Nitro compounds
10. Phenols

Part 2: Organic preparations: Recrystallization and determination of melting point and its importance may be mentioned

1. Acetylation: Preparation of acetanilide from aniline
2. Oxidation: Preparation of benzoic acid from benzaldehyde
3. Reduction: Preparation m-nitrobenzylalcohol from m-nitrobenzaldehyde
4. Hydrolysis: preparation of benzoic acid from ethyl benzoate

### **Semester-III: Practical-III**

Systematic semi-micro qualitative analysis of a mixture of two simple salts (with no interfering radicals) including ionic reactions

The constituent ions in the mixture to be restricted to the following

Anions:  $\text{HCO}_3^-$ ,  $\text{CO}_3^{2-}$ ,  $\text{SO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{NO}_3^-$ ,  $\text{BO}_3^{3-}$ ,  $\text{SO}_4^{2-}$  and  $\text{PO}_4^{3-}$

Cations:  $\text{Pb}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{Cd}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$ ,  $\text{Na}^+$  and  $\text{NH}_4^+$

Note:

1. Mixtures requiring elimination of phosphate and borate should not be given.
2. Combination of anions in 2nd group shall be avoided.
3. Salts that yield double decomposition shall be avoided (like  $\text{BaSO}_4$ ).
4. The combination of two cations in the mixture should belong to different groups. However combinations like  $\text{Mg}^{2+}$  and  $\text{NH}_4^+$  and  $\text{Na}^+$  and  $\text{NH}_4^+$  can be given.

#### **Semester-IV: Practical:IV**

1. Determination of the density using specific gravity bottle and viscosity of a liquid using Ostwald's viscometer.
2. Determination of the density using specific gravity bottle and surface tension of a liquid using stalagmometer.
3. Determination of molecular mass of a non-volatile solute by Walker-Lumsden method.
4. Determination of rate constant of the decomposition of hydrogen peroxide catalyzed by  $\text{FeCl}_3$ .
5. Determination of transition temperature of the salt hydrates.
6. Determination of rate constant of saponification of ethyl acetate titrimetrically.
7. Determination of percentage composition of sodium chloride solution by determining the miscibility temperature of phenol - water system.
8. Determination of the mass present in the given solution of a strong acid using strong base by thermometric titration method.
9. Determination of molecular weight of a polymer material by viscosity measurements (cellulose acetate/methyl acrylate).
10. Study of kinetics of reaction between  $\text{K}_2\text{S}_2\text{O}_8$  and  $\text{KI}$ , second order, determination of rate constant.
11. Determination of distribution coefficient of iodine in water and carbon tetra chloride.

## **Semester-V: Practical-V and VI**

### **Practical-V:**

#### Gravimetric Estimations:

1. Gravimetric estimation of barium as barium sulphate.
2. Gravimetric estimation of iron as iron (III) oxide.
3. Gravimetric estimation of copper as copper (I) thiocyanate.
4. Gravimetric estimation of nickel as nickel dimethylglyoximate.
5. Gravimetric estimation of magnesium as magnesium -8-hydroxy oxinate.
6. Gravimetric estimation of sulphate as barium sulphate.
7. Gravimetric estimation of aluminum as aluminum oxide.
8. Gravimetric estimation of zinc as zinc oxide.
9. Gravimetric estimation of calcium as calcium oxide.
10. Paper chromatographic separation of  $\text{Fe}^{3+}$  and  $\text{Ni}^{2+}$  ions.
11. Paper chromatographic separation of  $\text{Na}^{+}$  and  $\text{K}^{+}$  ions

### **Practical-VI:**

#### Ore and Alloy Estimations:

1. Preparation of standard potassium dichromate solution and estimation of iron in the given sample of hematite by dichromate method.
2. Estimation of percentage of calcium in limestone by oxalate method.
3. Estimation of manganese in the given sample of pyrolusite.
4. Estimation of magnesium in the given sample of dolomite by EDTA method.
5. Estimation of copper in bronze by iodometric method.
6. Estimation of tin in solder using EDTA.

#### Preparation of Inorganic Complexes

1. Preparation of mercurytetrathiocyanatocobaltate(II).
2. Preparation of potassiumtrioxalatoferrate(III).
3. Preparation of ferrous oxalate.

4. Preparation of potassiumbisoxalatodiaquachromate(III).
5. Preparation of chloropentaminecobalt(III)chloride.
6. Preparation of manganese (III)acetylacetonate.

### **Semester-VI: Practical-VII and VIII**

#### **Practical-VII:**

1. Determination of equivalent conductance of the given electrolyte (strong and weak) by using Meter Bridge.
2. Determination of solubility of sparingly soluble salt (like  $\text{BaSO}_4$ ) by conductometric method.
3. Determination of  $K_a$  (dissociation constant of a weak acid) by conductometric method.
4. Determination of rate constant of saponification of ethyl acetate by conductivity measurements.
5. Conductometric titration of strong acid and strong base and weak acid and strong base.
6. Determination of percentage composition of a given mixture containing two miscible liquids by Abbe's refractometer.
7. Potentiometric titration of ferrous ammonium sulphate against potassium dichromate.
8. pH titration of strong acid against strong base (by observing change in pH).
9. Potentiometric titration of mixture of  $\text{HCl}$  and  $\text{CH}_3\text{COOH}$  using  $\text{NaOH}$  solution.
10. Colorimetric estimation of  $\text{Fe}^{3+}$  ion using ammonium thiocyanate as complexing agent.
11. Colorimetric estimation of  $\text{Cu}^{2+}$  ion using  $\text{NH}_4\text{OH}$  as complexing agent.
12. Colorimetric study of kinetics of oxidation of indigocarmine by chloramine-T.

#### **Practical-VIII**

##### **Organic Estimations:**

1. Separation of p- and o- nitroaniline by TLC method (Solvent extraction).
2. Separation of p- and o- nitroaniline by column chromatography.
3. Estimation of glucose by Fehling solution method.
4. Estimation of Phenol by acetylation method.

5. Estimation of ascorbic acid by iodometric method.
6. Determination of Iodine value of oils by chloramine-T.
7. Isolation of Caffeine from tea powder.
8. Isolation of Castor oil from Castor seeds.
9. Estimation of neutral amino acids by titrametric method.
10. Estimation of carboxylic acid by titrametric method.
11. Estimation of  $\text{NH}_2$  group by acetylation method.
12. Determination of saponification value of oils.

### **Reference textbooks**

#### **Inorganic chemistry**

1. *A Text book of Inorganic Chemistry; P. L. Soni, Sultan Chand & Sons*
2. *A Text book of Inorganic Chemistry; B. R. Puri & L. Sharma, Shobhanlal Nagin Chand Co.*
3. *Principles of Inorganic Chemistry; Puri, Sharma & Kalia Shobhanlal Nagin, Chand Co.*
4. *A Text book of Inorganic Chemistry; Gurudeep Raj, Krishna Prakashan Media (P) Ltd*
5. *Concise Inorganic Chemistry; J. D. Lee, Well Science Ltd.*
6. *A Text book of Inorganic Chemistry; Sathya Prakash & others, S Chand & Co Ltd.*
7. *Basic concepts of Analytical Chemistry; S. M. Khopkar, New Age International*
8. *Selected Topics in Inorganic Chemistry; Madan, Malik & Tuli S. Chand & Company*
9. *A Text book of Inorganic Chemistry; A. K. De, New Age International*
10. *Comprehensive Inorganic Chemistry; O. P. Agarwal; Disha Publication.*
11. *Inorganic Chemistry; Kapoor & Chopra, R. Chand & Co*
12. *Engineering Chemistry; B. K. Sharma, Krishna Prakashan Media P. Ltd.*
13. *Industrial Chemistry; B. K. Sharma, Krishna Prakashan Media P. Ltd.*
14. *Engineering Chemistry; Jayaprakash & Venugopal,*
15. *Engineering Chemistry; Jain and Jain, Dhanpal & Sons, New Delhi*

16. *Hand book of Industrial Chemistry; Riegel's James A. Kent B. S. Publishers & Distributors*
17. *Instrumental methods of Chemical analysis; B. K. Sharma, Goel Publishing House*
18. *Elements of Nuclear Chemistry R. Gopalan Vikas Publishing House*
19. *Industrial Chemistry B. N. Chakarbathy Oxford & IBH Publishers*
20. *Instrumental methods of Chemical analysis; Gurdeep R. Chatwal & Anand Sham, Himalaya Publishing House*
21. *A Textbook Quantitative analysis; A. I. Vogel, ELBS*
22. *A Textbook Quantitative analysis; A. I. Vogel, ELBS*
23. *Management of Water Resources in Agriculture; V. S. Shriramulu,*
24. *Inorganic Polymers; C. R. Chatwal, Himalaya Publishing House*
25. *Theoretical Principles of Inorganic Chemistry; Manku, Tata McGraw Hills*
26. *Advanced Practical Inorganic Chemistry; Gurudeep Raj, Goel Publishing House*
27. *Experimental Inorganic/Physical Chemistry; Mounir A. Malati Howard Series in Chemical science*
28. *University Chemistry; C. N. R. Rao, Mac Millan Company*
29. *A Text book of Inorganic Chemistry; Robinson & Heslop, New Age Publications*
30. *A Text book of Inorganic Chemistry; Emeleus & Anderson, New Age Publications*
31. *A Text book of Inorganic Chemistry; F. A. Cotton & G. Wilkinson, Wiley Interscience*
32. *Analytical Chemistry; Willard, Meritind & Dean, New Age Publications*
33. *Advanced Chemistry; Philip Mathews, Cambridge University Press*
34. *Instrumental methods of Chemical analysis; H. H. Willard, L. L. Merrite, K. A. Dean & F. A. Skettle, CBS Publishers*
35. *A Text book of Inorganic Chemistry; Emelius H. J., Sharpe A. G., University Book Stall New Delhi*
36. *Theoretical Inorganic Chemistry; Dey & Selbin, University Book Stall New Delhi*
37. *Analytical Chemistry; John. H. Chenady, Saunders College, Publishing New York*
38. *Introduction to nanoscience & nanotechnology; Chattopadhyay, PHI*
39. *Nanotechnology fundamentals & applications; Manasi Karkare, IKI NTPC*



40. *Nanotechnology*; Richard Brooker , Earl boyson, Wiley Dream Tech India
41. *Advances in nanoscience & nanotechnology*; Dr. Shuthosh Sharma & Dr. Bellari, CSIR Publications

### **Organic chemistry**

1. *A Text book of Organic Chemistry*; M. K. Jain, S. Chand & Company
2. *A Text book of Organic Chemistry*; Bhal&Bhal., S. Chand & Company
3. *A Text book of Organic Chemistry*; P. L. Soni., S. Chand & Company
4. *Laboratory Manual of Organic Chemistry*; Raj K. Bansal., New Age Publications
5. *Laboratory Manual of Organic Chemistry*; Jayaraman., S. Chand & Company
6. *Chemistry of Natural products*; Aggarwal., Goel Publishing House Meerut
7. *Organic Chemistry*; K. K. Sharma., Shobhanlal&Nagan Company
8. *Organic Chemistry*; Puri& Sharma., Shobhanlal&Nagan Company
9. *Medicinal Chemistry*; Ashuthosh Kar., Tata Mcgraw Hill Publications
10. *Organic Chemistry*; Handrickson., Tata Mcgraw Hill Publications
11. *Organic Synthesis special techniques* V. K. Ahluwalia &Renu Aggarwal Narosa publishing House
12. *Organic Chemistry Vol. I & II* I. L. Finar ELBS
13. *Stereo Chemistry* Eliel John Wiley Eastern Publications
14. *Text Book of Qualitative & Quantitative Organic Analysis*; Arthur Vogel, ELBS
15. *Heterocyclic Chemistry*; Raj K. Bansal, Tata McgrawHill, Publications
16. *Laboratory Manual of Organic Chemistry*; Skoog & West, Prentice-Hall of India Pvt. India
17. *Manual of organic Chemistry*; Dey & Seetharaman, Allied Publishers.
18. *A text book of Practical organic chemistry (Volume-III)*; A. I. Vogel
19. *Practical Organic chemistry*; Mann & Saunders,

### **Physical Chemistry**

1. *Physical Chemistry*; R. P. Verma, Pradeep Publication

- 2 *Kinetics of Chemical Reactions*; S. K. Jain, Vishal publications, Jalandhar New Delhi
- 3 *Physical Chemistry*; M. Kundan & S. K. Jain, S. Chand & Company
- 4 *Text book of Physical Chemistry*; K. K. Sharma & C. K. Sharma, Vani Educational Books
- 5 *Biophysical Chemistry*; Upadhyaya & Upadhyaya, Himalaya Publishing Homes
- 6 *Principles of physical chemistry*; Puri, Sharma & Pathania
- 7 *Essentials of physical chemistry*; B. S. Bahl, Arun Bahl & G. D. Tuli
- 8 *Polymer Science*; V. R. Gowriker, N. V. Vishwanathan & J. Sreedhar
- 9 *Quantum Chemistry (2nd edition)*; A. K. Chandra,
- 10 *Quantum Chemistry*; R. K. Prasad,
- 11 *Colloidal Chemistry*; D. K. Sharma, Goel Prakashan. Meerut
- 12 *Physical Chemistry*; R. L. Madan & G. D. Tuli S., Chand & Company
- 13 *Text book of advanced Physical Chemistry*; Gurudeep Raj, Goel Prakashan. Meerut
- 14 *Principles and Applications of Catalysis*; B. Vishwanath, Narosa Publishing House
- 15 *Engineering Chemistry*; Jain & Jain; Dhanpal & Sons, New Delhi
- 16 *Text Book of Physical Chemistry*; B. D. Khosla, R. Chand & Publications
- 17 *Fundamentals of Molecular Spectroscopy*; Colin N. Banwell & Elaine M. Meeash, Himalaya Publishing Group
- 18 *Physical Chemistry*; Colin N. Banwell, Himalaya Publishing Group
- 19 *Physical Chemistry*; Glasstone, ELBS
- 20 *Text book of Chemical Kinetics*; Laidier, New Age Publication
- 21 *Text book of Photochemistry*; W. Bansal, S. Chand & Company
- 22 *Text book of Thermodynamics*; Glasstone, East-West Press Pvt. Ltd.
- 23 *Text book of Electrochemistry*; Glasstone, East-West Press Pvt. Ltd.
- 24 *Physical Chemistry*; Rakshit,
- 25 *Physical Chemistry*; Pathania & Sharma, Vishal Publications Jalandhar & Delhi

## **9.4 COMPUTER SCIENCE**

### **SEMESTER-I: Basic concepts of computer & C programming language**

**BLOCK-I:Computer Fundamentals:** Introduction to Computer,Characteristics of Computers, Uses of computers, Types and generations of Computers.

Basic Computer Organization - Units of a computer, CPU, ALU, memory hierarchy, registers, I/O devices. Concepts of Hardware and Software,Secondary Storage Devices, language translator.

### **BLOCK-II:Introduction to programming languages**

Evolution of programming languages, structured programming, the compilation process, object code, source code, executable code, operating systems, interpreters, linkers, loaders, algorithms, flow charts.

**C Language Fundamentals:** Character set, Identifiers, Keywords, Data Types, Constant and Variables, Statements, Expressions, Operators, Precedenceof operators, Input-output Assignments, Control structures, Decision making and Branching, Decision making & looping.

**Arrays and Strings:** One dimensional Array, Multidimensional Array declaration and their applications, String Manipulation.

**BLOCK-III:C Functions:** User defined and standard functions, Formal and Actual arguments, Functions category, function prototypes, parameter passing, Call-by-value, Call-by-reference, Recursion, Storage Classes.

**Pointers, Structures, Unions:** Declaration of structures, declaration of unions, pointer to structure & unions.

### **Text Books**

1. Programming in C - Gottfried B.S., TMH
2. The 'C' programming language - B.W.Kernighan, D.M.Ritchie, PHI

### **Reference textbooks:**

1. *Programming in ANSI C - Balaguruswami, TMH*
2. *C The Complete Reference - H.Sohildt, TMH*
3. *Let us C - Y.Kanetkar, BPB Publications*

4. *A Structured Programming Approach using C: B.A. Forouzan & R.F. Gillberg, THOMSON Indian Edition*
5. *Computer fundamentals and programming in C: Pradip Dey & Manas Ghosh, OXFORD*
6. *P. K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 2007.*
7. *Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.*

### **C Programming Lab (Practical-1):**

1. Program to pick out the biggest and smallest number among three given numbers.
2. Program to find sum of even and odd numbers separately in the given list.
3. Program to find largest and smallest of N numbers
4. Program to find the roots of the quadratic equation using nested if.
5. Given two numbers, program to perform arithmetic operations using switch statement.
6. Program to generate Fibonacci series up to N numbers using do: while loop.
7. Program to find the reverse of the given number. Also sum and count the number of digits and check whether the given number is palindrome or not using while:do loop.
8. Program to generate prime numbers using for loop.
9. Program to search an element using linear search technique.
10. Program to check whether the given number is factorial of a number or not.

### **Part B**

11. Program to insert a sub-string into a given string.
12. Program to add and subtract two M x N matrices.
13. Program to multiply two M x N matrices.
14. Program to find trace and norm of a square matrix and print its principle diagonal elements.
15. Program to exchange principle and secondary diagonal elements of a square matrix.
16. Program to find the factorial of a number using recursion.
17. Program to swap two number using functions.

18. Program to read and write information of an employee using structure.
19. Program to create simple marks card assuming appropriate conditions.
20. Program to read and write information of an employee using a file

## **SEMESTER-II: Data structure using C++**

### **BLOCK-I: Introduction to C++**

C++ Fundamentals: C++ data types, operators, expressions. Control structures: Branching and looping statements-break and continue statements. User defined functions - Inline functions.

Defining classes, defining member functions, creating objects. Passing and returning objects to and from functions- Friend functions-Constructors: default constructors, parameterized constructors, constructors with default arguments, copy constructors- destructors. Nested member functions. Array of objects.

Overloading and polymorphism: Operator overloading, function overloading, constructor overloading. Inheritance: Single, multiple, multi-level, hierarchical and hybrid inheritance

### **BLOCK-II: Linear Data Structure and their sequential storage representation**

Concept and terminology for non-primitive Data structures, Storage structures for arrays, Various operations on Arrays-Traversal, Insertion, Deletion, Sorting and Searching. Stacks, Definitions and Concepts, Operations on stacks, Applications of stacks-Recursion, Infix to postfix, Evaluating postfix expressions, Queues-Linear and circular Queue.

**BLOCK-III:** Pointers and Linked Allocation, Linked linear lists, Operations on Linear lists using singly linked storage structures-Insertion and Deletion operations circularly linked linear lists-memory representation, Doublylinked linear lists- memory representation.

**Nonlinear Data Structures: Trees -** Introduction as non-linear data structure, Concepts of node, Terminal node, Depth, General Tree, Definition for Binary Tree, Left Skewed Tree, Right Skewed Tree, memory representation using Arrays and Linked List, Tree Traversal

**Algorithms-** Pre-order, In-order, Post-order and Implementation of Tree Traversal

Algorithm

**Reference textbooks:**

1. *Data Structures, Algorithms and Applications in C++, vaidyanathan, CBS; 1st edition (2013)*
2. *Data structures, Algorithms and Applications in C++, S.Sahni, University Press (India) Pvt.Ltd, 2nd edition, Universities Press, Pvt. Ltd.*
3. *Data structures and Algorithm Analysis in C++, Mark Allen Weiss, Pearson Education. Ltd., Second Edition.*
4. *Data structures and Algorithms in C++, Michael T.Goodrich, R.Tamassia and .Mount, Wiley student edition, John Wiley and Sons.*
5. *Problem-solving with C++, The OOP, Fourth edition, W.Savitch, Pearson education.*
6. *Data structures and algorithms in C++, 3rd Edition, Adam Drozdek, Thomson*
7. *A Data structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.*

## **Data Structures Lab using C++ (Practical -2)**

### **Part - A**

1. Program to illustrate class and object .
2. Program to demonstrate friend function and inline function.
3. Program to demonstrate operator overloading .
4. Program to demonstrate function overloading.
5. program to demonstrate single inheritance, multiple inheritance.
6. program to illustrate array of objects, nesting of member functions.
7. Program to illustrate types of constructors.

### **Part: B**

8. Write an interactive program to implement the following operations on stack using arrays
  - a. PUSH
  - b. POP
9. Program to implement Tower of Hanoi problem.

10. Write an interactive program to perform insertion and deletion operations in Linear Queue using arrays.
11. Write an interactive program to perform insertion and deletion operations in Circular Queue using arrays.
12. Write an interactive program to insert a node in a linked list at the front, delete a node from the rear and display.
13. Write an interactive program to implement preorder, post order and in order traversal of a binary tree using linked list.

### **SEMESTER-III: Python Programming**

#### **BLOCK-I: Introduction**

Introduction to Python - structure of python program, Python Interpreter, Using Python as calculator, Python shell, Indentation, the concept of data types; variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages. Input and Output Statements, Control statements Looping- while Loop, for Loop, Loop Control, Conditional Statement- if...else, Difference between break, continue and pass, short-circuit (lazy) evaluation.

**BLOCK-II: Strings and text files:** Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers

**Lists, tuples and dictionaries:** Basic list operators, replacing, inserting, removing an element; searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values; traversing dictionaries.

**BLOCK-III: Design with functions:** Hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions.

**OOPS concept:** Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modelling; persistent storage of objects, Inheritance, polymorphism, operator overloading (`_eq_`, `_str_`, etc); abstract classes; exception handling, try block. Graphical user interfaces; event-driven programming paradigm; tkinter module, creating simple GUI;

buttons, labels, entry fields, dialogs; widget attributes - sizes, fonts, colors layouts, nested frames.

### **Textbook**

1. Kenneth A. Lambert, The Fundamentals of Python: First Programs, 2011, Cengage Learning, ISBN: 978-1111822705

### **Reference textbooks:**

1. P. K. Sinha & Priti Sinha, "Computer Fundamentals", BPB Publications, 2007.
2. Dr. Anita Goel, Computer Fundamentals, Pearson Education, 2010.
3. T. Budd, Exploring Python, TMH, 1st Ed, 2011
4. Python Tutorial/Documentation [www.python.org](http://www.python.org) 2010
5. Allen Downey, Jeffrey Elkner, Chris Meyers, How to think like a computer scientist: learning with Python, Freely available online. 2012
6. <http://docs.python.org/3/tutorial/index.html>
7. <http://interactivepython.org/courselib/static/pythonds>
8. <http://www.ibiblio.org/g2swap/byteofpython/read/>

### **Python Programming Lab:**

1. Write a Python code to display system information using pywhois.
2. Check whether a number is prime or not
3. Make a Simple Calculator
4. Find the Factorial of a Number
5. Python Program to Generate a Random Number
6. Python Program to Check Whether a String is Palindrome or Not
7. Python Program to Sort Words in Alphabetic Order
8. Program to illustrate looping constructs.



9. Program to illustrate conditional statements.
  10. WAP to plot a graph of people with pulse rate p vs. height h. The values of p and h are to be entered by the user.
  11. Program to illustrate class and object.
  12. Python Program for Inheritance.
  13. Python Program for Operator overloading.
  14. Python Program for Exception Handling.
  15. Write a menu-driven program to create mathematical 3D objects
- I. curve
- II. sphere

#### **SEMESTER-IV: Object oriented programming with java**

**BLOCK-I:** History and Overview of Java, Object Oriented Programming, identifiers, Literals, comments, separators, Java Key words, Data types - Integers, Floating point, characters, Boolean, A closer look at Literals, Variables, Type conversion and casting.

**Operators & Control Statements:** Operators - Arithmetic operators, Bit wise operators, Relational Operators, Boolean Logical operators, Assignment Operator, Operator Precedence. Control Statements: Selection Statements - if, Switch, Iteration Statements - While, Do-while, for Nested loops, Jump statements. Arrays.

#### **BLOCK-II:Classes**

Class Fundamentals, Declaring objects, Access specifiers, Methods - constructors, “this” keyword, finalize ( ) method A stack class, Overloading methods. Using objects as parameters, Argument passing, Returning objects. Recursion, Access control, Introducing final, understanding static. Introducing Nested and Inner classes. Using command line arguments.

**Inheritance:** Basics, Using super, method overriding, Dynamic method Dispatch, Using abstract classes and final with Inheritance

**Packages:** Definition. Access protection importing packages. Interfaces: Definition and implementation. Exception Handling: Fundamentals, types, Using try and catch and Multiple catch clauses, Nested try Statements, throw, throws, finally. Java’s built-in exception, using Exceptions.

#### **BLOCK-III: Multithreaded Programming**

Java thread model: main thread, creating single and multiple thread. isalive( ) and join( ).

Thread: Priorities, Synchronization, Inter thread communication, suspending, resuming and stopping threads, using multi-threading. I / O basics: Reading control input, writing control output, Reading and Writing files.

**Applet Fundamentals:** AWT package, AWT Event handling concepts, The transient and volatile modifiers. Using instance of using assert.

## **PROGRAMMING IN JAVA: LAB**

### **Part A**

1. Write a program to check whether two strings are equal or not.
2. Write a program to display reverse string.
3. Write a program to find the sum of digits of a given number.
4. Write a program to display a multiplication table.
5. Write a program to display all prime numbers between 1 to 100.
6. Write a program to insert element in existing array.
7. Write a program to sort an array.
8. Write a program to check all math class functions.
9. Write a program to execute any Windows 95 application (Like notepad, calculator etc)
10. Write a program to find out total memory, free memory and free memory after executing garbage Collector (gc).

### **Part B**

11. Program to illustrate class and object.
12. Program to illustrate inheritance.
13. Program to illustrate multithreading.
14. Write a program to copy a file to another file using Java to package classes. Get the file names at run time and if the target file is existed then ask confirmation to overwrite and take necessary actions.
15. Write a program to get file name at runtime and display number of lines and words in that file.

16. Program to demonstrate applet.
17. Program to illustrate polymorphism.
18. Program to illustrate exception handling.

## **SEMESTER-V: DBMS**

### **BLOCK-I: Introduction to Database System Concepts and Architecture**

Databases and Database Users, Characteristics of the Database Approach, Actors on the Scene, Advantages of Using a DBMS, Data Models, Schemas and Instances, DBMS Architecture and Data Independence, Database Languages and Interfaces, The Database System Environment

**Data Modeling Using the Entity-Relationship Model:** Entity Types, Entity Sets, Attributes, and Keys, Relationship Types, Relationship Sets, Roles, and Structural Constraints, Weak Entity Types, ER Diagrams, Naming Conventions and Design Aspects

**BLOCK-II: Transaction-** Transaction Concepts, States, ACID properties, Concurrent executions, Serializability

### **Relational Data Model, Relational Constraints, and Relational Algebra**

Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Basic Relational Algebra Operations, Additional Relational Operations, Examples of Queries in Relational Algebra.

Normalization- Functional Dependencies, Transitive and Multivalued dependency, First Normal form, Second Normal Form, Third Normal Form and Boyce Codd Normal Form

**BLOCK-III: Advantages of RDBMS-** Codd's Rules.

**SQL-The Relational Database Standard:** Data Definition, SQL Data Types and Schemas, Constraints, Basic Queries in SQL, Insert, Delete, and Update Statements in SQL, Set Operations, Aggregate functions, Views (Virtual Tables) in SQL, Joins: Inner, Outer and Self, Additional Features of SQL, DCL-commit, Rollback, Save-point, Grant privileges.

### **Reference textbooks:**

1. *Fundamentals of Database Systems by Navathe and Elmasri: Pearson Education, Fifth Edition.*
2. *Database Systems Concepts, 3rd edition by Abraham Silberschatz, Henry Korth and S. Sudarshan McGraw Hill International Editions.*

3. *Introduction to Database systems by CJ Date, Published by Addison-Wesley.*

4. *Principles of database systems by Ullman, Computer Science press, 1984.*

5. *Introduction to database systems by Bipin C. Desai, Galgotia.*

DBMS Lab: (Practical-4)

Database: Student (DDL, DML statements)

Table: Student

NAME	ROLL NO	CLASS	MAJOR
Smith	17	1	CS
Brown	8	2	CS

Table: Course

CourseName	CourseNumber	CreditHours	Department
Intro to computer science	CS1310	4	CS
Data Structure	CS3320	4	CS
Discrete Mathematics	MATH2410	3	MATH
Database	CS3380	3	CS

Table: Section

SectionIdentifier	CourseNumber	Year	Instructor
85	MATH2410	98	King
92	CS1310	98	Andreson
102	CS3320	99	Knuth
112	MATH2410	99	Chang
119	CS1310	99	Andreson
135	CS3380	99	Stone

Table: Grade\_report

Regno	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	135	A

- Create Tables using create statement
- Insert rows to individual tables using insert statement
- Alter table section add new field section and update the records
- Delete brown's grade report
- Drop the table section

## Activity 2: (Select clause, Arithmetic Operators)

### Database: employee

Create Following **tables** and insert **tuples** with suitable constraints

Table: EMPLOYEE

EMPI D	FIRSTNAM E	LASTNAM E	Hire_Date	ADDRESS	CITY
1001	George	Smith	11-May-06	83 first street	Paris
1002	Mary	Jones	25-Feb-08	842 Vine Ave	Losantivill e
1012	Sam	Tones	12-Sep-05	33 Elm St.	Paris
1015	Peter	Thompson	19-Dec-06	11 Red Road	Paris
1016	Sarath	Sharma	22-Aug-07	440 MG Road	New Delhi
1020	Monika	Gupta	07-Jun-08	9 Bandra	Mumbai

Table: **EMPSALARY**

<b>EMPID</b>	<b>SALARY</b>	<b>BENEFITS</b>	<b>DESIGNATION</b>
1001	10000	3000	Manager
1002	8000	1200	Salesman
1012	20000	5000	Director
1015	6500	1300	Clerk
1016	6000	1000	Clerk
1020	8000	1200	Salesman

**Write queries for the following**

1. To display FIRSTNAME, LASTNAME, ADDRESS AND CITY of all employees living in PARIS.
2. To display the content of employee table in descending order of FIRSTNAME
3. Select FIRSTNAME and SALARY of salesman
4. To display the FIRSTNAME, LASTNAME, AND TOTAL SALARY of all employees from the table EMPLOYEE and EMPSALARY. Where TOTAL SALARY is calculated as SALARY+BENEFITS
5. List the Names of employees, who are more than 1 year old in the organization
6. Count number of distinct DESIGNATION from EMPSALARY
7. List the employees whose names have exactly 6 characters
8. Add new column PHONE\_NO to EMPLOYEE and update the records
9. List employee names, who have joined before 15-Jun-08 and after 16-Jun-07
10. Generate Salary slip with Name, Salary, Benefits, HRA-50%, DA-30%, PF-12%, Calculate gross. Order the result in descending order of the gross.

**Activity 3: (Logical, Relational Operators)**

### Database: Library

Create Following **tables** and insert **tuples** with suitable constraints

**Table: Books**

Book_Id	Book_name	Author_Name	Publishers	Price	Type	Quantity
C0001	The Klone and I	LataKappor	EPP	355	Novel	5
F0001	The Tears	William Hopkins	First Publ	650	Fiction	20
T0001	My First C++	Brain & Brooke	ERP	350	Text	10
T0002	C++ Brainworks	A.W.Rossaine	TDH	350	Text	15
F0002	Thunderbolts	Ana Roberts	First Publ.	750	Fiction	50

**Table: Issued**

Book_Id	Quantity_Issue d
T0001	4
C0001	5
F0001	2
T0002	5
F0002	8

### Write queries for the following

1. To show Book name, Author name and price of books of **First Publ.** publisher
2. Display Book id, Book name and publisher of books having quantity more than 8 and price less than 500
3. Select Book id, book name, author name of books which is published by other than ERP publishers and price between 300 to 700

4. Generate a Bill with Book\_id, Book\_name, Publisher, Price, Quantity, 4% of VAT —Total
5. Display book details with book id's C0001, F0001, T0002, F0002 (Hint: use IN operator)
6. Display Book list other than, type Novel and Fiction
7. Display book details with author name starts with letter \_A'
8. Display book details with author name starts with letter \_T' and ends with \_S'
9. Select BookId, BookName, Author Name , Quantity Issued where Books.BooksId = Issued.BookId
10. List the book\_name, Author\_name, Price. In ascending order of Book\_name and then on descending order of price

#### Activity 4: (Date Functions)

##### Database: Lab

Create Following **table** and insert **tuples** with suitable constraints

**Table:Equipment\_Details**

No	ItemName	Costperitem	Quantity	Dateofpurchase	Warranty	Operational
1	Computer	30000	9	21/5/07	2	7
2	Printer	5000	3	21/5/06	4	2
3	Scanner	8000	1	29/8/08	3	1
4	Camera	7000	2	13/6/05	1	2
5	UPS	15000	5	21/5/08	1	4
6	Hub	8000	1	31/10/08	2	1
7	Plotter	25000	2	11/1/09	2	2

(Use date functions and aggregate functions)

1. To select the ItemName purchase after 31/10/07
2. Extend the warrenty of each item by 6 months
3. Display Itemname ,Dateof purchase and number of months between purchase date and present date



4. To list the ItemName in ascending order of the date of purchase where quantity is more than 3.
5. To count the number, average of costperitem of items purchased before 1/1/08
6. To display the minimum warranty , maximum warrenty period
7. To Display the day of the date , month , year of purchase in characters
8. To round of the warranty period to month and year format.
9. To display the next Sunday from the date '07-JUN-96'
10. To list the ItemNaName, which are within the warranty period till present date

#### **Activity 5: ( Numeric, character functions)**

##### **Use Functions for the following**

1. Find the mod of 165,16
2. Find Square Root of 5000
3. Truncate the value 128.3285 to 2 and -1 decimal places
4. Round the value 92.7683 to 2 and -1 decimal places
5. Convert the string '\_Department' to uppercase and lowercase
6. Display your address convert the first character of each word to uppercase and rest are in lowercase
7. Combine your first name and last name under the title Full name
8. A) Take a string length maximum of 15 display your name to the left. The remaining space should be filled with '\_'
9. Take a string length maximum of 20 display your name to the right. The remaining space should be filled with '\_'
10. Find the length of the string '\_JSS College, Mysore'
11. Display substring '\_BASE' from '\_DATABASE'
12. Display the position of the first occurrence of character '\_o' in Position and Length
13. Replace string Database with Datatype
14. Display the ASCII value of '\_\_ (Space)

15. Display the Character equivalent of 42

**Activity: 6 (set operators)**

**Database: subject**

Create Following **table** and insert **tuples** with suitable constraints

**Table: Physics**

Regno	Name	Year	Combination
AJ00325	Ashwin	First	PCM
AJ00225	Swaroop	Second	PMCs
AJ00385	Sarika	Third	PME
AJ00388	Hamsa	First	PMCs

**Table: Computer Science**

Regno	Name	Year	Combination
AJ00225	Swaroop	Second	PMCs
AJ00296	Tajas	Second	BCA
AJ00112	Geetha	First	BCA
AJ00388	Hamsa	First	PMCs

1. Select all students from physics and Computer Science
2. Select student common in physics and Computer Science
3. Display all student details those are studying in second year
4. Display student those who are studying both physics and computer science in second year
5. Display the students studying only physics
6. Display the students studying only Computer Science
7. select all student having PMCs combination

8. select all student having BCA combination

9. select all student studying in Third year

10. Rename table Computer Science to CS

### Activity 7: (views)

#### Database: Railway Reservation System

Create Following **table** and insert **tuples** with suitable constraints

**Table: Train Details**

Train_no	Train_name	Start_place	Destination
RJD16	Rajdhani Express	Bangalore	Mumbai
UDE04	Udhyan Express	Chennai	Hyderabad
KKE55	Karnataka Express	Bangalore	Chennai
CSE3	Shivaji Express	Coimbatore	Bangalore
JNS8	Janashatabdi	Bangalore	Salem

**Table: Availability**

Train_no	Class	Start_Place	Destination	No_of_seats
RJD16	Sleeper Class	Banglore	Mumbai	15
UDE04	First Class	Chennai	Hyderabad	22
KKE55	First Class AC	Bangalore	Chennai	15
CSE3	Second Class	Coimbatore	Bangalore	8
JNS8	Sleeper Class	Bangalore	Salem	18

1. Create view **sleeper** to display train no, start place, destination which have sleeper class and perform the following

a. insert new record

b. update destination='Manglore' where train no='RJD16'

- c. delete a record which have train no='KKE55'
2. Create view **details** to display train no, train name, class
3. Create view **total\_seats** to display train number, start place, use count function to no of seats , group by start place and perform the following
  - a. insert new record
  - b. update start place='Hubli' where train no='JNS8'
  - c.delete last row of the view
4. Rename view sleeper to class
5. Delete view details

### Activity 8 (group by, having clause)

#### Database: Bank system

Create Following **table** and insert **tuples** with suitable constraints

**Table: Account**

Account_no	Cust_Name	Brach_ID
AE0012856	Reena	SB002
AE1185698	Akhil	SB001
AE1203996	Daniel	SB004
AE1225889	Roy	SB002
AE8532166	Sowparnika	SB003
AE8552266	Anil	SB003
AE1003996	Saathwik	SB004
AE1100996	Swarna	SB002

**Table: Branch**

Branch_ID	Branch_Name	Branch_City
SB001	Malleshwaram	Bangalore

SB002	MG Road	Bangalore
SB003	MG Road	Mysore
SB004	Jainagar	Mysore

**Table: Depositor**

Account_no	Branch_Id	Balance
AE0012856	SB002	12000
AE1203996	SB004	58900
AE8532166	SB003	40000
AE1225889	SB002	150000

**Table: Loan**

Account_no	Branch_Id	Balance
AE1185698	SB001	102000
AE8552266	SB003	40000
AE1003996	SB004	15000
AE1100996	SB002	100000

1. Display Total Number of accounts present in each branch
2. Display Total Loan amount in each branch
3. Display Total deposited amount in each branch by descending order
4. Display max , min loan amount present in each city.
5. Display average amount deposited in each branch , each city
6. Display maximum of loan amount in each branch where balance is more than 25000
7. Display Total Number of accounts present in each city
8. Display all customer details in ascending order of branchid
9. Update Balance to 26000 where accno=AE1003996

10. Display Customer Names with there branch Name

**Activity 9: (Nested Query)**

**Database: Book Dealer Table: Author**

Author_id	A_Name	City	Country
EE10258	Sudaker Samuel	Bangalore	India
PE96358	Natarasu	Kolkata	India
LT45879	Tenenbaum	Toronto	Canada
PW56325	Sumitabha Das	Kolkata	India
KA56983	Galvin	Loss Angles	USA

**Table: Publisher**

Publisher_ID	Name	City	Country
21	TMH	Delhi	India
22	PHI	Kolkata	India
23	PEARSON	Mumbai	India
24	EEE	Singapore	Singapore
25	LPE	Banglore	India

**Table: Category**

Cateogry_ID	Description
31	CSE
32	ISE
33	E&E
34	E&C

**Table: Catalog**

Book_id	Title	Author_ID	Publisher_ID	Category_ID	Year	Price
41	OS	PW56325	23	31	1998	275
42	CN	LT45879	22	32	2000	475
43	EC	EE10258	23	34	2002	380
44	SE	LT45879	24	32	2002	480
45	DBMS	PW56325	21	31	1999	650
46	EC	PE96358	25	33	2004	250

**Table: Order Details**

Order_no	Book_id	Quantity
51	41	15
52	45	50
53	42	20
54	44	10
55	43	35
56	46	25

1. List the other publications located where PEARSON publication is located
2. List the book with maximum price
3. Display book details having quantity=25
4. Display the author details those who are publishing with PHI publisher
5. Display the Books details published for '\_CSE' category
6. Display the author details those who publish in Indian publications
7. Display book details those who have orders less than 20
8. Display all the books published under '\_CSE' & '\_ISE' category

9. Delete book details of order\_no=56

10. Alter table order details add new column order\_date& update the columns

### Activity 10:

#### Database: Mobile Shoppe (Using Joins)

Create Following **table** and insert **tuples** with suitable constraints

**Table: Mobile Handsets**

Custno	Cname	Model	Handsetno	Amount
1010	Sita	Nokia	RM560	9500
1020	Ritesh	Samsung	SR12365	3200
1030	Reena	Nokia	RM236	1200
1040	Karan	Sony Ericsson	SE12334	8200
1050	Anu	LG	LT1255	2000

**Table: Connection Details**

Custno	Cname	Connection	ActivationDate	Validity	Amount	Phoneno
1010	Seetha	Airtel	11-May-09	365	650	9985632551
1020	Ritesh	Vodafone	10-Sep-08	180	400	9923033652
1030	Reena	Tata Docomo	12-Aug-09	100	150	9036225636
1040	Karan	Airtel	12-Jan-09	90	200	9896325415
1060	Anoop	Reliance	12-Sep-09	365	220	9342653326

1. Display Customer Name, Handset Model, connection, Validity of the connection



2. Display All Mobile Handsets along with Connection and Activation date
3. Display all Connection Details along with handset model and Handset purchase date
4. Display The Handset Details which is having highest amount than Samsung handset
5. Display Customer Name, Handset Model, connection, Validity which is having validity of one year
6. Display Customer number, customer name, connection and activation date of connections activated between 01-Jan-08 to 30-Dec-09
7. Display Customer number, Model, Connection which is having 'Airtel' Connection
8. Display Customer number, Model, Connection which is having model is Nokia and connection is Airtel
9. Select Customer number, customer name and model which is having price more than model samsung
10. Perform Cartesian join on Mobile Handsets and Connection details table

## **SEMESTER-V: Operating system**

### **BLOCK-I: Introduction**

**Types of operating systems-** Batch Systems, Multi programmed Systems, Time-Sharing Systems, Real-Time Systems

**Operating System Organization:** Factors in operating system design, basic OS functions, implementation consideration; process modes, methods of requesting system services: system calls and system programs.

**Process:** Process Concept, process state diagram process Control block , Process Scheduling- Scheduling queues, scheduler, Cooperating process, Interprocess Communication, Threads-meaning , user threads , Kernel Threads, Multithreading Models, Threading Issues,

**CPU Scheduling:** Basic concepts, Preemptive and Non-preemptive Scheduling, Scheduling Criteria, Scheduling algorithms- FCFS, Shortest job first Priority scheduling, Round Robin Scheduling.

### **BLOCK-II:Deadlocks**

Deadlock Characterization, Methods for Handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock

**Memory Management:** Introduction, Logical versus physical address space, Dynamic Loading, Dynamic Linking, Swapping, Contiguous Allocation, Partitioned Memory Allocation, Paging, Segmentation

**Virtual Memory:** Concept, Advantages of Virtual Memory, Implementation of Virtual Memory, Demand Paging, Demand segmentation, Advantages of Demand paging, Page Replacement, Page-Replacement Algorithms- FIFO Algorithm, Optimal Page Replacement Algorithm, and Least Recently used Algorithm, (LRU) Allocation of Frames, Thrashing.

### **BLOCK-III:** Shell Programming

**Shell introduction and Shell Scripting:** What is shell and various type of shell, Various editors present in linux, Different modes of operation in vi editor, What is shell script, Writing and executing the shell script, Shell variable (user defined and system variables), System calls, Using system calls, Pipes and Filters, Decision making in Shell Scripts (If else, switch), Loops in shell, Functions, Utility programs (cut, paste, join, tr, uniq utilities), Pattern matching utility (grep), Usage of following commands: ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd, cal, cat(append), cat(concatenate), mv, cp, man, date, chmod, grep, tput (clear, highlight), bc.

### **Reference textbooks:**

1. A Silberschatz, P.B. Galvin, G. Gagne, *Operating Systems Concepts, 8th Edition, John Wiley Publications 2008.*
2. A.S. Tanenbaum, *Modern Operating Systems, 3rd Edition, Pearson Education 2007.*
3. G. Nutt, *Operating Systems: A Modern Perspective, 2nd Edition Pearson Education 1997.*
4. W. Stallings, *Operating Systems, Internals & Design Principles, 5th Edition, Prentice Hall of India. 2008.*
5. M. Milenkovic, *Operating Systems- Concepts and design, Tata McGraw Hill 1992.*

### **Shell Programming Lab: (Practical -5)**

1. Usage of following commands:

ls, pwd, tty, cat, who, who am I, rm, mkdir, rmdir, touch, cd.

2. Usage of following commands:

cal, cat(append), cat(concatenate), mv, cp, man, date.

3. Usage of following commands:

chmod, grep, tput (clear, highlight), bc.

4. Write a shell script to check if the number entered at the command line is prime or not.

5. Write a shell script to modify “cal” command to display calendars of the specified months.

6. Write a shell script to modify “cal” command to display calendars of the specified range of months.

7. Write a shell script to accept a login name. If not a valid login name display message: “Entered login name is invalid”.

8. Write a shell script to display date in the mm/dd/yy format.

9. Write a shell script to display on the screen sorted output of “who” command along with the total number of users .

10. Write a shell script to display the multiplication table any number,

11. Write a shell script to compare two files and if found equal asks the user to delete the duplicate file.

12. Write a shell script to find the sum of digits of a given number.

13. Write a shell script to merge the contents of three files, sort the contents and then display them page by page.

14. Write a shell script to find the LCD(least common divisor) of two numbers.

15. Write a shell script to perform the tasks of basic calculator.

16. Write a shell script to find the power of a given number.

17. Write a shell script to find the factorial of a given number.

### **SEMESTER-VI: Computer Networks**

**BLOCK-I:** Data Communication, Component and Basic Concepts:Introduction,Characteristics: delivery, Accuracy, Timeliness and Jitter,Components: Message, Sender, Receiver, Transmission medium and protocol.Topology: Mesh, Star, Tree, Bus, Ring and Hybrid Topologies. Transmission modes: Simplex, Half Duplex, Full Duplex Categories of networks: LAN, MAN, WAN. DNS, IP address, MAC address, Web browser, ISP,URL, WWW,BroadbandTransmissions.Guided Media: Twisted-Pair Cable, Coaxial Cable, Fiber-Optic Cable ,Unguided Media: Radio Wave Transmission Systems, Microwave Transmission Systems, Infrared Transmission Systems and Satellite Communication System.

**BLOCK-II:** The OSI Model: Functions of all the Seven Layers. Networking Devices: Functions and Applications of Hub, Switches, Bridges, Repeaters. Internetworking Devices: Functions and Applications of Routers and Gateways. IP Addressing: Dynamic IP Addressing, Static IP Addressing, Types of IP Addresses. Protocols: Overview only- TCP, UDP, IP, IPV4, IPV6, TCP/IP Suite, SMTP, POP3, SNMP, HTTP, FTP, DNS, ICMP IGMP, ARP, RARP, OSPF, BGP, ALOHA

**BLOCK-III:** Packet Switching Networks: Network Services and Internal Network Operations, Packet Network Topology, Datagrams and Virtual Circuits, Connectionless Packet Switching, Virtual Circuit Packet Switching.

Routing Concepts: Routing Tables, Dijkstra's Shortest Path Routing Algorithm,

Congestion Control Algorithms-Leaky Bucket Algorithm.

Data Link Issues: Single bit error and Burst Error, concepts of Redundancy, Checksum,

Single Bit Error correction and Hamming Code correction method.

**Reference textbooks:**

1. *Introduction to Data Communications and Networking by Behrouz Forouzan.*
2. *Computer Networks by Andrew S Tanenbaum.*
3. *Networking Essentials: Third Edition: Jeffrey S. Beasley, Piyasat Nilkaew*

**Computer Networking Lab: BASICS OF NS2**

1. Introduction to NS2
2. XGraph
3. Awk and advanced 10 P

**Part: A**

1. Three node point to point network
2. Transmission of Ping messages

3. Ethernet Lan using n-nodes with multiple traffic
4. Simple ESS with wireless Lan
5. Performance of GSM using MAC layer
6. Performance of CDMA

## **Part-B**

1. CRC-CCITT
2. Bellman-Ford Algorithm
3. Client server using TCP/IP sockets
4. Client-Server Communication
5. RSA Algorithm to Encrypt and Decrypt the Data
6. Congestion Control Using Leaky Bucket Algorithm

## **SEMESTER-VI: Web designing**

**BLOCK-I:** www, W3C, Web Browser, Web server, Web hosting, Web Pages, DNS,URL, Introduction e-documents - Static, Active & Dynamic. Web programming - client-side scripting and server-side scripting.

**HTML:** Introduction to HTML, Basic formatting tags: heading, para-graph, underline break, bold, italic, underline, superscript, subscript,font and image. Di\_erent attributes like align, color, bgcolor, font face,border, size. Navigation Links using anchor tag: internal, external, mailand image links.Lists: ordered, unordered and de\_nition, Table tag,

**HTML Form controls:** form, text, password, textarea, button, checkbox, radio button, select box, hidden controls, Frameset and frames

**CSS:** Introduction to Cascading Style Sheet (CSS), CSS Syntax, Comments, Id and Class, Background - Background Color, Background Image Text - Text Color, Text Alignment, Text Decoration, Text Transformation, Text Indentation - CSS Font - Font Families, Font Style, Font Size- Setting Text Size - Using Pixels and Em - CSS Lists - Different List, Item Markers, Unordered List, Ordered List, An Image as The List ItemMarker - CSS Tables - Table Borders, Collapse Borders, Table Widthand Height, Table Text Alignment, Table Padding, Table Color  
**CSS Positioning-** Static Positioning, Fixed Positioning, Relative Positioning,Absolute Positioning, Overlapping Elements - Float - Horizontal Align -Image Gallery - Image Opacity/Transparency - Image Sprites

**BLOCK-II: Javascript:** Introduction, Client side programming, script tag, comments, variables, **Document Methods:** write and writeln methods, alert, **Operators:** Arithmetic, Assignment, Relational, Logical, Javascript **Functions,** Conditional Statements, Loops, break and continue. Events

**Familiarization:** onLoad, onClick, onBlur, onSubmit, onChange

**BLOCK-III: PHP:** Introduction to PHP, Server side scripting, Role of Web Server software, including files, comments, variables and scope, echo and print,

**Operators:** Logical, Comparison and Conditional operators, Branching statements, Loops, break and continue, PHP functions.

**Working with PHP:** Passing information between pages, HTTP GET and POST method, String functions: strlen, strpos, strstr, strcmp, substr, str\_replace, string case, Array constructs: array(), list() and foreach(),

**PHP advanced functions:** Header, Session, Cookie, Object-Oriented Programming using PHP: class, object, constructor, destructor and inheritance.

**Text books:**

1. Jon Duckett, Web Programming with HTML, XHTML, CSS, Wrox Beginning.
2. Jim Converse & Joyce Park, PHP & MySQL Bible, Wiley.

**Reference textbooks:**

*1. Deitel, Harvey M. and Paul J., INTERNET & WORLD WIDE*

*WEB HOW TO PROGRAM, 3/E, 2004*

*2. HTML 4.0 IN SIMPLE STEPS, Author: Kogent Solutions Publishers: Wiley*

*3. HTML 4 FOR DUMMIES, Author: ED TITTEL & MARY BURMEISTER Publishers: Wiley*

*4. Beginning PHP, DW Mercer, A Kent, S D Nowicki Publisher: Wrox.*

*5. PHP & MYSQL FOR DUMMIES, 3RD ED, Author: JANET VALADE*

*Publishers: Wiley*

## **Web Designing Lab ( Practicals-8)**

Lab 1:

- \_ Setup WAMP/XAMPP Server or Setup Apache, MySQL and PHP separately in your PHP Lab.
- \_ Simple PHP program that displays a welcome message.
- \_ Write a php program to generate a random number between 1 and 100.
- \_ Modify above program to accept range of the random number from HTML interface.

Lab 2: Programs involving various control structures like:

- \_ `if, else, elseif/else if`
- \_ Alternative Syntax for `if, else, elseif/else if`

Lab 3: Programs involving various control structures like:

- \_ while, do-while, for, foreach, switch, break, continue.
- \_ Try alternative syntax for while, do-while, for, foreach, switch.

Lab 4: Programs involving the following.

- \_ declare, return.
- \_ require, include, require once, include once and goto.

Lab 4: Programs to demonstrate PHP Array functions.

- \_ PHP Array Sorting,
- \_ PHP Key Sorting,
- \_ PHP Value Sorting,
- \_ PHP MultiArray Sorting,
- \_ PHP Array Random Sorting,

Lab 5: Programs to demonstrate PHP Array functions.

- PHP Array Reverse Sorting,
- \_ Array to String Conversion,

- \_ Implode() function,
- \_ String to Array, Array Count,
- \_ Remove Duplicate Values

Lab 6: Programs to demonstrate PHP Array functions.

- \_ Array Search,
- \_ Array Replace,

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B.Sc. Computer Science - 2012 Admission onwards.

- \_ Array Replace Recursive,
- \_ Array Sub String Search

Lab 7: Demonstrate the following.

- \_ Use of regular expression to compare two strings.
- \_ Extract Domain name from URL.
- \_ Find the number of rows from a mysql database for your query.

Lab 8: Generate a Guestbook which will allow your website visitor to enter some simple data about your website.

Lab 9: Develop a PHP program for Email Registration.

Lab 10: Develop a project for making Application form and performing Degree Admission On-line.

### **SEMESTER: V: Visual Technology**

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#### **BLOCK-I**

**Unit-1:** Understanding the Previous State of Affairs, The .NET Solution, The Building Block of the .NET Platform (CLR, CTS, and CLS), The Role of the .NET Base Class Libraries, What C# Brings to the Table, An Overview of .NET Binaries (aka Assemblies), the Role of the Common Intermediate Language. The Role of .NET: Type Metadata,



**Unit-2:** The Role of the Assembly Manifest, Compiling CIL to Platform: Specific Instructions, Understanding the Common Type System, Intrinsic CTS Data Types, Understanding the Common Language Specification, Understanding the Common Language Runtime.

**Unit-3:** A Tour of the .NET, Namespaces, Increasing Your Namespace Nomenclature, Deploying the .NET Runtime. Building C# Applications The Role of the Command Line. Compiler (csc.exe), Building C # Application using csc.exe Working with csc.exe Response Files, Generating Bug Reports, Remaining C# Compiler Options.

**Unit-4:** The Command Line Debugger (cordbg.exe) Using the, Visual Studio .NET IDE, Other Key Aspects of the VS.NET IDE, C# “Preprocessor”. 14 Directives, An Interesting Aside: The System. Environment Class.

## **BLOCK-II**

**Unit-5:** C# Language Fundamentals The Anatomy of a Basic C# Class, Creating objects: Constructor Basics, The Composition of a C# Application, Default Assignment and Variable Scope. The C# Member Initialization Syntax, Basic Input and Output with the Console Class. Understanding Value Types and Reference Types,

**Unit-6:** The Master Node: System, Object, The System Data Types (and C# Aliases), Converting Between Value Types and Reference Types: Boxing and Unboxing, Defining Program Constants. C# Iteration Constructs, C# Controls Flow Constructs, The Complete Set of C# Operators, Defining Custom Class Methods, Understating Static Methods, Methods Parameter Modifies.

**Unit-7:** Array Manipulation In C#, String Manipulation in C#, C# Enumerations, Defining Structures in C#, Defining Custom Namespaces. Object: Oriented Programming with C# Forms Defining of the C# Class, Definition the “Default Public Interface” of a Type, Recapping the Pillars of OOP,

**Unit-8:** The First Pillars: C#’s Encapsulation Services, Pseudo: Encapsulation: Creating Read: Only Fields. The Second Pillar C#’s Inheritance Supports, keeping Family Secrets: The “Protected” Keyword, Nested Type Definitions, The Third Pillar: C #’s Polymorphic Support, Casting Between.

## **BLOCK-III**

**Unit-9:** Exceptions and Object Lifetime Ode to Errors, Bugs, and Exceptions, The Role of .NET Exception Handling, the System. Exception Base Class, Throwing a Generic Exception, Catching Exception, CLR System- Level Exception (System. System Exception),

**Unit-10:** Custom Application: Level Exception (System. System Exception), Handling Multiple Exception.The Family Block, The Last Chance Exception dynamically Identifying Application: and System Level Exception Debugging System Exception Using US.

**Unit-11:** NET, Understanding Object Lifetime, the CIT of “new”, The Basics of Garbage Collection, Finalization a Type, The Finalization Process, Building an Ad Hoc Destruction Method, Garbage Collection Optimizations, The System, GC Type.

**Unit-12:** Interfaces and Collections Defining Interfaces Using C# Invoking Interface Members at the object Level, Exercising the Shapes Hierarchy. Understanding Explicit Interface Implementation Interfaces As Polymorphic Agents.

### **SEMESTER: VI: Digital Image Processing**

**BLOCK-I: Unit-1: Introduction to Image Processing:** Definition, applications of Digital Image Processing, Fundamental steps in Digital Image Processing, components of an Image Processing System.

**Unit-2:** Image sensing and acquisition, Digital Image representation, ,color image representation. image sampling and quantization”, Introduction to the Basic Mathematical Tools Used in Digital ImageProcessing

**Unit-3:** Intensity Transformations and Spatial Filtering

Some Basic Intensity Transformation Functions , Histogram Processing ,Fundamentals of Spatial Filtering,Smoothing (Lowpass) Spatial Filters

**Unit-4:** Sharpening (Highpass) Spatial Filters ,Highpass, Bandreject, and Bandpass Filters from Lowpass Filters, Combining Spatial Enhancement Methods

**BLOCK-II: Unit-5: Image enhancement in the spatial domain:** Basic gray-level transformation, histogram processing, arithmetic and logic operators, basic spatial filtering, smoothing and sharpening spatial filters

**Unit-6:Image restoration:** A model of the image degradation/restoration process, noise models, restoration in the presence of noise:only spatial filtering, Weiner filtering, constrained least squares filtering, geometric transforms; Introduction to the image enhance in frequency domain

**Unit-7: Image Transformation & Filtering:** Intensity transform functions, histogram processing, Spatial filtering, Fourier transforms and its properties, frequency domain filters, colour models, Pseudo colouring, color transforms, Basics of Wavelet Transforms

**Unit-8:Image Compression:** Coding redundancy, Interpixel redundancy, Psychovisual redundancy, Huffman Coding, Arithmetic coding, Lossy compression techniques, JPEG Compression.

**BLOCK-III:Unit-9:Morphological Image Processing:** Preliminaries, dilation, erosion, open and closing, basic morphologic algorithms, The Hit-or-Miss Transformation.

**Unit-10: Image Segmentation:** Detection of discontinuous, edge linking and boundary detection, thresholding, Hough Transform Line Detection and Linking, region:based segmentation.

**Unit-11:Image Pattern Classification:** patterns and pattern classes, pattern classification by prototype matching, optimum Statistical classifiers

**Unit-12:** Neural networks and Deep learning, Deep convolution Neural Networks.

**Text Book:**

1. Digital Image Processing, RafealC.Gonzalez, Richard E.Woods, Second Edition, Pearson Education/PHI.

**Reference textbooks:**

1. *Image Processing, Analysis, and Machine Vision*, Milan Sonka, Vaclav Hlavac and Roger Boyle, Second Edition, Thomson Learning.
2. *Introduction to Digital Image Processing with Matlab*, Alasdair McAndrew, Thomson Course Technology
3. *Computer Vision and Image Processing*, Adrian Low, Second Edition, B. S. Publications
4. *Digital Image Processing using Matlab*, Rafeal C. Gonzalez, Richard E. Woods, Steven L. Eddins, Pearson Education

## **9.5 ENVIRONMENTAL SCIENCE**

### **SEMESTER - I**

#### **Fundamentals of Environmental Science (includes Practical-1)**

**Unit- I:** Environmental Science-Definition, Scope, Importance. Relationship with other branches of science: environmental biology, environmental chemistry, environmental engineering, environmental geology, environmental physics, Environmental Toxicology, Environmental Education and its importance.

**Unit- II:** The earth system: atmosphere, hydrosphere, lithosphere and biosphere. Water resource: Hydrological cycle: introduction, components- Evaporation, Transpiration, Trans - evaporation, condensation, percolation and precipitation. Factors affecting hydrological cycle.

**Unit- III:** Evolution of Universe: Theories: Big bang theory, steady state theory and pulsating theory, Origin of elements: origin of earth , sun and solar system, origin and evolution of life and life forms .

**Unit- IV:** Climatology: Weather and climate, tropical monsoon climate - Humidity, temperature, pressure, wind. Microclimate: causes and fluctuation of environmental factors, topography, microclimates of valleys and urban area. El-nino and La-nina effect.

**Unit- V:** Abiotic factors - Importance of temperature and light, Essential elements and limiting factors - Liebig's Law of limiting factors. Shelford's law of tolerance. Classification of organisms according to temperature tolerance and regulation. Thermal adaptation of plants and animals. Effect of light on plants and animals.

#### **Practicals**

Determination of pH of water sample using pH paper/ pH meter

Humidity: Principle and use of dry & wet bulb thermometer.

Wind: direction and speed- wind vane and Anemometer.

Construction of wind rose: wind vane and Anemometer.

Mean rainfall calculation over a drainage basin using Thiessen's Polygon method and

Isohyetal method.

Demonstration of Rain gauge.

Demonstration of Altimeter.

Determination of turbidity of water sample using Sacchi disc.

Determination of  $\text{CaCO}_3$  in water sample.

Field visit - study of pond ecosystem.

**Reference textbooks:**

1. Forth H.D. (1984). *Fundamentals of Soil Science*:: John Wiley
2. Turk J & Turk A (1984). *Environmental Science*- - Saunders
3. Strahler & Strahler (1977). *Geography and man's environment* - Eiley
4. Eugene E.D. (1983). *Environmental Science*:- W.C. Brown Co.
5. Dusman, R.S. (1974). *Man and Biosphere today*- Sterling publication
6. R.G. Franke, D.N. Franks Publ: Holt, Rinehart & Winston. *Man and Changing environment*
7. W.L. Donn- *The Earth: Our physical Environment*- John Wiley & Sons, N. Y.
8. S. C. Santra, *Environmental Science*- New Central Book Agency Private limited, London

**SEMESTER: II**

**Ecology and Ecosystem Dynamics (includes Practical-2)**

**Unit-I:** Definition, Scope and basic principles of ecology and environment. Biological levels of organization, population, community, ecosystem and biosphere. Climatic factors - Solar radiations, temperature, water and precipitation.

**Unit-II:** Population: Basic concepts, population characteristics: density, natality, mortality, age-structure, population growth. Ecological niche and habitat. Positive and negative interactions of populations: competition, predation, parasitism, mutualism.

**Unit-III:** Community: Basic concepts, community structure, growth forms, life form. Analytical and synthetic characters of plant community. Methods of plant community analysis. Concept of keystone species and ecotone.

**Unit-IV:** Ecosystem: Basic concepts, components of ecosystem. Trophic levels, food chains and food webs. Ecological pyramids, ecosystem functions. Energy flow in ecological systems,

energy efficiencies. Succession: Concepts of succession, Types of Succession. Trends in succession. Climax and stability. Co-evolution and group selection.

**Unit-V:** Major biomes of the world. Characteristics of terrestrial fresh water and marine ecosystems. Forests, grasslands, lake, river and marine ecosystems of India.

### **Practicals**

Determination of requisite size of the quadrant for vegetation analysis.

Analysis of frequency distribution of plants in a piece of vegetation by quadrat method.

To determine chlorophyll content of the given plant material.

To determine basal cover of trees in a forest ecosystem/forest plantation.

Quantitative analysis of soil pH.

To study pore space, water holding capacity and bulk density of soil.

### **Reference textbooks:**

1. Muller-Dombois, D. and Ellenberg, H. (1974). *Aims and Methods of Vegetation Ecology*, Wiley, New York.
2. Odum, E.P. (1983), *Basic Ecology*, Sanders, Philadelphia.
3. Robert Ricklefs (2001). *The Ecology of Nature. Fifth Edition*. W.H. Freeman and Company.
4. Singh K.P. and J.S. Singh (1992). *Tropical Ecosystems: Ecology and Management*. Wiley Eastern Limited, Lucknow, India.
5. Singh, J.S. (ed.) 1993. *Restoration of Degraded Land: Concepts and Strategies*. Rastogi Publications, Meerut.
6. Smith, R.L. (1996). *Ecology and Field Biology*, Harper Collins, New York.
7. Botkin, D.B. and Keller, E.A. 2000. *Environment Science: Earth as a living planet. Third Edition*. John Wiley and Sons Inc.

### **SEMESTER: III**

Environmental Pollution and Monitoring (includes Practical-3)

**Unit-I:** Air pollution: sources of air pollution, Primary and secondary air pollutants. Origin and effects of SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>x</sub>, CFC, Hydrocarbon, Photochemical smog, heavy metals, particulates, control of air pollution. Air pollution monitoring techniques and its control.

**Unit-II:** Water pollution: sources and types of water pollution, Effects of water pollution, Eutrophication, Marine and groundwater pollution. Water treatment techniques.

**Unit-III:** Soil pollution: Causes of soil pollution Effects of soil pollution Pesticides in soil environment and their effects biological magnification, pollution through mining. Soil characteristics. Noise pollution: Definition, sources and types of noise pollution. Noise and its measurement, effects of noise pollution and control measures.

**Unit-IV: Solid waste management:** definition, sources and classification, methods of collection, disposal method- open dumping, sanitary land fill, incineration, composting. Potential methods of disposal- utilization recovery and recycling of paper, glass, metals and plastics. **Radioactive pollution:** Sources, types and properties of radiation, ionizing and non-ionizing radiation. Impact of radioactive pollution on plants, animals and humans.

**Unit-V:** National and International criteria for drinking water. Indian standards, World Health Organization (WHO) standard for drinking water quality and air quality. Biological indicators of water quality. Noise standards. Solid Waste Management Rules.

## **Practicals**

Study of moisture content of different solid wastes.

Estimation of total exchangeable acidity of soil.

Quantitative analysis of soil organic carbon.

Determination of turbidity of water sample.

Visit to water treatment plant.

Determination of chlorine demand.

Determination of copper by titration method.

Estimation of COD.

Determination of total dissolved solids by gravimetric method.

## **Reference textbooks:**

1. *Environmental Pollution Engineering* by C. S. Rao

2. *Environmental chemistry by Sharma and Kaur*
3. *Environmental chemistry by A K De*
4. *Water pollution control by Kholey*
5. *Quantitative chemical analysis by vogal*

### **SEMESTER: IV**

Environmental Conservation and Management (includes Practical-4)

**Unit-I:** Objectives of conservation, definition and awareness, conservation of water resources. Forestry (agro forestry, social forestry).

**Unit-II:** Extinction of wildlife, endangered species, Wild life management, Biodiversity conservation - national parks, biosphere reserves and sanctuaries of India. Hotspots of Biodiversity.

**Unit-III: Energy resources:** use of alternate energy resources, tidal, wind, solar, biomass and geothermal energy.

**Unit-IV: Environmental Impact Assessment** - concept, evaluation and impact assessment methods. Environmental movements - Chipko movement, Appiko movement and World Wildlife Fund. Environmental episodes - Chernobyl nuclear disaster, Three Mile Island, Minamata episode and Bhopal gas tragedy.

**Unit-V: Rainwater harvesting:** Introduction, objectives, methods of rainwater harvesting-catchments, coarse mesh, gutters, conduits, first flushing and filters. Storage facility, Ground water recharge methods. Watershed management.

### **Practicals**

Study of vegetation map of Karnataka.

The Study of wildlife sanctuaries.

Forest conservation methods ( Agro forestry, Social forestry).

Energy conservation ( Hydel energy, wind energy.)

Rain water conservation methods:

1. Rooftop harvesting
2. Ground water recharge methods

Watershed management.



Impacts study of mining on forest:

1. Deforestation
2. Land sliding
3. Biodiversity depletion
4. Ecosystem disturbance
5. Pollution

### **SEMESTER: V**

#### **Natural Resource Management**

**Unit I: Natural resources:** Classification and types of natural resources. Renewable and non-renewable resources.

**Unit II:** Biological Resources- Forest resources: types, importance of forests, afforestation, deforestation, mining, dams and their effects on environment.

**Unit III:** Water resources: Use and over utilization of surface and ground water, floods, drought. Conflicts over water sharing.

**Unit IV:** Land resources-Land as a resource, land degradation, Landslides, desertification. Mineral resources: metals and non-metals, Use and exploitation. Food resources: Fisheries and marine resources, world food problems.

**Unit-V:** Energy resources: classification. Conventional: fossil fuels, nuclear energy. Non-Conventional: solar, wind, tidal, geothermal, biogas, bio-fuel.

#### **Reference textbooks:**

1. Donahue R.L. and Miller R.W. 1997 *Soils In Our Environment*, Prentice Hall of India Pvt. Ltd., New Delhi.
2. Morgen, M.D. Morgen J.M. and Wiersima J.H. 1993, *Environmental Science: Managing Physical and Biological Resources* Wm C Brown Publishers London.
3. Tyler Miller Jr. G. 2005. *Living in the Environment*. Wadsworth Publishing Company, Belmont California.
4. Botkin, D.B and Keller E.A., 2000, *Environmental Studies: The earth as a living plant*. Charles E. Merrill, Publishing Co. London.
5. Shastri M.N. 1995, *Energy Options: Himalaya Publishing House*, New Delhi.
6. Dhaliwal G.S., Sangha G.S. and Ralhan P.K. 2000, *Fundamentals of Environmental Science*, Kalyani Publishers, New Delhi.
7. Singh J.S., Singh S.P. and Gupta S.R., 2006, *Ecology Environment and Resource Conservation*, Anamaya Publishers, New Delhi.

## **Environmental Laws and Policies**

**Unit-I:** Constitution of India; fundamental rights; fundamental duties; Union of India; union list, state list, concurrent list; legislature; state assemblies; judiciary; panchayats and municipal bodies; National Green Tribunal.

**Unit-II:** Environmental legislation Legal definitions (environmental pollution, natural resource, biodiversity, forest, sustainable development); Article 48A (The protection and improvement of environment and safeguarding of forests and wildlife); Article 51 A (Fundamental duties).

**Unit-III:** The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986.

**Unit-IV:** The Public Liability Insurance Act 1991; Noise Pollution (Regulation and Control) Rules 2000; The Biological Diversity Act 2002; The Schedule Tribes and other Traditional Dwellers (Recognition of Forests Rights) Act 2006; The National Green Tribunal Act 2010; scheme and labeling of environment friendly products, Ecomarks.

**Unit-V:** Ramsar convention, 1971; Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21); Montreal Protocol 1987; Kyoto Protocol 1997; Copenhagen and Paris summits.

## **Practicals**

Study of important rock forming and economic minerals in hand specimens.

Identification of igneous rocks.

Identification of Sedimentary rocks.

Identification of metamorphic rocks.

Sampling techniques of soil

Identification of soil types, soil texture and structures.

Determination of specific gravity of soil samples

Soil analysis: Major elements like  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ .

Determination of pH of soil samples

Determination of lime content of the soil

Determination of water holding capacity of different soil.

Study of electrical conductivity of soil samples.

## **SEMESTER: VI**

### **Climate Change: Mitigation and adaptation**

**Unit-I:** Atmospheric structure and composition, Milankovitch cycles. Chemistry of atmospheric particles and gases; smog: types and processes; photochemical processes; ions and radicals in atmosphere

**Unit-II: Meteorology and atmospheric stability:** Meteorological parameters (temperature, relative humidity, wind speed and direction, precipitation); atmospheric stability and mixing heights; temperature inversion; plume behavior; Gaussian plume model. Movement of air masses; atmosphere and climate; air and sea interaction; southern oscillation; western disturbances; El Nino and La Nina; tropical cyclone; Indian monsoon and its development, changing monsoon in Holocene in the Indian subcontinent, its impact on agriculture and Indus valley civilization; effect of urbanization on micro climate; Asian brown clouds.

**Unit-III:** Global warming and climate change Earth's climate through ages; trends of global warming and climate change; drivers of global warming and the potential of different greenhouse gases (GHGs) causing the climate change; atmospheric windows; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO<sub>2</sub> fertilization and agriculture; impact on economy and spread of human diseases.

**Unit-IV:** Ozone layer depletion Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion; mitigation measures and international protocols.

**Unit-V:** Climate change and policy Environmental policy debate; International agreements; Montreal protocol 1987; Kyoto protocol 1997; Convention on Climate Change; carbon credit and carbon trading; clean development mechanism.

### **Eco Restoration and Sustainable Development**

**Unit-I:** Degraded lands: agricultural practices and land degradation, Mining and its impact on soil quality Conservation of degraded lands, Rehabilitation of mine soils and salt affected soils,

**Unit-II:** Soil Conservation: Biological reclamation techniques Bio fertilizers, mycorrhizae, Vermicomposting, afforestation, Organic farming, Bioremediation.

**Unit-III:** Approaches for environmental awareness and education, Role of media in environmental awareness, Role of women in environmental awareness. Eco development and environment friendly products and technologies.

**Unit-IV:** Sustainable development: Scope and importance; Concept of sustainability and sustainable development.

**Unit-V:** Approaches in resource management: ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies.

### **Practicals**

Based on Theory Papers

## **9.6 FOOD SCIENCE AND NUTRITION**

### **BFSNDSC-1 HUMAN PHYSIOLOGY**

#### **BLOCK-I: General Physiology**

**Unit 1:** Cell Physiology: Structure and Functions.

**Unit 2:** Blood- Composition and Functions-WBC, RBC, Platelets

**Unit 3:** Cardiovascular System- Circulation, Cardiac Cycle, Blood pressure and its regulation

**Unit 4:** Nervous System- Structure, Functions of Neuron, Brain, Principles, Synapse, reflex action, Spinal cord, Brain stem, cerebellum, Thalamus, Cerebrum, Hypothalamus

#### **BLOCK-II: Non-Endocrine System**

**Unit 5:** Muscular System – structure and function

**Unit 6:** Respiratory System- Functional organization, Mechanics of breathing, exchange of gases and regulation

**Unit 7:** Digestive system- Structure and Functions of Gastro-intestinal Tract, process of digestion and absorption

**Unit 8:** Renal System- Structure and functions of Kidney, formation of urine, micturition, Role of kidney in water, temperature and acid base regulation.

#### **BLOCK-III: Endocrine System- Structure, function, hypo and hyper secretion**

**Unit 9:** Pituitary Gland.

**Unit 10:** Thyroid Gland and Parathyroid gland

**Unit 11:** Adrenal gland

**Unit 12:** Pancreas, Thymus and Pineal Body

## **BLOCK-IV: Reproductive system, Special senses and Immune system**

**Unit 13:** Reproductive System: Male and female, pregnancy, parturition, fetal circulation, Development of breast and lactation

**Unit 14:** Special Senses- Skin, Ear, Nose, Tongue, Eyes- Physiology and functions

**Unit 15:** Immune System

**Unit 16:** Basics of Human Genetics

## **HUMAN PHYSIOLOGY - PRACTICALS 1**

1. Identification of tissue slides – epithelial tissues, connective tissues, muscular tissues and nervous tissues
2. Determination of Bleeding and clotting time (both methods)
3. Determination of Blood groups and Rh factor
4. Estimation of hemoglobin (Sahli's method and Cyanomethaemoglobin method)
5. Enumeration of RBC, WBC, Differential count of WBC
6. Determination of blood pressure (under various positions) – demonstration
7. Urine analysis – microscope observation, pH, glucose and albumin
8. Spotters-Instruments, reagents and Cellular component of Blood
9. Visit to anatomy and pathology units (Optional)

## **BSC FSN-2 FOOD SCIENCE**

### **BLOCK-I: Cereals, Pulses, Nuts & Oilseeds**

**Unit 1:** Cereals - Structure and composition of rice and wheat grains, Starch, nature and effect of cooking. Malting and cooking of cereals, milling of wheat, Parboiling of Rice, Fermentation

**Unit 2:** Cereal Products- Flours and flour quality, extruded foods, breakfast cereals, wheat germ, puffed and flaked cereals, non-enzymatic reactions, leavening agents

**Unit 3:** Pulses and Legumes – Varieties of pulses and grams, Composition, nutritive value, cooking quality of pulses, germination and its effect

**Unit 4:** Nuts & Oilseeds- Composition, nutritive value (almonds, cashews, coconut, groundnut, walnut, flaxseed, soya bean, sesame and sunflower), oil extraction and by-products.

### **BLOCK-II: Vegetables, Fruits, Spices & Sugar**

**Unit 5:** Vegetables - Classification, composition, selection and preparation for cooking, Effects of cooking on color, texture and acceptability, Browning reaction and its prevention

**Unit 6:** Fruits - Classification of fruits, Composition, changes during ripening Effects of cooking on color, texture and acceptability, Browning reaction and its prevention

**Unit 7:** Spices- Composition, flavoring extracts - Natural and synthetic and abuses, role of spices in cookery.

**Unit 8:** Sugar, Jaggery and Honey- Composition, Stages of sugar cookery, crystallization and factors affecting crystallization, application in food preparations

### **BLOCK-III: Animal Foods**

**Unit 9:** Egg- Structure, composition, grading for quality of egg, nutritive value, Effect of cooking on egg quality, Use of eggs in cookery, methods of cooking, foam formation and factors affecting foam formation.

**Unit 10:** Meat- Structure, composition, nutritive value, selection of meat, Post-mortem changes, aging, tenderness, methods of cooking meat and their effects. Factors to be considered in selection and preparation of meat, poultry and fish

**Unit 11:** Fish & Poultry- Structure, composition, nutritive value, selection of fish, methods of cooking and effects. Types of poultry, composition, nutritive value, selection, methods of cooking.

**Unit 12:** Milk & Milk Products- Composition, nutritive value, types of milk, Factors affecting the quality, pasteurization and homogenization of milk, changes in milk during heat processing, Dairy products, cultured milk, yoghurt, butter, cheese and milk powder

### **BLOCK-IV: Fats and oils, Beverages, Properties of Foods and Sensory Evaluation**

**Unit 13:**Physico-chemical properties of fats and oils, Functions of fat, shortening effects of oil, smoking point and its application, factors affecting absorption of oil, Rancidity

**Unit 14:** Beverages- Tea; Coffee. Cocoa Powder-Processing, nutritional aspects, other Beverages-Aerated beverages, juices

**Unit 15:** Properties of food- Colloids, sols, gels, foam, Emulsion formation, Bound and

free water, pH Value, osmosis and osmotic pressure, Boiling, melting and freezing points

**Unit 16:** Sensory Evaluation- Subjective and objective; threshold test, Difference test, Hedonic scoring, acceptance and preference tests.

## **FOOD SCIENCE – PRACTICALS 2**

1. Cereals - Microscopic examination of starch molecules, Gelation of cereal flours
2. Pulses – Effect of soaking, sprouting, addition of acid and alkali on cooking quality.
3. Vegetable and fruits – Effect of adding acid and alkali on vegetables, Prevention of browning
4. Eggs -Demonstration of grading eggs for quality, Ferrous sulphate formation and prevention
5. Oils – Smoking points of oils and its uses.
6. Milk and milk products –Separation of cream and preparation of paneer and khoa
7. Sugar cookery – Stages of crystallization and its uses.

## **BFSNDSC-3 PRINCIPLES OF NUTRITION**

### **BLOCK-I: BASICS OF NUTRITION**

**Unit 1:** Introduction to nutrition – definition - nutrition and nutrients, adequate, optimum & good nutrition, malnutrition, Food as source of nutrients, functions of food, relationship between food, nutrition and health.

**Unit 2:** Concepts of food and nutrition- Food groups and their application, balanced diet, dietary guidelines, food pyramid, Importance of food exchange list (in brief).

**Unit 3:** Development of dietary reference intakes- History and concept of Dietary Reference Intakes, DRI categories, Parameters used in developing DRIs, Application of DRIs, role of WHO, ICMR and IOM in computing nutrient recommendations

**Unit 4:** Nutrient requirements and recommendations - Nutrient requirements and Recommended Dietary Allowances, Importance of nutrients at various stages of life, Approaches to assess nutrient requirements for humans, Factors to be considered while computing RDA, Reference body weights, Individual variability in nutrient requirements, Application of RDA

### **BLOCK-II: BODY COMPOSITION, ENERGY AND ELECTROLYTE**

**Unit 5:** Composition of the body – chemical composition, body compartments- lean body mass, fat mass, water. Methods of studying body composition (in brief). Body fluids and Body water compartments.

**Unit 6:** Energy- forms of energy, food as a source of energy, units of measurements. a) Determination of energy content in foods (Bomb calorimeter), physiological fuel values (at water factors), energy expenditure at rest (BMR/RMR)- methods of determination of BMR. b) Factors effecting energy expenditure for physical work, energy cost of physical activities, post-prandial thermogenesis.

**Unit 7:** Water: Functions, requirements, sources, water balance, Regulation of water balance, disorders of water imbalance.

**Unit 8:** Electrolyte and acid base balance: Electrolyte- Sodium, Chloride, Potassium- functions, sources and RDA.

### **BLOCK-III: MACRO NUTRIENTS**

**Unit 9:** Carbohydrates: classification (Available & Non-Available), Functions, food sources, storage in body, Digestion & absorption, RDA and deficiencies

**Unit 10:** Dietary Fibre- Classification, Role of fibres in human nutrition, Food Sources

**Unit 11:** Proteins – Composition, Classification, essential and non-essential amino acids, food sources- animal/vegetable protein for growth and maintenance, Protein Deficiency

**Unit 12:** Lipids- Classification, sources, composition, distribution-visible and invisible fat, digestion, absorption, functions, requirements, Recommended Dietary Allowances, effects of deficiency and/ or excess consumption on health. Essential fatty acids and cholesterol - sources, function and health implications

### **BLOCK-IV: MICRONUTRIENTS**

**Unit 13:** Introduction to vitamins and classification of vitamins, Fat-Soluble Vitamins- functions, sources, dietary requirements, body stores, effects of deficiency, toxicity

**Unit 14:** Water-Soluble Vitamins- Classification, functions, sources, dietary requirements, effects of deficiency, toxicity



**Unit 15:** Introduction to vitamins and classification of Minerals, Macro Minerals- Calcium, Phosphorus, and magnesium: Functions, absorption, RDA, sources and deficiencies.

**Unit 16:** Micro Minerals- Iron, Zinc, Fluorine, copper, selenium, molybdenum, and Iodine: function, absorption, RDA, sources and deficiency.

### **PRINCIPLES OF NUTRITION – PRACTICALS 3**

1. Food groups: calculation of mean energy, carbohydrates, protein, fat and dietary fiber content of foods using ICMR Tables. Preparation of a table for all the food groups and identification of their role to Indian diet.
2. Determination and calculation of nutrients of food ingredients using household measures and tools - dry and liquid measures.
3. Determination of edible portions of fruits and vegetables as purchased from the market. Calculation of percent edible portion and its nutrient content.
4. Identification and preparation of macro and micronutrient dense recipes and calculation of nutrient contents for the same.

## **BFSNDSC-4 FOOD CHEMISTRY**

### **BLOCK-I: INTRODUCTION TO FOOD CHEMISTRY**

**Unit 1:** Principal components of foods, chemical functions of foods, properties of foods- physical, chemical, functional and kinetic properties.

**Unit 2:** Colloidal system in foods – meaning, types, properties. Sols – meaning, types, properties: gels – meaning, type, properties, theory of gel formation, factors influencing gel formation.

**Unit 3:** Emulsion – meaning, types, properties, emulsifying agents, natural and synthetic emulsifier, functions of emulsifying agent, common food emulsions: foams – meaning, methods of foam formation, theory of foam formation, properties – factors influencing foam formation, factors affecting stability of foam, foaming agents – natural and synthetic.

**Unit 4:** Water –Types of water, hydrogen bonding in water, water and ice properties, functions of water in food. Water activity– definition, measurement and control of water activity, estimation of moisture in foods.

## **BLOCK-II: CHEMISTRY OF FOODS**

**Unit 5:** Heat transfer operations in foods – conduction, convection, radiation, gelatinization, retrogradation, dextrinisation of starches, enzymatic and non-enzymatic browning reaction in foods, rancidity – types and prevention. Biochemical changes in foods.

**Unit 6:** Physico-chemical and nutritional changes occurring during food processing treatments- Drying and dehydration, Irradiation, Freezing, Canning

**Unit 7:** Pigments indigenous to food, structure, chemical and physical properties. Effect of processing and storage.

**Unit 8:** Flavours – Vegetables, fruit and spice flavours, fermented food, Meat and sea food.

## **BLOCK-III: CHEMISTRY OF NUTRIENTS**

**Unit 9:** Carbohydrates: Definition, classification. Structure of monosaccharides, disaccharides and polysaccharides, Stereochemistry of Monosaccharides, Linkage in sucrose, lactose and maltose. Homopolysaccharides and heteropolysaccharides (starch, cellulose and glycogen). Physico-chemical properties of carbohydrates, metabolism and regulation of carbohydrate metabolism

**Unit 10:** Lipids: Definition and classification, types and properties of fatty acids, composition and Characteristics → Physical properties-melting point, softening point, specific gravity, refractive index, smoke, flash and fire point, turbidity point. → Chemical properties-reichertmeissel value, polenske value, iodine value, peroxide value, saponification value. Effect of frying on fats. Changes in fats and oils- rancidity, lipolysis, flavor reversion. Auto-oxidation and its prevention. Technology of edible fats and oils- Refining, Hydrogenation and Interesterification

**Unit 11:** Proteins: Definition, classification, structure and properties of amino acids, essential and non-essential amino acids, Protein classification and structure. Nature of food proteins (plant and animal proteins). Properties of proteins (electrophoresis, sedimentation, amphoterism and denaturation,). Functional properties of proteins eg. organoleptic, solubility, viscosity, binding gelation / texturization , emulsification , foaming.

**Unit 12:** Artificial sweeteners: Other sweetening agents, functions of sugar in food (Browning reaction), changes during cooking and processing. Food additives: Antioxidants

chelating agents Coloring Agents Curing Agents Emulsions Flavorsome flavour enhancers Humectants and anti-caking agents

#### **BLOCK-IV: ENZYMES**

**Unit 13:** Definition, types and classification of enzymes and coenzymes, specificity of enzymes, Isozymes, enzyme kinetics including factors affecting velocity of enzyme catalyzed reactions, enzyme inhibition.

**Unit 14:** Vitamins as coenzymes in the metabolism of carbohydrates, lipids and proteins, Coenzyme functions of Biotin, folic acid, Vitamin B12.

**Unit 15:** Use of Enzymes in Food Industry-Carbohydratases, Proteases, lipases, oxidoreductases, hydrolases (eg: Cheese, fruit, juice, Wine, Meat tenderizing & dairy).

**Unit 16:** Enzyme Technology- Production of enzymes- Amylase, Protease, Lipase, Lactase and pectinase, Application of enzymes and immobilized enzymes.

#### **FOOD CHEMISTRY-PRACTICALS 4**

1. **Carbohydrates** -Estimation of reducing and total sugars in foods  
-Estimation of lactose in milk
2. **Fats** -Determination of acid value,  
-Saponification and Iodine number of natural fats and oils  
-Estimation of crude fat content of foods by soxhlet's method
3. **Proteins** -Reactions of amino acids and their identification in unknown mixtures  
-Estimation of total N of foods by Kjeldahl method
4. **Enzymes**-Effect of pH and temperature on enzyme activity  
-amylase on starch, pepsin on proteins and lipase on fats

#### **BFSNDSE-1 COMMUNITY NUTRITION**

##### **BLOCK-I:NUTRITION PROBLEMS AND INTERVENTION PROGRAMMES**

**Unit 1:**Prevalence and causes of nutritional problems in India: Energy protein malnutrition, Nutritional Anemia, deficiencies of vitamin A, Iodine, Fluorine

**Unit 2:**Nutritional intervention programmes – Supplementary feeding. School lunch, Goiter control programmes

**Unit 3:** Objectives & operation of feeding programmes- ICDS, TINP, NNMS, IRDP, DWACRA. Food supplementation, Fortification and enrichment

**Unit 4:** National organizations and their role in nutrition programmes - ICMR, NIN, NNMB, ICAR, CFTRI, NIPCCD. International organizations - FAO, WHO, UNICEF, UNESCO, World Bank.

**Unit 5:** Demography, population dynamics and vital events and their health implications, indicators of health and nutrition (IMR, TMR, MMR).

## **BLOCK-II: NUTRITION DURING LIFE CYCLE**

**Unit 6:** Pregnancy and Lactation— physiological stages of pregnancy, complications of pregnancy, nutritional requirements, food selection.

**Unit 7:** Infancy and Early Childhood (Toddler/preschool) – Growth and development, nutritional requirements, breast feeding, infant formula, Weaning and supplementary foods, feeding patterns

**Unit 8:** School children and Adolescence – Nutritional requirement – Importance of snacks, school lunch, Nutritional problem in school age child, food choices, eating habits, factors influencing

**Unit 9:** Adult hood and Elderly – food and nutrient requirements, Factors affecting food and nutrient use. Nutrient needs. Nutrition related problems

## **BLOCK-III: ROLE OF NUTRITION IN NATIONAL DEVELOPMENT**

**Unit 10:** National nutritional policy - Aim, objectives, guidelines and thrust areas. PDS - Public distribution system. National nutrition surveillance system. Food for work

**Unit 11:** Role of nutritionist in health care delivery. Health Indices: fertility indicator, vital statistics, mortality, morbidity and demographic indicator, Human development Index, Reproductive health index. IMR, MMR, birth rate, sex ratio, poverty level

**Unit 12:** Food borne infection and intoxication diseases- Definition, classification, foods involved, target group, prevention of disease and nutritional care

**Unit 13:** Nutrition education - Meaning, nature and importance of nutrition education to the community, Training of workers in nutrition education programme. Principles of planning,

executing and evaluation nutrition education programme. Methods and Techniques of organizing nutrition programmes using audio, video aids and exhibition

**Unit 14:** Assessing food and nutrition security – Definition and assessment schedules, National and household food security. Factors affecting food security system. National and International systems to improve food security

## **COMMUNITY NUTRITION - PRACTICALS 5**

1. **Nutritional anthropometry** –Height, weight and mid arm circumference and Classifications & interpretation of data.
2. **Planning, calculation and evaluation Normal diets** - adults (men and women) pregnant women, lactating women, elderly, pre- school, adolescent (boys and girls).
3. **Planning, preparation and evaluation** -Different types of weaning food and comparing with commercial weaning foods in terms of nutritive value and cost.
4. **Visit to Anganwadi and other community centers to observe their activities.**

## **BFSNDSE-2 FOOD MICROBIOLOGY**

### **BLOCK-I: INTRODUCTION OF MICROBIOLOGY**

**Unit 1:** Basic concept of food microbiology- Introduction of microbiology and its relevance to everyday life, History and Development of Food Microbiology. Definition and Scope of food microbiology, role of microorganism in food processing, General characteristics of bacteria, fungi, virus, protozoa, and algae. Beneficial effect of microorganisms.

**Unit 2:** Characteristics of Microorganisms in Food: Types of microorganisms associated with food, their morphology and structure. Significance of spores in food microbiology. Growth of microorganisms, factors affecting the growth of microorganisms.

**Unit 3:** Food contamination- definition, introduction to microbiology of air, water and soil, sources of food contamination, control and destruction of microorganisms.

**Unit 4:** Foodborne Diseases: Microbial intoxication and infections: Sources of contamination of food, Types – food borne infections, food borne intoxications, symptoms, and method of control.

## **BLOCK-II: MICROBIAL SPOILAGE OF FOODS AND HEALTH HAZARDS**

**Unit 5:** Basics concepts of food spoilage- definition, factors responsible for food spoilage, chemical and physical changes due to spoilage. Spoilage of animal foods- meat, fish, egg and poultry and milk and milk products.

**Unit 6:** Spoilage of cereals and cereal products, sugar and sugar products.

**Unit 7:** Spoilage of fruits and vegetables and products, effect on canned foods- soft drinks, fruit juices, fruit preserves, pickles.

**Unit 8:** Food borne diseases- food borne infection, intoxications, toxic infections, mycotoxins, naturally occurring toxicants in foods.

## **BLOCK-III: APPLICATIONS OF MICROORGANISMS**

**Unit 9:** Food Fermentation- definition and types , Basic of food fermentation process, Microbial fermentation of Indian Traditional foods - A. Cereal and legume-based products, traditional and yeast leavened products, Vegetables and fruits – lactic acid fermentation, Milk products – yoghurt, butter- milk, cheese, Meat and fish- fermentation and drying procedures, concept of probiotics and prebiotics: effect on gut microflora, methods of manufacture for vinegar, soya sauce ,beer, wine and traditional Indian foods

**Unit 10:** Control of Microorganisms in Foods: Principles and methods of preservation. Physical Methods of Food Preservation- Dehydration, Freezing, Cool Storage, Heat Treatment (esp. thermobacteriology), Irradiation, Chemical methods, Bio preservatives esp. Bacteriocins. Introduction to Hurdle concept and non-Thermal methods.

**Unit 11:** Food packaging: Definitions, objectives and functions of packaging and packaging materials. Food packaging systems: Different forms of packaging such as rigid, semi-rigid, flexible forms and different packaging system for (a) dehydrated foods (b) frozen foods (c) dairy products (d) fresh fruits and vegetables (e) meat, poultry, and sea foods.

**Unit 12:** Relevance of microbial standards for food safety- Indian and International Food Laws and standards, General principles of food safety management systems including traceability and recall – sanitation, HACCP, Good production, and processing practices (GMP, GAP, GHP, GLP, BAP, etc), role of FSSAI in food safety.

## **FOOD MICROBIOLOGY – PRACTICALS 6**

1. Study of laboratory equipments in microbiology.
2. Preparation of laboratory media and special media, cultivation of bacteria, yeasts and moulds.
3. Staining of microorganisms -fungal.
4. Cultivation and identifications of important molds and yeast in food items.
5. Demonstration of available rapid methods and diagnostic kits used in identification of microorganisms or their products.

## **BFSNDSE-3 CLINICAL NUTRITION**

### **BLOCK-I:NUTRITIONAL ASSESSMENT AND CARE OF THE SICK**

**Unit 1:** Nutritional assessment- methods, importance, nutritional assessment of hospitalized patients, importance of psychological and environmental factors in patient's care. Advantages of nutritional assessment, interpretation of nutritional assessment.

**Unit 2:** Nutritional assessment of the sick: Anthropometry, Biochemical, Clinical, Dietary and Functional indices of assessments:

A. Anthropometry: Methods, reference standards in children and adults, scales of comparison (percentiles, Z score), classification and interpretation of somatic data, somatic indicators of PEM

B. Biochemical: Use of specimen types, indicators of protein-energy status, anemia, immune function, CVD risk, oxidative stress. Urine and stool analyses.

C. Dietary- Methods, nutrient intake analysis, dietary assessment in special populations and specific situations, Dietary reference intakes

D. Clinical- Components of clinical assessment, associations with nutrient deficiencies and biochemical status

**Unit 3:** Feeding the patients - Psychology of feeding the patient, assessment of patient needs. Feeding infants & children - problems in feeding children in hospitals.

**Unit 4:** Team approach in nutrition care of the sick: team approach- aims and objectives,

Importance of nutritional and rehabilitation services, inter-relational inpatient care and patient centered nutrition care, nutrition and medical ethics.

## **BLOCK-II: BASICS OF DIET THERAPY**

**Unit 5:** Dietitians- definition, classification, responsibilities, code of ethics, diet counselling.

**Unit 6:** Role of dietitian – Interpersonal relationship with patients, team approach in nutritional care. Role of dietitian in the hospital & community. Role of dietitian in hospital- specific functions, team approach in patient care, psychological consideration, interpersonal relationship with patients. Hospital dietary- scope and importance, types of foodservice, quality management.

**Unit 7:** Basic concepts of diet therapy- objectives, concept of desirable diet, balanced diet, basic principles in planning diet, factors to be considered while planning diet, tailor made diet, my plate concepts, use of dietary guide and food exchange list.

**Unit 8:** Diet therapy- therapeutic nutrition for changing needs, Adaptation of normal diet for changing needs. Concept of diet therapy: purpose and principle of therapeutic diets, modification of normal diet, classification of therapeutic diet.

## **BLOCK-III: APPROACHES FOR IMPROVING NUTRITION AND HEALTH STATUS**

**Unit 9:** Nutrient and drug- Diet and drug interactions, effect on ingestion, digestion, absorption and metabolism of nutrients, effect on nutritional status, effect on organ function, drug dosage and efficacy, drug abuse and drug resistance.

**Unit 10:** Nutrition and Infection – hospital malnutrition, Relationship between nutrition and infection, role of foods in boosting immunity, immunization and its importance.

**Unit 11:** Health based interventions- provision of safe drinking water, sanitation, prevention and management of diarrhoeal diseases, Food based interventions including food fortification, dietary diversification, supplementary feeding and biotechnological approaches.

**Unit 12:** Education based interventions- growth monitoring and promotion (GMP), health and nutrition related behaviour change communication.

**Unit 13:** Nutritional counselling- Communication in nutrition counseling, counseling plans, Counseling approaches and counseling application, Implementation and evaluation aspects of counseling

## **CLINICAL NUTRITION – PRACTICALS 7**

1. Assessment of patients –



- Anthropometry: Methods, reference standards in children and adults, scales of comparison (percentiles, Z score), classification and interpretation of somatic data, somatic indicators of PEM
  - Biochemical: Use of specimen types, indicators of protein-energy status, anemia, immune function, CVD risk, oxidative stress. Urine and stool analyses.
  - Dietary- Methods, nutrient intake analysis, dietary assessment in special populations and specific situations, Dietary reference intakes
  - Clinical- Components of clinical assessment, associations with nutrient deficiencies and biochemical status
2. **Nutritional counseling** – Case studies.
  3. **Visit to rehabilitation centers/ old age home**

## **9.7 MATHEMATICS**

### **SEMESTER – I**

#### **BLOCK-I:Differential Calculus -I**

**Unit-1:** Derivative of a function - Derivatives of higher order –  $n^{\text{th}}$  derivatives of the functions:  $e^{ax}$ ,  $(ax + b)^n$ ,  $\log(ax + b)$ ,  $\sin(ax + b)$ ,  $\cos(ax + b)$ ,  $e^{ax}\sin(bx + c)$ ,  $e^{ax}\cos(bx + c)$  – Problems,

**Unit-2:** Leibnitz theorem and its applications.

**Unit-3:** Monotonic functions – Maxima and Minima.

**Unit-4:** Concavity, Convexity and points of inflection.

#### **BLOCK-II:Differential Calculus -II**

**Unit-1:** Polar coordinates – angle between the radius vector and the tangent at a point on a curve – angle of intersection between two curves.

**Unit-2:** Pedal equations – Cartesian, Polar and Parametric forms.

**Unit-3:** Derivative of arc length in Cartesian, Parametric and Polar form, Radius of curvature.

**Unit-4:** Coordinates of center of curvature -- Circle of curvature – Evolutes.

#### **BLOCK-III:Matrix Theory**

**Unit-1:** Rank of a matrix – Elementary row/column operations – Invariance of rank under elementary operations – Inverse of a non-singular matrix by elementary operations.

**Unit-2:** System of  $m$  linear equations in  $n$  unknowns – Matrices associated with linear equations – trivial and non-trivial solutions – Criterion for existence of non-trivial solution of homogeneous and non-homogeneous systems – Criterion for uniqueness of solutions for non-homogeneous equations.

**Unit-3:** Eigen values and eigenvectors of a square matrix – Properties – Diagonalization of a real symmetric matrix.

**Unit-4:** Cayley - Hamilton theorem – Applications to determine the powers of square matrices and inverses of non-singular matrices.

**Reference textbooks:**

1. *Lipman Bers – Calculus, Volumes 1 and 2*
2. *N. Piskunov – Differential and Integral Calculus*
3. *B S Vatssa, Theory of Matrices, New Delhi: New Age International Publishers, 2005.*
4. *G B Thomas and R L Finney, Calculus and analytical geometry, Addison Wesley, 1995.*
5. *Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.*
6. *Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.*
7. *R Balakrishnan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.*
8. *Natarajan, Manicavasagam Pillay and Ganapathy – Algebra.*
9. *G. D. Birkhoff and S MacLane – A brief Survey of Modern Algebra.*
10. *N P Bali, Differential Calculus, India: Laxmi Publications (P) Ltd., 2010.*
11. *S Narayanan & T. K. Manicavachogam Pillay, Calculus.:S. Viswanathan Pvt. Ltd., vol. I & II 1996.*
12. *Shanti Narayan and P K Mittal, Text book of Matrices, 5th edition, New Delhi, S Chand and Co. Pvt.Ltd.,2013.*
13. *Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.*

**SEMESTER – II**

## **BLOCK- I:Theory of Equations**

**Unit-1:** Euclid's algorithm – Polynomials with integral coefficients – Remainder theorem – Factor theorem – Fundamental theorem of algebra (statement only). Irrational and complex roots occur in conjugate pairs – Relation between roots and coefficients of a polynomial equation.

**Unit-2:** Symmetric functions – Transformations – Reciprocal equations.

**Unit-3:** Solving cubic equations by Cardon's method – Descartes' rule of signs – Multiple roots.

**Unit-4:** Solving quartic equations by Descarte's method and Ferrari's method.

## **BLOCK-II:Limits and Continuity:**

**Unit-1:** Limit of a function – Properties and problems.

**Unit-2:** Continuity of functions – Properties and problems.

**Unit-3:** Infimum and supremum of a function – Theorems on continuity – Intermediate value theorem.

**Unit-4:** Differentiability- Properties and problems

## **BLOCK-III:Differential Calculus - III**

**Unit-1:** Rolle's theorem – Lagrange's Mean Value theorem.

**Unit-2:** Cauchy's mean value theorem – Taylor's theorem – Maclaurin's theorem, Taylor's series expansion.

**Unit-3:** Maclaurin's infinite series expansion – problems.

**Unit-4:** Indeterminate forms.

## **Reference textbooks:**

1. *Serge Lang – First Course in Calculus*
2. *Lipman Bers – Calculus, Volumes 1 and 2*
3. *N. Piskunov – Differential and Integral Calculus.*
4. *Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.*
5. *Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.*

6. *R Balakrishnan and N.Ramabadran, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.*
7. *Natarajan, Manicavasagam Pillay and Ganapathy – Algebra.*
8. *N P Bali, Differential Calculus, India: Laxmi Publications (P) Ltd., 2010.*
9. *S Narayanan & T. K. Manicavachogam Pillay, Calculus.:S. Viswanathan Pvt. Ltd., vol. I & II 1996.*
10. *Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.*

### **SEMESTER – III**

#### **BLOCK - I: Vector Calculus**

**Unit-1:** Scalar field – gradient of a scalar field, geometrical meaning – directional derivative – Maximum directional derivative.

**Unit-2:** Angle between two surfaces, Vector field– divergence and curl of a vector field – Standard derivations, solenoidal and irrotational fields.

**Unit-3:** Scalar and vector potentials – Laplacian of a scalar field. Vector identities, Standard properties, Harmonic functions, Problems.

**Unit-4:** Vector integration – Green’s theorem in plane, problems.

#### **BLOCK- II: Integral Calculus**

**Unit-1:** Integration of Rational functions  $\int \frac{1}{ax^2+bx+c} dx$  ,  $\int \sqrt{ax^2 + bx + c} dx$  ,  $\int \frac{1}{\sqrt{ax^2+bx+c}} dx$ ,  $\int \frac{px+q}{ax^2+bx+c} dx$ .

**Unit-2:** Integration of Rational functions  $\int (px + q)\sqrt{ax^2 + bx + c} dx$ ,  $\int \frac{px+q}{\sqrt{ax^2+bx+c}} dx$ ,  $\int \frac{1}{(px+q)\sqrt{ax^2+bx+c}} dx$ ,  $\int \frac{1}{(px^2+qx+r)\sqrt{ax+b}} dx$ .

**Unit-3:** Reduction formulae for  $\int \sin^n x dx$  ,  $\int \cos^n x dx$  ,  $\int \tan^n x dx$  ,  $\int \cot^n x dx$  ,  $\int \sec^n x dx$ ,  $\int \csc^n x dx$  with definite limits.

**Unit-4:** Reduction formules for  $\int \sin^m x \cos^n x dx$ ,  $\int x^n e^{ax} dx$  ,  $\int x^n (\log x)^m dx$  ,  $\int x^n \sin mx dx$  ,  $\int x^n \cos mx dx$  with definite limits.

#### **BLOCK- III: Partial Derivatives**

**Unit-1:** Functions of two or more variables – Explicit and implicit functions – The neighbourhood of a point – The limit of a function – Continuity – Partial derivatives.

**Unit-2:** Homogeneous functions – Euler’s theorem – Chain rule.

**Unit-3:** Change of variables – Directional derivative – Partial derivatives of higher order – Taylor’s theorem for two variables.

**Unit-4:** Derivatives of implicit functions – Jacobians – Some illustrative examples.

**Reference textbooks:**

1. *N P Bali, Differential Calculus, India: Laxmi Publications (P) Ltd., 2010.*
2. *D E Bournesand, P C Kendall, Vector Analysis, ELBS, 1996.*
3. *Lipman Bers – Calculus, Volumes 1 and 2.*
4. *N. Piskunov – Differential and Integral Calculus.*
5. *S Narayanan & T. K. Manicavachogam Pillay, Calculus.:S. Viswanathan Pvt. Ltd., vol. I & II 1996N. Piskunov – Differential and Integral Calculus*
6. *M D Raisinghanian, Vector calculus,S Chand Co. Pvt. Ltd., 2013.*
7. *Serge Lang – First Course in Calculus*
8. *Shanthi Narayan and P K Mittal, Differential Calculus, Reprint. New Delhi: S Chand and Co. Pvt. Ltd., 2014.*
9. *B Spain,Vector Analysis , ELBS, 1994.*

**SEMESTER – IV**

**BLOCK-I:Differential Equations**

**Unit-1:** Recapitulation – Definition, examples of differential equations, formation of differential equations by elimination of arbitrary constants.

**Unit-2:** Differential equations of first order, first degree – Separation of variables, Reducible to separation of variables, Homogeneous differential equations, Reducible to homogeneous equations.

**Unit-3:** Linear differential equations, Bernoulli’s equation (Reducible to linear differential Equations).

**Unit-4:** Exact differential equations, reducible to exact by determining integrating factors.

## **BLOCK-II: Group Theory**

**Unit-1:** Definition and examples of groups – Some general properties of Groups– Subgroups.

**Unit-2:** Group of permutations, Cyclic permutations – Even and odd permutations.

**Unit-3:** Order of an element of a group – Cyclic groups problems and theorems.

**Unit-4:** Cosets, Index of a group, Lagrange's theorem, consequences.

## **BLOCK-III: Normal Subgroups and Homomorphism**

**Unit-1:** Normal Subgroups and its properties.

**Unit-2:** Homomorphism, Isomorphism and their properties.

**Unit-3:** Range and Kernel of homomorphism – Properties.

**Unit-4:** Quotient groups – Fundamental theorem of homomorphism.

## **Reference textbooks:**

1. *Daniel A Murray – Introductory Course to Differential equations*
2. *Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.*
3. *Herstein I N, Topics in Algebra, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.*
4. *Joseph Gallian – Contemporary Abstract Algebra, Narosa Publishing House, New Delhi, Fourth Edition.*
5. *G. D. Birkhoff and S MacLane – A brief Survey of Modern Algebra.*
6. *J B Fraleigh – A first course in Abstract Algebra.*
7. *Michael Artin – Algebra, 2nd ed. New Delhi, India: PHI Learning Pvt. Ltd., 2011.*
8. *Vashista, A First Course in Modern Algebra, 11th ed.: Krishna Prakasan Mandir, 1980.*
9. *R Balakrishnan and N.Ramabadrana, A Textbook of Modern Algebra, 1st ed. New Delhi, India: Vikas publishing house pvt. Ltd., 1991.*
10. *M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.*
11. *F Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA*

McGraw-Hill, 2010.

12. S Narayanan and T K Manicavachogam Pillay, *Differential Equations: S V Publishers Private Ltd., 1981.*

13. G F Simmons, *Differential equation with Applications and historical notes, 2nd ed.: McGraw- Hill Publishing Company, Oct 1991.*

## **SEMESTER - V**

### **PAPER I**

#### **BLOCK- I: Ordinary Differential Equations**

**Unit-1:** Ordinary Linear differential equations with constant coefficients – Complementary function.

**Unit-2:** Particular integral – Inverse differential operators.

**Unit-3:** Cauchy – Euler differential equations.

**Unit-4:** Simultaneous differential equations (two variables with constant coefficients)

#### **BLOCK – II: Linear differential equations**

**Unit-1:** Solution of ordinary second order linear differential equations with variable coefficient by various methods such as: (i) Changing the independent variable. (ii) Changing the dependent variable.

**Unit-2:** Solution of ordinary second order linear differential equations with variable coefficient by various methods (iii) By method of variation of parameters. (iv) Exact equations.

**Unit-3:** Total differential equations - Necessary and sufficient condition for the equation  $Pdx + Qdy + Rdz = 0$  to be exact (proof only for the necessary part).

**Unit-4:** Simultaneous equations of the form  $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$ , where  $P, Q, R$  are functions of  $x, y, z$ .

#### **BLOCK – III: Partial differential equations**

**Unit-1:** Basic concepts – Formation of a partial differential equations by elimination of arbitrary constants and functions – Solution of partial differential equations – Solution by Direct integration.

**Unit-2:** Lagrange's linear equations of the form  $Pp + Qq = R$ .

**Unit-3:** Standard types of first order non-linear partial differential equations – Charpit's method.

**Unit-4:** Homogenous linear equations with constant coefficients – Rules for finding the complementary functions – Rules for finding the particular integral, Method of separation of variables (product method).

**Reference textbooks:**

1. *Daniel A Murray – Introductory Course to Differential equations*
2. *Earl David Rainville and Philip Edward Bedient – A short course in Differential equations, Prentice Hall College Div; 6th edition.*
3. *M D Raisinghania, Advanced Differential Equations, S Chand and Co. Pvt. Ltd., 2013.*
4. *F Ayres, Schaum's outline of theory and problems of Differential Equations, 1st ed. USA McGraw-Hill, 2010.*
5. *S Narayanan and T K Manicavachogam Pillay, Differential Equations .: S V Publishers Private Ltd., 1981.*
6. *G F Simmons, Differential equation with Applications and historical notes, 2nd ed.: McGraw- Hill Publishing Company, Oct 1991.*
7. *G. Stephenson – An introduction to Partial Differential Equations.*
8. *B. S. Grewal – Higher Engineering Mathematics.*
9. *E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.*
10. *Martin Brown – Application of Differential Equations.*

**PAPER II**

**BLOCK – I: Theory of Numbers**

**Unit-1:** Division algorithm, Divisibility, The greatest common divisor (g.c.d), Euclidean algorithm, Diophantine equations, Fundamental theorem of arithmetic.

**Unit-2:** The theory of congruences – Basic properties of Congruences, Binary and decimal representation of integers.

**Unit-3:** Simultaneous linear congruences and the Chinese Remainder Theorem.

**Unit-4:** Euler's Phi-function, Some properties of Phi-function, Fermat's theorem, Wilson's theorem, Euler's theorem.

**BLOCK – II: Rings and Fields**



**Unit-1:** Rings – Examples – Properties.

**Unit-2:** Integral Domains – Division rings – Fields – Subrings, Subfields.

**Unit-3:** Characteristic of a ring – Imbedding of a ring into another ring – The field of quotients.

**Unit-4:** Ideals – Algebra of Ideals – Principal ideal ring – Divisibility in an integral domain – Units and Associates – Prime elements.

### **BLOCK – III: Numerical methods-I**

**Unit-1:** Errors and types of errors. Numerical solutions of Algebraic and transcendental equations – Bisection method, The method of false position.

**Unit-2:** Numerical solutions of Algebraic and transcendental equations – Newton-Raphson method.

**Unit-3:** Numerical solutions of first order linear differential equations – Euler-Cauchy method, Euler's modified method.

**Unit-4:** Numerical solutions of first order linear differential equations – Runge -Kutta fourth order method, Picard's method.

### **Reference textbooks:**

1. David M Burton, *Elementary Number Theory*, 6th edition, McGraw Hill, 2007.
2. Emil Grosswald, *Topics from the Theory of Numbers*, Modern Birhauser, 1984.
3. Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, *An Introduction to the Theory of Numbers*, John Willey (New York), 1991.
4. Herstein I N, *Topics in Algebra*, 4th ed. New Delhi, India: Vikas Publishing House Pvt. Ltd, 1991.
5. B. S. Grewal – *Higher Engineering Mathematics*.
6. E Kreyszig– *Advanced Engineering Mathematics*, Wiley India Pvt. Ltd.
7. S C Malik – *Real Analysis*.
8. S S Bali – *Real analysis*.
9. M K Jain, S R K Iyengar, and R K Jain, *Numerical Methods for Scientific and Engineering Computation*, 4th ed. New Delhi, India: New Age International, 2012.
10. S S Sastry, *Introductory methods of Numerical Analysis*, Prentice Hall of India, 2012.

### **OPTIONAL PAPERS**

#### **OPTIONAL PAPER I: GRAPH THEORY**

#### **BLOCK – I**

**Unit-1:** Definition of graph and examples, incidence and degree, subgraphs, isomorphism, complement of a graph, operation on graphs.

**Unit-2:** Walks, trails and paths, connectedness and components, cut-points and bridges, blocks. Eulerian graphs, Konigsburg bridge problem, Hamiltonian graphs.

**Unit-3:** Trees, center of a tree. Planarity of Graphs. Colourability, chromatic number, Chromatic Polynomial, five-colour theorem, four-colour problem. Matrix associated with graphs: Incidence matrix, Adjacency matrix.

**Unit-4:** Graphs and Planar Graphs: Introduction, Basic terminology, Multigraphs and Weighted graphs, Digraphs and relations, Representation of graphs, Operations on graphs, Paths and circuits, Eulerian paths and circuits, Hamiltonian paths and circuits, Planar graphs,

### **Books for References:**

1. F. Harary, *Graph Theory*, Addison-Wesley Publishing Co., Reading, Mass. Menlo Park, Calif. London, 1969.
2. S. Arumugam and S. Ramachandran, *Invitation to graph theory*, Scitech Publications (India) Pvt. Ltd., 2013.
3. Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, PHI Learning Private Limited, 2004.
4. Douglas B. West, *Introduction to Graph Theory*, Pearson, 2017.
5. K. Chandrasekhara Rao, *Discrete Mathematics*, Narosa Publishing House, 2012.
6. John Clark, D.A. Holton, *A first look at Graph Theory*, World Scientific, 1991.
7. Robin J Wilson, *Introduction to Graph Theory*, 5th Ed., Pearson, 2010.

## **OPTIONAL PAPER II: COMPLEX ANALYSIS**

### **BLOCK – I: Functions of a Complex Variable**

**Unit-1:** Equation to a circle and a straight line in complex form.

**Unit-2:** Limit of a function – Continuity and differentiability.

**Unit-3:** Analytic functions – Singular points – Cauchy-Riemann equations in Cartesian and polar forms – Necessary and sufficient condition for function to be analytic.

**Unit-4:** Harmonic functions – Real and Imaginary parts of an analytic function are harmonic – Construction of analytic function i) Milne Thomson Method – ii) using the concept of Harmonic function.

### **BLOCK – II: Transformations**

**Unit-1:** Definition – Jacobian of a transformation – Identity transformation – Reflection – Translation – Rotation – Stretching – Inversion – Linear transformation.

**Unit-2:** The Bilinear transformations – Cross Ratio of four points, cross ratio preserving property.

**Unit-3:** The Bilinear transformations – Preservation of the family of straight lines and circles, conformal mappings.

**Unit-4:** Discussion of the transformations  $w = z^2$ ,  $w = \sin z$ ,  $w = e^z$ ,  $w = \frac{1}{2} (z + 1/z)$ .

### **BLOCK – III: Complex Integration**

**Unit-1:** The complex Line integral – Examples and Properties.

**Unit-2:** Cauchy's Integral theorem, Proof of Cauchy's Integral theorem using Green's Theorem, Direct consequences of Cauchy's theorem.

**Unit-3:** The Cauchy's integral formula for the function and the derivatives, Applications to the evaluations of simple line integrals using Cauchy's integral theorem and formula.

**Unit-4:** Cauchy's Inequality, Liouville's theorem, Fundamental theorem of Algebra.

### **Reference textbooks:**

1. S Shanthinarayan, *Theory of Functions of a Complex Variable*, S Chand Co. Pvt. Ltd., 2012.
2. L V Ahlfors, *Complex Analysis*, 3rd ed.: Mc Graw Hill. , 1979.
3. A R Vashista, *Complex Analysis*, Krishna Prakashana Mandir, 2012.
4. R V Churchill & J W Brown, *Complex Variables and Applications*, 5th ed.: McGraw Hill Companies., 1989.
5. James Ward Brown and Ruel V. Churchill, *Complex Variables and Applications*, 8th Ed., McGraw – Hill International Edition, 2009. 122
6. Joseph Bak and Donald J. Newman, *Complex analysis*, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.
7. Bruce P. Palka – *Introduction to the Theory of Function of a Complex Variable*
8. S. Ponnuswamy – *Foundations of Complex Analysis*
9. R. P. Boas – *Invitation to Complex Analysis*.
10. Tristan Needham, *Visual Complex Analysis*, Clarendon Press Oxford.

## **SEMESTER – VI**

### **PAPER I:**

## **BLOCK- I:Riemann integration**

**Unit-1:** Partitions of an interval – Upper and lower Riemann sums.

**Unit-2:** Criterion for integrability and problems.

**Unit-3:** Integrability of continuous functions and monotonic functions.

**Unit-4:** Fundamental theorem of Calculus – Change of variables – Integration by parts – First and second mean value theorems of integral calculus.

## **BLOCK- II:Line and Multiple Integrals**

**Unit-1:** Definition of a line integral and basic properties – Examples on evaluation of line integrals.

**Unit-2:** Definition of a double integral – Evaluation of double integrals under given limits – Evaluation of double integrals in regions bounded by given curves.

**Unit-3:** Changing the order of integration, Change of variables from Cartesian to polar – Surface areas.

**Unit-4:** Definition of a triple integral – Evaluation – Change of variables (Cylindrical and Spherical) – Volume as a triple integral.

## **BLOCK- III: Numerical methods-II**

**Unit-1:** Finite differences – Definition and properties of  $\mu, \delta, \nabla, \Delta$  and  $E$ , the relation between them.

**Unit-2:** The  $n$ th differences of a polynomial, Factorial notations, separation of symbols, divided differences and related theorems.

**Unit-3:** Newton –Gregory forward and backward interpolation formulae – Lagrange's and Newton's interpolation formulae for unequal intervals –Inverse interpolation.

**Unit-4:** Numerical Integration: Quadrature formula – Trapezoidal rule –Simpon's 1/3 and 3/8 rule(without proofs) and problems.

## **Reference textbooks:**

1. David M Burton, *Elementary Number Theory*, 6th edition, McGraw Hill, 2007.
2. Emil Grosswald, *Topics from the Theory of Numbers*, Modern Birhauser, 1984.

3. *Ivan Niven, Herbert S. Zuckerman and Hugh L. Montgomery, An Introduction to the Theory of Numbers, John Willey (New York), 1991.*
4. *F B Hildebrand, Methods in Applied Mathematics.*
5. *B Spain, Vector Analysis ,ELBS, 1994.*
6. *D E Bournesand, P C Kendall, Vector Analysis, ELBS, 1996.*

## **PAPER II:**

### **BLOCK – I:Sequences**

**Unit-1:** Sequence of real numbers – Bounded and unbounded sequences – Infimum and supremum of a sequence.

**Unit-2:** Limit of a sequence – Sum, product and quotient of limits – Standard theorems on limits.

**Unit-3:** Convergent, divergent and oscillatory sequences – Standard properties.

**Unit-4:** Monotonic sequences and their properties – Cauchy’s general principle of convergence.

### **BLOCK – II: Infinite Series**

**Unit-1:** Infinite series of real numbers – Convergence and Divergence - Oscillation of series – Properties of convergence – Series of positive terms.

**Unit-2:** Geometric series – p – series – Comparison tests.

**Unit-3:** D’Alembert’s ratio test –Raabe’s test – Cauchy’s root test – Leibnitz’s test for alternating series.

**Unit-4:** Summation of Binomial, Exponential and Logarithmic series.

### **BLOCK – III: Linear Algebra**

**Unit-1:** Vector space – Examples – Properties – Subspaces – criterion for a subset to be a subspace –linear span of a set - linear combination – linear independent and dependent subsets.

**Unit-2:** Basis and dimensions– Standard properties – Examples illustrating concepts and results.

**Unit-3:** Linear transformations – properties – matrix of a linear transformation – change of basis.

**Unit-4:** Range and kernel – rank and nullity – Rank – Nullity theorem – Non-singular and singular linear transformations - Standard properties – Examples.

### **Reference textbooks:**

1. S.C. Malik and Savita Arora, *Mathematical Analysis*, 2nd ed. New Delhi, India: New Age international (P) Ltd., 1992
2. S.C Mallik, *Principles of Real Analysis*, New Age International Publications, 2008.
3. Donald R. Sherbert and Robert G. Bartle, *Introduction to Real Analysis*, 4th Ed., John Wiley & sons, 2011.
4. Ajith Kumar and S. Kumaresan, *A Basic Course in Real Analysis*, CRC Press, 2014.
5. Richard R Goldberg, *Methods of Real Analysis*, Indian ed. New Delhi, India: Oxford and IBH Publishing Co., 1970.
6. Krishnamoorthy V K and Mainra V P and Arora J L, *An Introduction to Linear Algebra*, Reprint. New Delhi, India: Affiliated East West Press Pvt. Ltd., 2003.

### **OPTIONAL PAPERS:**

#### **OPTIONAL PAPER I: DISCRETE MATHEMATICS**

**Unit-1:** Graphs and Planar Graphs: Introduction, Basic terminology, Multigraphs and Weighted graphs, Digraphs and relations, Representation of graphs, Operations on graphs, Paths and circuits, Eulerian paths and circuits, Hamiltonian paths and circuits, Planar graphs Graph coloring.

**Unit-2:** Trees and Cut-sets: Trees, Rooted trees, Path lengths in rooted trees, Prefix codes, Spanning trees and cut-sets, Minimum spanning trees; Kruskal's Algorithm, Prim's algorithm, Shortest path Algorithms.

**Unit-3:** Discrete numeric functions and Generating functions: Introduction, Manipulation of numeric functions, Asymptotic behavior of numeric functions,

**Unit-4:** Generating functions. Recurrence relations and Recursive Algorithms: Introduction, Recurrence relations, Linear recurrence relations with constant coefficients, Homogeneous solutions, Particular solutions.

### **Reference textbooks:**

1. C. L. Liu and D P Mohapatra, *Elements of Discrete Mathematics - A Computer Oriented Approach*, 4th Ed., Tata Macgraw Hill Publishers, 2013.
2. J. P. Trembley and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science*, Tata Macgraw Hill Publishers, 1975.
3. K. Chandrasekhara Rao, *Discrete Mathematics*, Narosa Publishing House, 2012.
4. Swapan Kumar Sarkar, *A Text Book of Discrete Mathematics*, S Chand and Company, New Delhi, 2008.
5. J. K. Truss, *Discrete Mathematics for Computer Scientists*, Addison Wesley, 1999.

## **OPTIONAL PAPER II: APPLIED MATHEMATICS**

### **BLOCK – I: Laplace Transforms-I**

**Unit-1:** Definition and basic properties – Laplace transforms of  $e^{kt}$ ,  $\cos kt$ ,  $\sin kt$ ,  $a^t$ ,  $t^n$ ,  $\cosh kt$  and  $\sinh kt$ .

**Unit-2:** Laplace transform of  $e^{at} F(t)$ ,  $t^n F(t)$ ,  $F(t)/t$  – problems.

**Unit-3:** Laplace transform of derivatives of functions.

**Unit-4:** Laplace transforms of integrals of functions.

### **BLOCK-II: Laplace Transforms-II**

**Unit-1:** Laplace transforms of  $\alpha$ -functions.

**Unit-2:** Inverse Laplace transforms – problems.

**Unit-3:** Convolution theorem – Simple initial value problems.

**Unit-4:** Solution of first and second order differential equations with constant coefficients by Laplace transform method.

### **BLOCK – III: Fourier series**

**Unit-1:** Introduction – Periodic functions – Fourier series and Euler formulae (statement only). Fourier series of period  $2\pi$ .

**Unit-2:** Fourier series of arbitrary period.

**Unit-3:** Even and odd functions.

**Unit-4:** Half range Fourier expansion.

### **Reference textbooks:**

1. *Murray R Spiegel – Laplace Transforms*
2. *E Kreyszig- Advanced Engineering Mathematics, Wiley India Pvt. Ltd.*
3. *M D Raisinghania, Laplace and Fourier Transforms S. Chand publications.*

## **9.8 MICROBIOLOGY**

### **MB-1 DSC:SEMESTER I**

#### **General Microbiology**

- i. History of microbiology and introduction to the microbial world. Germ theory of disease, Development of various microbiological techniques and golden era of microbiology. Contributions of Antony von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Martinus W. Beijerinck, Sergei N. Winogradsky, Selman A. Waksman, Paul Ehrlich, Elie Metchnikoff and Edward Jenner.
- ii. Physiochemical and biological characteristics of microorganisms (including viruses); Baltimore classification. Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. General characteristics of Cellular microorganisms, wall-less forms - MLO (mycoplasma and spheroplasts) with emphasis on distribution and occurrence, morphology, mode of reproduction and economic importance.
- iii. General concept of phytoplanktons and zooplanktons. General characteristics, structure, mode of reproduction and economic importance of actinomycetes with special reference to its



application in medicine and industry. General characteristics, occurrence, structure, reproduction and importance of protozoa.

iv. Methods of studying microorganism; Staining techniques: simple staining, Gram staining, negative staining and acid-fast staining. Sterilization techniques (physical & chemical sterilization). Culture media & conditions for microbial growth. Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation of pure cultures.

v. Beneficial and harmful microbes and their role in daily life. Concept of disease in plant and animal caused by microorganism.

### **Practical-1**

1. Microbiology Good Laboratory Practices and Bio-safety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter) used in the microbiology laboratory.
3. Preparation of culture media (liquid & solid) for bacterial cultivation.
4. Handling and care of laboratory equipment - autoclave, hot air oven, incubator, and laminar airflow.
5. Sterilization of media using autoclave and assessment of sterility.
6. Sterilization of glassware using hot air oven.
7. Sterilization of heat sensitive material by membrane filtration.
8. Demonstration of the presence of microflora in the environment by exposing nutrient agar plates to air.
9. Observation of microorganisms - bacteria, cyanobacteria protozoa, fungi, yeasts, and algae from natural habitats.
10. Study of common fungi, algae and protozoan using temporary / permanent mounts.

### **Reference textbooks:**

1. Klein, D.A. *Microbiology*. 5th Edition WCB Mc Graw Hill, New York, (2002).
2. Tortora, G.J., Funke, B.R. and Case, C.L. *Microbiology: An Introduction*. Pearson Education, Singapore, (2004).
3. Alcom, I.E. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).

4. Black J.G. *Microbiology-Principles and Explorations*. JohnWiley& Sons Inc. New York, (2002).
5. Pelczar, MJ Chan ECS and Krieg NR, *Microbiology McGraw-Hill*.
6. Willey, Sherwood, Woolverton. *Prescott, Harley, and Klein's Microbiology McGraw-Hill publication*
7. Tortora, Funke, Case. *Microbiology. Pearson Benjamin Cummings*.
8. JACQUELYN G. BLACK. *Microbiology Principles and explorations. JOHN WILEY & SONS, INC.*
9. Madigan, Martinko, Bender, Buckley, Stahl. *Brock Biology of Microorganisms. Pearson*
10. Tom Besty, D.C Jim Koegh. *Microbiology Demystified McGRAW-HILL*.

### **MB-2 DSC: SEMESTER II**

#### **Structure and Classification of Microbes**

- i. Cell size, shape and arrangement, capsule, flagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, archaeobacterial cell wall, Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasm: Ribosomes, mesosomes, inclusion bodies, nucleoid. Endospore: Structure, formation, stages of sporulation.
- ii. Gram negative and Gram positive bacteria: characteristics and examples. Study of typical eubacteria (*Bacillus*, *Clostridium*, *Staphylococcus*, *Streptococcus*, *Corynebacterium*, *Mycobacterium*, *Escherichia*, *Salmonella*, *Shigella*, *Vibrio*, *Helicobacter*, *Meningococcus*, *Spirochetes*, *Rickettsia*, *Mycoplasma* and *Chlamydia*)
- iii. Nutritional requirements in bacteria and nutritional categories. Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, enriched and enrichment media. Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation. Chemical methods of microbial control: disinfectants, types and mode of action. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.

- iv. Bacterial taxonomy and Diversity: Classification based on Bergey's manual of Determinative Bacteriology-the Gram negative, Gram positive, the mycoplasmas and archea ; Classification based on serology, biochemistry, 16s rRNA, G+C content and other molecular tools.
- v. Virology: Discovery of viruses, nature and definition of viruses, general properties, concept of viroids, virusoids, satellite viruses and Prions. Theories of viral origin; Structure of Viruses. Viral taxonomy- Classification and nomenclature of different groups of viruses. Baltimore system of classification.
- vi. Isolation, purification and cultivation of bacterial viruses. Study of one step growth curve of bacterial viruses. Types of bacteriophages, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage. T even, T odd,  $\phi$ X174 and M13 phages.
- vii. Modes of viral transmission: Persistent, non- persistent, vertical and horizontal. Replication Assembly, maturation and release of viruses. Salient features of viral nucleic acid and the presence of unusual bases. Influenza and Hepatitis B virus, HIV, polio virus, Vaccinia virus, Rabies Virus. TMV, Cauliflower Mosaic Virus.
- viii. Introduction to oncogenic viruses. Types of oncogenic DNA and RNA viruses: Concepts of oncogenes and proto-oncogenes. Antiviral compounds and their mode of action Interferon and their mode of action; Viral vaccines; Introduction to use of viral vectors in cloning and expression, and gene therapy.
- ix. Characteristics, classification and cellular & thallus organization of fungi. General features, structure, nutrition, reproduction of different fungi group - Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Heterothallism and Para-sexuality. Sex hormones in fungi, physiological specialization, phylogeny of fungi.
- x. General features, taxonomic status and evolutionary significance economic importance of important fungal genera - Mucor, Saccharomyces, Neurospora, Agaricus, Fusarium, Alternaria, Curvularia and Cladosporium. General account and importance of lichen. Important plant diseases caused by fungi- symptoms, disease cycles and control (Late & Early blight, Black rust, Smut, Wilt and Red rot).
- xi. Role of fungi in biotechnology, Application of fungi in food industry (Flavour & texture, Fermentation, Baking, Organic acids, Enzymes, Myco -proteins); Secondary metabolites

(Pharmaceutical preparations); Agriculture (Biofertilizers); Mycotoxins; Biological control (Mycofungicides, Mycoherbicides, Mycoinsecticides). Mushroom and its cultivation

xii. General characteristics and evolution of algae. Occurrence, thallus organization, algae cell ultra-structure, pigments, flagella, eye- spot food reserves and vegetative, asexual and sexual reproduction. Classification of algae.

xiii. General features, structure and reproduction and economic importance of *Chlamydomonas*, *Chlorella*, Diatoms, *Microcystis*, *Oscillatoria*, *Spirulina*, *Anabaena*, *Nostoc*, *Rivularia* and *Scytonema*. Mass cultivation of algae as a source of protein.

## **Practical-2**

1. Preparation of different media: synthetic media, complex media- Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram staining
5. Acid fast staining – study using permanent slide.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
10. Estimation of CFU count by spread plate method/pour plate method.
11. Motility by hanging drop method.
12. Study of the structure of important animal viruses (rhabdo, influenza, paramyxo, hepatitis and retroviruses) using electron micrographs.
13. Study of the structure of important plant viruses (caulimo, gemini, tobacco ringspot, cucumber mosaic and alpha-alpha mosaic viruses) using electron micrographs.
14. Study of the structure of important bacterial viruses ( $\phi$ X174, T4, 3) using electron micrograph.
15. Isolation and enumeration of bacteriophages (PFU) from water/sewage sample using double agar layer technique.
16. Studying isolation and propagation of animal viruses by chick embryo technique.

17. Study of cytopathic effects of viruses using photographs.
18. Perform local lesion technique for assaying plant viruses.
19. Isolation and identification of pathogenic and non-pathogenic fungi.
20. Study of host-pathogen interaction.
21. Study of the vegetative and reproductive structures of following genera through temporary and permanent slides: *Mucor*, *Saccharomyces*, *Penicillium*, *Agaricus* and *Alternaria*
22. Purification and preservation of pure cultures of common algae and fungi.

**Reference textbooks:**

1. Prescott, M.J., Harley, J.P. and Klein, D.A. *Microbiology*. 5th Edition WCB Mc GrawHill, New York, (2002).
2. Tortora, G.J., Funke, B.R. and Case, C.L. *Microbiology : An Introduction*. Pearson Education, Singapore, (2004).
3. Alcom, I.E. *Fundamentals of Microbiology*. VI Edition, Jones and Bartlett Publishers. Sudbury. Massachusetts, (2001).
4. Black J.G. *Microbiology-Principles and Explorations*. John Wiley & Sons Inc. New York, (2002).
5. Tom Besty, D.C Jim Koegh. *Microbiology Demystified McGRAW-HILL*.
6. Pelczar M., Chan E.C.S. and Krieg, N.R. *Microbiology*. Tata Mc Grew Hill Publishing Co. Ltd., New Delhi.
7. Stainier R.V., Ingraham, J.L., Wheelis, M.L. and Painter P.R. *The Microbial World*. Printice-Hall of India (Pvt.) Ltd., New Delhi
8. Ellen Strauss, James Strauss. *Viruses and Human Disease 2nd Edition*. Academic Press
9. Christopher Burrell Colin Howard Frederick Murphy. *Fenner and White's Medical Virology 5th Edition*. Academic Press
10. Bernard N. Fields. *Fields Virology Lippincott Williams & Wilkins*
11. S. Jane Flint. *Principles of Virology*. American Society for Microbiology
12. Alexopoulos, C.J., Mims, C.W. and Blackwel, M, *Introductory Mycology*. John Wiley, New York.
13. Mehrotra, R.S. and K.R. Aneja *An Introduction to Mycology*. New Age International Press, New Delhi.
14. Webster, J. *Introduction to fungi*. Cambridge University Press. Cambridge, U.K. (1985).
15. Bessey E.A. *Morphology and Taxonomy of fungi*. Vikas Publishing House Pvt. Ltd., New Delhi.
16. Jhon Webster and R W S Weber. *Introduction to Fungi*. Cambridge University Press 2007.
17. A. V. S. S. .Sambamurty. *A Textbook of Algae*. I.K. International Publishing House Pvt. Limited, 2010

### **MB-3 DSC: SEMESTER: III**

#### **Techniques in Microbiology**

- i. Microbial techniques: Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria. Buffers in culture medium. Cultivation of fungi, actinomycetes, yeasts, algae. Cultivation of anaerobes.
- ii. Sterilization, Disinfection, Antiseptic, Germicide, Sanitizer, Fungicide, Virucide, Bacteriostatic and Bactericidal agent. Chemical Disinfectants. Sterilization by Physical Agent, Heat: Moist Heat, Dry heat, Boiling, Tyndallization, Pasteurisation, Steam under pressure (Autoclave), Incineration, Hot air Oven. Radiations: Ionizing and Non-ionizing radiations. Inoculation and incubation, Principle and application of Laminar airflow.
- iii. Microscopy: Principle, mechanism and application of photo optical instruments (different types of Microscopes), Phase contrast microscope, Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence microscopy, Confocal microscopy, Scanning and Transmission Electron Microscopy. Micrometry. Principles of Centrifugation and Ultracentrifugation techniques and its applications.
- iv. Chromatography: Principle and techniques with applications (Partition, adsorption, ion exchange, exclusion and affinity chromatography). Electrophoretic technique (agarose and polyacrylamide gel) its Components, working and applications
- V. Principle, mechanism and application of instruments used in Spectrophotometric techniques (UV and visible). Radiobiological techniques – characters of radioisotopes, autoradiography, Radioisotope dilution technique and pulse chase experiments. Basic principles & Law of absorption and radiation and its application.

#### **Biofertilizers and Biopesticides**

Biofertilizers: General account of the microbes used as biofertilizers for various crop plants and their advantages over chemical fertilizers.

Symbiotic N<sub>2</sub> fixers: Rhizobium - Isolation, characteristics, types, inoculum production and field application, legume/pulses plants Frankia - Isolation, characteristics, Alder, Casurina plants, non-leguminous crop symbiosis.

Cyanobacteria as bio-fertilizers- Isolation, characterization, mass multiplication, Role in rice cultivation, Crop response, field application. Non - Symbiotic Nitrogen Fixers. Free living Azospirillum, Azotobacter free isolation, characteristics, mass inoculums, production and field application

Phosphate Solubilizers :Phosphate solubilizing microbes - Isolation, characterization, mass inoculum production, field application. PGPR – Isolation and Characterization; mass production and application.

Mycorrhizal Bio-fertilizers: Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

Bioinsecticides :General account of microbes used as bioinsecticides and their advantages over synthetic pesticides, Bacillus thuringiensis, production, Field applications, Viruses – cultivation and field applications.

**List of practical experiments:**

1. Isolation and characterization of symbiotic and non-symbiotic N<sub>2</sub> fixing microorganisms.
2. Isolation and characterization of P, K and Zn solubilizing microorganisms.
3. Isolation and characterization of PGPR and biocontrol microorganisms.
4. Mass scale production of biofertilizer microbes and their quality control.
5. Isolation, characterization and culturing techniques of different bio-agents for biopesticides.
6. Evaluation of biofertilizers and biopesticides under greenhouse and field conditions.
7. Commercial bio-formulation and its production techniques.
8. Major steps in production process of biopesticides and quality control.

**Reference textbooks:**

1. Eldor A. Paul. Soil Microbiology. Ecology and Biochemistry. VI Edition: Academic Press, (2007).

2. Eugene L. Madsen. *Environmental Microbiology: From Genomes to Biogeochemistry*. 1st Edition, Wiley Blackwell Publishing. (2008).
3. Agrios, G.N. *Plant pathology*. Harcourt Asia Pvt. Ltd. (2000).
4. Buchanan, B.B., Gruissem, W. and Jones, R.L. *Biochemistry and Molecular Biology of Plants*. I.K. International Pvt. Ltd. (2000).
5. Mehrotra R S and Ashok Agrawal. *Plant Pathology*. Tata Mc Graw Hill, 6th reprint (2006).
6. K. S. Bilgrami, H. C. Dube. *A textbook of modern pathology*. 6th Edition, Vani Educational Books, a division of Vikas, (1984).
7. Shalini Suri. *Biofertilizer and Biopesticide* Aph Publishing Corporation (2011)

### **Practical-3**

1. Study of fluorescent micrographs to visualize bacterial cells.
2. Ray diagrams of phase contrast microscopy and Electron microscopy.
3. Separation of mixtures by paper / thin layer chromatography.
4. Demonstration of column packing in any form of column chromatography.
5. Separation of protein mixtures by any form of chromatography.
6. Separation of protein mixtures by Polyacrylamide Gel Electrophoresis (PAGE).
7. Determination of absorption max for an unknown sample and calculation of extinction coefficient.
8. Separation of components of a given mixture using a laboratory scale centrifuge.
9. Understanding density gradient centrifugation with the help of pictures.

### **Reference textbooks:**

1. Wilson & Walker. *Principles and Techniques in Practical Biochemistry*. 5th Edition Cambridge University Press (2000).
2. Murphy D.B. *Fundamentals of Light Microscopy & Electron Imaging*. 1st Edition. Wiley-Liss. (2001).
3. K L Ghatak. *Techniques And Methods In Biology* PHI Publication (2011)
4. Pranav Kumar. *Fundamentals and Techniques of Biophysics and Molecular Biology* (2016)
5. Aurora Blair. *Laboratory Techniques & Experiments In Biology*. Intelliz Press 6.
6. D.T Plummer. *An Introduction to Practical Biochemistry*. McGraw Hill Publication 1987
7. Beckner, W.M., Kleinsmith L.J and Hardin J. *The world of cell*. IV edition Benjamin/Cummings (2000)



## **MB-4 DSC: SEMESTER IV**

### **Microbial Physiology and Genetics**

- i. Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve. Microbial growth in response to environment -Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermodurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.
- ii. Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph. Passive and facilitated diffusion. Primary and secondary active transport, concept of uniport, symport and antiport Group translocation Iron uptake
- iii. Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle. Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors. Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways
- iv. Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction). Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and Cyanobacteria
- v. Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction). Introduction to biological nitrogen fixation Ammonia assimilation. Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification.
- vi. Genome organization: E. coli, Saccharomyces, Tetrahymena. Mutations and mutagenesis: Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations.

Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes.

vii. Microbial Genetics: Transformation- discovery, Griffith's experiment, mechanism of transformation; Factors affecting transformation process, Competence and development of competence in *S. Pneumonia*. Transduction – discovery, Lederberg and Tatum's experiment, mechanism and types of transduction- Generalized transduction, Specialized transduction, Sexduction and abortive transduction.

viii. Conjugation- discovery, experimental evidence, F-factor, F+&Hfr, mechanism of conjugation, Cross between Hfr, F+&F- Conjugant and its application. Features of T4genetics , Genetic basis of lytic versus lysogenic switch of phage lambda

ix. Types of plasmids – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast- 2 3 plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

x. Prokaryotic transposable elements – Insertion Sequences, composite and non-composite transposons, Replicative and Non replicative transposition, Mu transposon. Eukaryotic transposable elements - Yeast (Ty retrotransposon), Drosophila (P elements), Maize (Ac/Ds). Uses of transposons and transposition

## **Mushroom Cultivation Technology**

Introduction: Morphology, Classification and identification of edible & non-edible/poisonous mushroom. Nutritional and Medicinal value of mushroom, Scope of mushroom cultivation.

Structure & Life cycle: Button mushroom (*Agaricusbisporus*), Milky mushroom (*Calocybe indica*), Oyster mushroom (*Pleurotussajorcaju*) and paddy straw mushroom (*Volvariellavolvcea*). Breeding and genetic improvement of mushroom strains.

Principles & Requisites: Sterilization and disinfections of substrates, Pasteurization of different substrates, Isolation, growth media, Spawns production and their maintenance.

Techniques of Cultivation: Structure and construction of mushroom house, layout of Traditional and Greenhouse method. Multiplication of spawn, Composting, bed and polythene bag preparation, spawning - casing – cropping 12 Hours Unit – 5 Cultivation management: Insect pests, fungal competitors and other important diseases. pest

management-chemical control Harvest and Post harvest technology- freezing, dry freezing, drying, canning and entrepreneurship.

**Reference textbooks:**

1. *Handbook on Mushrooms by Bahl N.*
2. *Benjamin Hirst Mushrooms: A Beginners Guide to Home Cultivation Paperback ( 20150*
3. *V. N. Pathak .Mushroom Production and Processing Technology IST Edition Hardcover – 2011*
4. *Eiri Staff Hand Book of Mushroom Cultivation, Processing and Packaging Paperback – Import, 2007*

**Practical-4**

1. Study and plot the growth curve of E.coli by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Effect of temperature on growth of E.coli.
4. Effect of pH on growth of E.coli.
5. Effect of carbon and nitrogen sources on growth of E.coli.
6. Effect of salt on growth of E.coli.
7. Demonstration of alcoholic fermentation.
8. Demonstration of the thermal death time and decimal reduction time of E.coli.
9. Preparation of Master and Replica Plates.
10. Study the effect of chemical (HNO<sub>2</sub>) and physical (UV) mutagens on bacterial cells.
11. Study survival curve of bacteria after exposure to ultraviolet (UV) light.
12. Isolation of Plasmid DNA from E.coli.
13. Study different conformations of plasmid DNA through agarose gel electrophoresis.
14. Demonstration of bacterial conjugation
15. Demonstration of bacterial transformation and transduction.
16. Demonstration of Ames test.

**Reference textbooks:**

1. Stanier, Ingraham, Wheelis and Painter. *The Microbial world*. Mc Millan Educational Ltd., London.
2. Moat and Foster, *Microbial Physiology*. Wiley.
3. Umbreit. *Essentials of Bacterial Physiology*.
4. Skokatch. *Bacterial Physiology and Metabolism*.
5. Kushner, D.J. *Microbial life in Extreme Environments*. Academic Press.
6. Pawar. C.B. *Cell Biology*.
7. Sturart. Harris and Harris. *The control of Antibiotic Resistance in Bacteria*.
8. Franklin and Snow, *Biochemistry of Antimicrobial Action*. Chapman and Hall, New York.
9. Philipp. G. *Manual of Methods for General Bacteriology*.
10. David T. Plummer. *An Introduction to Practical Biochemistry*.
11. Subba Rao, N.S. *Soil Microorganisms and Plant Growth*.
12. Pelczar, MJ Chan ECS and Krieg NR, *Microbiology McGraw-Hill*.
13. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's *Microbiology McGraw-Hill publication*
14. Tortora, Funke, Case. *Microbiology*. Pearson Benjamin Cummings.
15. JACQUELYN G. BLACK. *Microbiology Principles and explorations*. JOHN WILEY & SONS, INC.
16. Madigan, Martinko, Bender, Buckley, Stahl. *Brock Biology of Microorganisms*. Pearson
17. Tom Besty, D.C Jim Koegh. *Microbiology Demystified McGRAW-HILL*.
18. J. R. Sokatch *Bacterial Physiology and Metabolism*. Academic Press
19. Daniel R. Caldwell. *Microbial Physiology and Metabolism*. Star Pub Co; (1999)
20. Benjamin Lewin, *Gene VII*, Oxford University Press, (2000).
21. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular biology of the Cell*, 4th Edition. Garland publishing Inc. (2002).
22. Darnell, Lodish and Baltimore, *Molecular Cell Biology*, Scientific American Publishing Inc. (2000).
23. Watson. J.D, Baker. T.A, Bell. S.P, Gann. A. Levine. M. Losick. R, *Molecular Biology of Gene*, 5th Edition. The Benjamin/Cummings Pub. Co. Inc. (2003).
24. Brown T.A., *Gene Cloning and DNA analysis*. 2nd Edition, ASM press. (2004). 6. Sandy Primrose. *Principles of Gene Manipulation and Genomics*. 7th Ed., Blackwell Publishers. (2006).
25. Glick BR and Pasternak JJ, *Molecular Biotechnology*, 2nd Ed. ASM press. (2003).
26. Uldis N. Streips, Ronald E. Yasbin. *Modern Microbial Genetics*. 2nd Edition Wiley- Liss, Inc. (2002).
27. Gardner E J, Simmons M J and Snupstad DP, *Principles of genetics*, 8th edition John Wiley & Sons, (2006).
28. Harvey Lodish; Arnold Berk; Chris A. Kaiser; Monty Krieger; Anthony Bretscher; Hidde Ploegh; Angelika Amon; Kelsey C. Martin, Stephen C. Harrison. *Molecular Cell biology*. Macmillan Higher Education

**MB-5 DSE-1 SEMESTER V**

**Medical Microbiology and Immunology**

- i. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.
- ii. Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS.
- iii. Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).
- iv. List of diseases of various organ systems and their causative agents. Symptoms, mode of transmission, prophylaxis and control of the diseases caused by *Streptococcus pyogenes*, *Mycobacterium*, *Haemophilus influenzae*, *tuberculosis*, *Bacillus anthracis*, *Clostridium tetani*, *Treponema pallidum*, *Clostridium difficile*, and the viruses causing Polio, Herpes, Hepatitis, Dengue, AIDS, influenza and Japanese encephalitis.
- v. Study of following animal diseases with respect to etiology, symptoms, mode of transmission, prophylaxis and control: FMD, swine flu, bird flu, Rabies, bovine tuberculosis, Marek's, ranikhet, brucellosis, distemper.
- vi. Mycoses: Cutaneous mycoses: Tinea pedis (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis. Occurrence, habitat, morphology and reproduction of Protozoa. Structure and reproduction of important Protozoans- Entamoeba, Giardia, Trichomonas, Leishmania, Trypanosoma and Plasmodium.
- vii. Immune system: Structure and function of the cells, tissues and organs of immune system. Types of immunity - Humoral and cell-mediated, innate, acquired immunity. Complement system - function and pathways.
- viii. Antigens and Antibodies: types, properties. Haptens, adjuvants, Immunoglobulins: Structure types, Properties and their function - Theory of antibody production. Antigen-Antibody Interactions, Agglutination, Precipitation, Complement fixation test.

Hypersensitivity reactions; IgE mediated Type I Hypersensitivity, Antibody-mediated cytotoxic (Type II) Hypersensitivity, Immune complex mediated (Type III) Hypersensitivity, DTH mediated (Type IV) Hypersensitivity.

**Reference textbooks:**

1. Ananthanarayan R and Paniker CKJ. *Textbook of Microbiology*. 7th Edition. University Press Publication. (2005).
2. Brooks GF, Carroll KC, Butel JS and Morse SA. *Jawetz, Melnick and Adelberg's Medical Microbiology*. 24th edition. McGraw Hill Publication. (2007).
3. Goering R, Dockrell H, Zuckerman M and Wakelin D. *Mims Medical microbiology*. 4th edition. Elsevier. (2007).
4. Bernard, Davis B. Dulbecco, Eisen and Ginsberg. *Microbiology including immunology and molecular Genetics*. 3rd Edition
5. Roitt I. *Essential Immunology*. 10th Ed. Blackwell Science.
6. Kuby. *Immunology*. 4th edition. W. H. Freeman & company.
7. Ellen Strauss, James Strauss. *Viruses and Human Disease* 2nd Edition. Academic Press
8. Christopher Burrell Colin Howard Frederick Murphy. *Fenner and White's Medical Virology* 5th Edition. Academic Press
9. Patrick R. Murray PhD, Ken S. Rosenthal PhD, Michael A. Pfaller MD. *Medical microbiology*. Elsevier
10. Jawetz. *Medical microbiology*. Mc. Graw Hill
11. Kenneth, J. Ryan. *Medical microbiology, Sherri's an introduction to infectious diseases*. Mc. Graw Hill

**Industrial Microbiology**

- i. Brief history and developments in industrial microbiology. Sources of industrially important microbes.
- ii. Methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates
- iii. Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (e.g. baker's yeast) and continuous fermentations.
- iv. Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters,

- v. Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration Down-stream processing; Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying.
- vi. Microbial cells as food. SCP -mushroom cultivation
- vii. Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)- Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12. Enzymes (amylase, protease, lipase) wine, beer. viii. Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase). ix. Role of Microbes in Medicine and textile industry.

### **Reference textbooks:**

1. Richard H. Baltz. Julian E Davies and Arnold L.Demain *Manual of Industrial Microbiology and Biotechnology*. 3rd edition, ASM Press (2010).
2. Daniel Forciniti. *Industrial Bioseperation: Principles and practice*. 1st edition, Wiley-Blackwell (2008).
3. Reed. G. Prescott and Dunn's *Industrial Microbiology*. CBS Publishers. (1999).
4. Demain, A. L. *Industrial Microbiology and Biotechnology*. 2nd Edition. (2001).
5. EL Mansi. E.M.T. *Fermentation Microbiology and Biotechnology*. 2nd Edition, CRC Taylor & Francis (2007).
6. Waites, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. *Industrial Microbiology: An Introduction*. Blackwell Science Publishers (2002).
7. Casida LE, *Industrial Microbiology*, J. Wiley, (1968).
8. Pelczar, MJ Chan ECS and Krieg NR, *Microbiology* McGraw-Hill.
9. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's *Microbiology* McGraw-Hill publication
10. Tortora, Funke, Case. *Microbiology*. Pearson Benjamin Cummings.
11. JACQUELYN G. BLACK. *Microbiology Principles and explorations*. JOHN WILEY & SONS, INC
12. Madigan, Martinko, Bender, Buckley, Stahl. *Brock Biology of Microorganisms*. Pearson
13. Tom Besty, D.C Jim Koegh. *Microbiology Demystified* McGRAW-HILL.
14. Wulf Crueger. *Cruegers Biotechnology: A Textbook of Industrial Microbiology* 2017

### **Molecular Biology and Genetic Engineering**

Structures of DNA and RNA/Genetic Material: DNA structure, Salient features of double helix, Types of DNA, denaturation and renaturation, topoisomerases; Organization of DNA Prokaryotes, Viruses, Eukaryotes.

- i. RNA Structure. Replication of DNA: Bidirectional and unidirectional replication, semi-conservative, semi- discontinuous replication
- ii. Mechanism of DNA replication: Enzymes and proteins involved in DNA replication – DNA polymerases, DNA ligase, primase, telomerase – for replication of linear ends.
- iv. Gene Expression: Transcription - Definition, promoter - concept and strength of promoter. Transcriptional Machinery and Mechanism of transcription.
- v. Translation - Genetic code, Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of polypeptides.
- vi. Regulation of gene Expression: Principles of transcriptional regulation, regulation at initiation with examples from lac and trp operons.
- vii. Introduction to genetic engineering: Milestones in genetic engineering and biotechnology  
Restriction modification systems: Mode of action, applications of Type II restriction enzymes in genetic engineering.
- viii. DNA modifying enzymes and their applications: DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases
- ix. Cloning: Use of linkers and adaptors: Transformation of DNA: Chemical method, Electroporation.
- x. Methods of DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, DNA microarray analysis, SDS-PAGE, and Western blotting
- xi. Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors. xii. Cosmids, BACs, YACs Expression vectors: E.coli lac and T7 promoter-based vectors, yeast YIp, YEplac and YCp vectors, Baculovirus based vectors, mammalian SV40-based expression vectors .
- xii. DNA Amplification and DNA sequencing: PCR: Basics of PCR, RT-PCR, Real-Time PCR
- xiii. Genomic and cDNA libraries: Preparation and uses, Genome sequencing Sanger's method of DNA Sequencing: traditional and automated sequencing
- xiv. Application of Genetic Engineering and Biotechnology: Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral- mediated delivery, Agrobacterium - mediated delivery.
- xv. Products of recombinant DNA technology: Products of human therapeutic interest - insulin, hGH, antisense molecules. Bt transgenic - cotton, brinjal, flavo-savory tomato, Gene therapy, recombinant vaccine, protein engineering

**Reference textbooks:**



1. Benjamin Lewin, *Gene VII*, Oxford University Press, (2000).
2. Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter, *Molecular biology of the Cell*, 4th Edition. Garland publishing Inc. (2002).
3. Darnell, Lodish and Baltimore, *Molecular Cell Biology*, Scientific American Publishing Inc. (2000).
4. Watson, J.D, Baker, T.A, Bell, S.P, Gann, A. Levine, M. Losick, R, *Molecular Biology of Gene*, 5th Edition. The Benjamin/Cummings Pub. Co. Inc. (2003).
5. David Friefelder, Stanely R. Maloy, *Molecular biology and Microbial genetics*. 2nd Edition, Jones and Barlett Publishers. (1994).
6. Brown T.A., *Gene Cloning and DNA analysis*. 2nd Edition, ASM press. (2004).
7. Sandy Primrose. *Principles of Gene Manipulation and Genomics*. 7th Ed., Blackwell Publishers. (2006).
8. Glick BR and Pasternak JJ, *Molecular Biotechnology*, 2nd Ed. ASM press. (2003).
9. Udis N. Streips, Ronald E. Yasbin. *Modern Microbial Genetics*. 2nd Edition Wiley-Liss, Inc. (2002).
10. Desmond S. T. Nicholl. *An Introduction to Genetic Engineering*. Cambridge University Press; (2008)

### **Practical-5**

1. Identify bacteria (any three of *E.coli*, *Salmonella*, *Pseudomonas*, *Staphylococcus*, *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method.
4. Perform antibacterial sensitivity by Kirby-Bauer method.
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chickenpox, HPV warts, AIDS (candidiasis), dermatomycoses (ringworms).
7. Study of various stages of malarial parasite in RBC using permanent mounts.
8. Study different parts of fermenter
9. Microbial fermentations for the production and estimation (qualitative and quantitative) of:
10. Enzymes: Amylase and Protease
11. Amino acid: Glutamic acid

12. Organic acid: Citric acid
13. Alcohol: Ethanol
14. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations.
15. Isolation of Plasmid DNA from *E.coli*
16. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
17. Ligation of DNA fragments
18. Interpretation of sequencing gel electropherograms
19. Designing of primers for DN Amplification
20. Amplification of DNA by PCR
21. Demonstration of Southern blotting

#### **MB-9 DSE-4: SEMESTER VI**

##### **Agriculture, Food and Dairy Microbiology**

- i. History of Agricultural Microbiology; Microbes and their importance in maintenance of soil, Biogeochemical cycles, role of microbes in maintaining the fertility of soil.
- ii. Bio fertilizers – Bacterial, - Azotobacter and vermiform compost. Soil microorganism - association with vascular plants- phyllosphere, Rhizobium, Rhizoplane associative nitrogen fixation. Biofertilizers- Cyanobacterial and Azolla.
- iii. Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.
- iv. Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods. Principles of food preservation: temperature, canning, drying, irradiation, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO<sub>2</sub>, citrates, benzoates nitrite and nitrates etc.
- v. Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market. Utilization and disposal of dairy by-product – whey
- vi. Food borne diseases (causative agents, foods involved, symptoms and preventive measures)- Food intoxications: Staphylococcus aureus, Clostridium botulinum and

mycotoxins; Food infections: *Bacillus cereus*, *Vibrio parahaemolyticus*, *Escherichia coli*, Salmonellosis, Shigellosis, *Yersinia enterocolitica*, *Listeria monocytogenes* and *Campylobacter jejuni*

vii. Food sanitation and control; HACCP, Indices of food sanitary quality and sanitizers. Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology.

viii. Genetically modified foods, Nutraceuticals, Biosensors in food, Applications of microbial enzymes in dairy industry [Protease, Lipases].

### **Reference textbooks:**

1. Stanbury, P.F., *Principles of Fermentation Technology*. Whittaker, A and Hall, S.J 2nd Edition. Pergamon Press (1995).
2. Banwart, G.J. *Basic Food Microbiology*. CBS Publishers and Distributors, Delhi. (1989).
3. Hobbs BC and Roberts D. *Food poisoning and Food Hygiene*. Edward Arnold (A division of Hodder and Stoughton) London.
4. Joshi. *Biotechnology: Food Fermentation Microbiology, Biochemistry and Technology*. Volume 2.
5. John Garbult. *Essentials of Food Microbiology*. Arnold International.
6. John C. Ayres. J. Orwin Mundt. William E. Sandinee. *Microbiology of Foods*. W.H. Freeman and Co.
7. D. J. Bagyaraj and G. Rangaswami. *AGRICULTURAL MICROBIOLOGY*. Prentice Hall of India Pvt Ltd. 2005
8. N S Subba Rao. *Soil Microbiology*. Oxford and IBH publishing Company 2009
9. Photis Papademas. *Dairy Microbiology: A Practical Approach*. CRC Press
10. Rao M.K. *Food and Dairy Microbiology*. Manglam Publishers
11. William Frazier. *Food Microbiology*. McGraw Hill Education
12. Jay, James M., Loessner, Martin J., Golden, David A. *Modern Food Microbiology*. Springer .

### **Environmental Microbiology and Microbial Ecology**

1. Terrestrial Environment: Soil profile and soil microflora. Aquatic Environment: Microflora of fresh water and marine habitats Atmosphere: Aeromicroflora and dispersal of microbes.

ii. Animal Environment: Microbes in/on human body (microbiomics) & animal (ruminants) body.

- iii. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.
- iv. Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill). Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment
- v. Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants.
- vi. Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests.
- vii. History, significance and developments in the field of microbial ecology. Contributions of Beijerinck, Winogradsky, Kluver, Van Niel, Martin Alexander, Selman A. Waksman
- viii. Structure and function of ecosystems. Microbial succession in decomposition of plant organic matter. Biological Interaction: A. Microbe–Microbe Interactions- Mutualism, Synergism, Commensalism, Competition, Amensalism, Parasitism, Predation, Biocontrol agents. B. Microbe–Plant Interactions Roots, Aerial Plant surfaces, Biological Nitrogen fixation (symbiotic/nonsymbiotic - biofertilizers) C. Microbe-Animal Interactions - Role of Microbes in Ruminants, Nematophagous fungi, Luminescent bacteria as symbiont
- ix. Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin  
 Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction  
 Phosphorus cycle: Phosphate immobilization and solubilisation. Sulphur cycle: Microbes involved in sulphur cycle Other elemental cycles: Iron and manganese

**Reference textbooks:**

1. Medigan, M.T., Martinko, J. M. and Parker, J. Brock Biology of Microorganisms. Pearson Education Inc. , New York
2. Alexander, M John. Microbial ecology. Wiley & Sons, Inc., New York.
3. Alexander, M John. Introduction to soil microbiology. Wiley & Sons Inc., New York.
4. Barker, KH, and Herson, D.S. Bioremediation. Mc Craw Hill Inc., New York.
5. Pelczar, MJ Chan ECS and Krieg NR, Microbiology McGraw-Hill.

6. Willey, Sherwood, Woolverton. Prescott, Harley, and Klein's Microbiology McGraw-Hill publication
7. Tortora, Funke, Case. Microbiology. Pearson Benjamin Cummings.
8. JACQUELYN G. BLACK. Microbiology Principles and explorations. JOHN WILEY & SONS, INC.
9. Madigan, Martinko, Bender, Buckley, Stahl. Brock Biology of Microorganisms. Pearson
10. Tom Besty, D.C Jim Koegh. Microbiology Demystified McGRAW-HILL.

## **Microbial Biotechnology**

- i. Microbial biotechnology: Scope and its applications in human therapeutics, agriculture (Biofertilizers, PGPR, Mycorrhizae), environmental, and food technology.
- ii. Use of prokaryotic and eukaryotic microorganisms in biotechnological applications  
Genetically engineered microbes for industrial applications: Bacteria and yeast
- iii. Recombinant microbial production processes in pharmaceutical industries - Streptokinase, recombinant vaccines (Hepatitis B vaccine). Microbial polysaccharides and polyesters, Microbial production of bio-pesticides, bioplastics Microbial biosensors  
Microbial based transformation of steroids and sterols.
- iv. Bio-catalytic processes and their industrial applications: Production of high fructose syrup and production of cocoa butter substitute
- v. Microbial product purification: filtration, ion exchange & affinity chromatography techniques
- vi. Immobilization methods and their application: Whole cell immobilization. RNAi and its applications in silencing genes, drug resistance, therapeutics, and host pathogen interactions
- vii. Bio-ethanol and bio-diesel production: commercial production from lignocellulosic waste and algal biomass, Biogas production: Methane and hydrogen production using microbial culture.
- viii. Microorganisms in bioremediation: Degradation of xenobiotics, mineral recovery, removal of heavy metals from aqueous effluents

## **References**

1. Richard H. Baltz. Julian E Davies and Arnold L. Demain Manual of Industrial Microbiology and Biotechnology. 3rd edition, ASM Press (2010).
2. Daniel Forciniti. Industrial Bioseparation : Principles and practice. 1st edition edition, Wiley-Blackwell (2008).
3. Reed. G. Prescott and Dunn's Industrial Microbiology. CBS Publishers. (1999).
4. Demain, A. L. Industrial Microbiology and Biotechnology. 2nd Edition. (2001).

5. EL Mansi. E.M.T., *Fermentation Microbiology and Biotechnology. 2nd Edition, CRC Taylor & Francis* (2007).
6. Waite, M.J., Morgan, N.L., Rockey, J.S. and Higton, G. *Industrial Microbiology: An Introduction. Blackwell Science Publishers* (2002).
7. Casida LE, *Industrial Microbiology*, J. Wiley, (1968).
8. James Bailey and David Ollis, *Fundamentals of Biochemical Engineering*, 2nd edition, McGraw-Hill, (1986).
9. Jayanta Kumar Patra, Gitishree Das, Han-Seung Shin. *Microbial Biotechnology*. Springer

### **Practical-6**

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any foodborne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
6. Preparation of Yogurt/Dahi
7. Analysis of soil pH, moisture content, water holding capacity, percolation, capillary action.
8. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
9. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
10. Assessment of microbiological quality of water.
11. Determination of BOD of wastewater sample.
12. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
13. Isolation of *Rhizobium* from root nodules.
14. Study yeast cell immobilization in calcium alginate gels
15. Study enzyme immobilization by sodium alginate method
16. Pigment production from fungi (*Trichoderma* / *Aspergillus* / *Penicillium*)
17. Isolation of xylanase or lipase producing bacteria

## **9.9 PHYSICS**

### **SEMESTER-I: PHY 101- Mechanics**

#### **BLOCK-I:**

**Unit-1: Vectors:** Scalars and vectors, vector algebra, scalar and vector products, derivatives of a vector with respect to a parameter, vector integration: line, surface and volume integrals of vector fields, Gauss-divergence theorem and Stokes's theorem of vectors (statement only).

**Unit-2: Ordinary Differential Equations:** 1<sup>st</sup> order homogeneous differential equations, 2<sup>nd</sup> order homogeneous differential equations with constant coefficients.

**Unit-3: Frames of reference:** frames of reference, inertial reference frames with examples, uniform rectilinear motion in an inertial frame, Galilean transformation equations, Galilean principle of relativity, motion in a non-inertial frame of reference, qualitative discussion of centrifugal force, Coriolis force and earth as a non-inertial frame.

**Unit-4: Special theory of relativity:** postulates of Special Theory of Relativity, length contraction, time dilation, twin paradox, relativistic addition of velocities.

## **BLOCK-II:**

**Unit-5: Motion of a point particle:** point mass, the position vector of a moving point particle and its cartesian components, velocity and acceleration as the vector derivatives, derivation of planar vector of a constant magnitude, radial and transverse components of velocity and acceleration for arbitrary planar motion, deduction of results for uniform circular motion centripetal force.

**Unit-6: Conservation of linear momentum:** conservation of the linear momentum for a system of two particles, rocket motion in a uniform gravitational field (single stage rocket equation with and without gravity), elastic and inelastic collisions, elastic head-on collision and elastic oblique collision in a lab frame, reduced mass.

**Unit-7: Conservation of angular momentum:** review of angular momentum and torque, relation between angular momentum and torque, law of conservation of angular momentum, areal velocity derivation, central force: Kepler's laws of planetary motion, satellite in circular orbit and applications, geosynchronous orbits, weightlessness, basic idea of global positioning system (GPS).

**Unit-8: Conservation of energy:** work and energy, conservative force and non-conservative forces with examples, conservation of energy in a conservative force field, Applications: (i) vertical oscillations of a loaded light spiral spring and (ii) calculation of escape velocity in the gravitational field of the earth.

## **BLOCK-III:**

**Unit-9: Rigid body dynamics:** Review of definitions, moment of inertia and radius of gyration, review of statements of the theorems of the parallel and perpendicular axes, expression for kinetic energy of a rigid body, calculation of moment of inertia of rectangular lamina and circular lamina, theory of compound pendulum.

**Unit-10: Elasticity:** Concepts of moduli of elasticity, Hooke's law and Poisson's ratio  $\sigma$ , relation between the elastic constants  $q$ ,  $k$ ,  $n$  and  $\sigma$ , limiting values for  $\sigma$ , work done in stretching, elastic potential energy, bending moment, theory of light single cantilever, torsion- calculation of couple per unit twist, torsional pendulum, static torsion.

**Unit-11: Fluid Mechanics:** Viscosity- basic concepts, variation of viscosity of liquids with temperature and pressure, rate flow of liquid in a capillary tube - Poiseuille's formula - determination of coefficient of viscosity of a liquid, Stokes' formula.

**Unit-12: Surface Tension:** Basic concepts, pressure inside curved liquid surface, examples, surface tension and interfacial tension by drop-weight method, surface tension of mercury by Quincke's method, variation of surface tension with temperature.

**Reference textbooks:**

1. Halliday D, Resnick R, and Walker J, *Principles of Physics*, 9th Edn., Wiley India Pvt. Ltd. (2013).
2. Upadhyaya J C, *Classical Mechanics*, 2nd Edn., Himalaya Publishing House (2017).
3. Arora C L, and Hemne P S, *Physics for Degree Students, Revised Edn.*, S Chand and Company (2012).
4. Charles Kittel, and Walter Knight, *Berkeley Physics Course, Mechanics Vol. 1*, 2nd Edn., Tata McGraw Hill (2011).
5. Arora C L, *Refresher Course in B.Sc. Physics Vol. 1*, Revised Edn., S Chand and Company (2008).
6. Mathur D S, *Elements of Properties of Matter*, S Chand and Company (2007).
7. Mathur D S, *Mechanics*, S Chand and Company (2007).
8. Brij Lal, and Subrahmanyam N, *Properties of Matter*, 6th Edn., S Chand and Company (2002).
9. Shankara Narayana S R, *Mechanics and Properties of Matter*, 2nd Revised Edn., Sultan Chand and Sons (1998).

**PHY102: Practical-I**

(Any eight of the following experiments have to be performed)

1. Determination of acceleration due to gravity using bar pendulum.
2. Determination of moment of inertia and mass of a fly wheel.
3. Determination of surface tension by drop weight method.
4. Determination of interfacial tension between water and kerosene using drop weight method.
5. Determination of Young's modulus by the method of stretching.
6. Determination of Young's modulus using single cantilever.
7. Determination of various elastic constants using Searle's double bar.
8. Determination of rigidity modulus by static torsion.
9. Determination of rigidity modulus using torsional pendulum.
10. Determination of spring constant and acceleration due to gravity using a helical spring.
11. Verification of parallel axes theorem using bar pendulum.



12. Verification of perpendicular axes theorem.
13. Determination of moment of inertia of a irregular plane lamina using torsional oscillations.
14. Determination of viscosity of water using Poiseuille's formula.
15. Determination of viscosity of oil using Stokes method.

## **SEMESTER-II: PHY 201-Thermal Physics and Sound**

### **BLOCK-I:**

**Unit-1: Thermodynamics:** State variables- intensive and extensive variables, zeroth Law of thermodynamics, internal energy and first law of thermodynamics, thermodynamical processes, applications of First Law: relation between  $C_p$  &  $C_v$ , work done during isothermal and adiabatic processes, compressibility & expansion coefficient.

**Unit-2: Second Law of thermodynamics:** Reversible and irreversible process with examples, Kelvin-Planck and Clausius statements and their equivalence, Carnot's cycle, Carnot engine and efficiency, Carnot's theorem, refrigerator & coefficient of performance.

**Unit-3: Entropy:** Concept of entropy, Clausius theorem, Clausius inequality, second Law of thermodynamics in terms of entropy, entropy of a perfect gas, principle of increase of entropy, entropy of the universe, entropy changes in reversible and irreversible processes, temperature–entropy diagrams for Carnot's cycle, third law of thermodynamics, unattainability of absolute zero.

**Unit-4: Thermodynamic Potentials:** Thermodynamic potentials: internal energy, enthalpy, Helmholtz free energy, Gibb's free energy and applications, first and second order phase transitions with examples, Clausius Clapeyron equation and Ehrenfest equations.

### **BLOCK-II:**

**Unit-5: 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) Joule-Kelvin coefficient for ideal and Van der Waal gases, (5) Energy equations.

**Unit-6: Radiation:** Blackbody radiation, spectral distribution, concept of energy density, derivation of Planck's law using Einstein's coefficients, deduction of Wien's distribution law, Rayleigh- Jeans law, Stefan Boltzmann law and Wien's displacement law from Planck's law.

**Unit-7: Thermal conductivity:** Equation for the flow of heat through a solid bar, determination of thermal conductivity of a bad conductor by Lee and Charlton method.

**Unit-8: Low temperature physics:** Ideal gas and real gas, Van der Waals equation of state, porous plug experiment and its theory, Joule-Thomson expansion expression for the temperature of inversion, inversion curve, relation between Boyle temperature, temperature of inversion and

critical temperature of a gas, principle of regenerative cooling, liquefaction of air by Linde's method, adiabatic demagnetization.

### **BLOCK-III:**

**Unit-9: Kinetic theory-1:** Maxwell's law of distribution of molecular velocity; its graphical interpretation, degrees of freedom, principle of equipartition of energy, application to specific heats of gases.

**Unit-10: Kinetic theory-2:** Derivation of  $U = 3/2RT$ , mean free path, probability of a particle having mean free path, real gases, Van der Waals equations expression for critical constants, calculation of mean velocity, most probable velocity and RMS velocity.

**Unit-11: Sound:** Waves in one dimension- differential equation of wave motion, expression for velocity of progressive waves in a medium, Laplace's correction to Newton's formula, expression for frequency of vibration of a stretched string-harmonics, longitudinal vibrations in a rod, Kundt's tube experiment.

**Unit-12: Acoustics:** Intensity and loudness of sound, intensity levels, musical notes, musical scale, acoustics of buildings: reverberation and time of reverberation - absorption coefficient - Sabine's formula (qualitative) - measurement of reverberation time - acoustics of halls and auditoria.

### **Reference textbooks:**

1. Agarwal b.k. And eisner m., *statistical mechanics, new age international publishers, 2000.*
2. Roy s. k., *thermal physics and statistical mechanics, new age international pub., 2000.*
3. Huang k., *statistical mechanics, wiley-eastern, 1975.*
4. Laud b. b., *fundamentals of statistical mechanics, new age international pub., 2000.*
5. Schroeder d. v., *an introduction to thermal physics, pearson education new delhi, 2008.*
6. Salinas s. r. a., *introduction to statistical physics, springer, 2004.*
7. *Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill.*
8. *A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press.*
9. *Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications.*
10. *Heat and Thermodynamics, M.W.Zemasky and R. Dittman, 1981, McGraw Hill*
11. *Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W.Sears&G.L.Salinger. 1988, Narosa*
12. *University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.*

## **PHY202: Practical-II**

(Any eight of the following experiments have to be performed)

1. Determination of specific heat of a liquid using Newton's law of cooling.
2. Determination of electric equivalent of heat using Joule's calorimeter.
3. Verification of Stefan-Boltzmann law.
4. Determination of Stefan constant.
5. Verification of Gaussian distribution law and calculation of standard deviation in Monte Carlo experiment.
6. Determination of thermal conductivity of copper rod using Searle's operator.
7. Determination of thermal conductivity of a bad conductor by Lee-Charlton method.
8. Determination of temperature coefficient of resistance of copper wire.
9. Determination of Planck's constant using radiation experiment.
10. Determination of coefficient of thermal conductivity of copper by Angstrom's method.
11. Study of variation of thermo emf across two junctions of a thermocouple with temperature.
12. Determination of boiling point of a liquid using platinum resistance thermometer.

## **SEMESTER-III: PHY 301-Electricity and Magnetism**

### **BLOCK-I:**

**Unit-1:** Electrostatic field, electric flux, Gauss's theorem of electrostatics, applications of Gauss theorem- electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.

**Unit-2:** Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere, calculation of electric field from potential.

**Unit-3:** Electrostatic energy of system of charges, electrostatic energy of a charged sphere, conductors in an electrostatic Field, surface charge and force on a conductor.

**Unit-4:** Capacitance of a system of charged conductors, capacitance of an isolated conductor, method of images and its application to: (1) Plane infinite sheet and (2) Sphere.

### **BLOCK-II:**

**Unit-5: Dielectric properties of matter:** Electric field in matter, polarization, polarization charges, electrical susceptibility and dielectric constant, capacitor (parallel plate, spherical, cylindrical) filled with dielectric, displacement vector  $\mathbf{D}$ , Gauss' law in dielectrics.

**Unit-6:** Magnetostatics: Biot-Savart's law & its applications- straight conductor, circular coil,

solenoid carrying current, divergence and curl of magnetic field, magnetic vector potential.

**Unit-7:** Ampere's circuital law, magnetic properties of materials: magnetic intensity, magnetic induction, permeability, magnetic susceptibility, brief introduction of dia-, para- and ferro-magnetic materials, B-H curve and hysteresis.

**Unit-8: Electromagnetic induction:** Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, self-inductance of single coil, mutual inductance between pair of coils, energy stored in magnetic field.

### **BLOCK-III:**

**Unit-9:** DC currents: growth and decay of current in RL, RC, and RLC circuits.

**Unit-10:** Alternating current: average, peak, and RMS values, response of LR, CR, and LCR circuits to sinusoidal voltages (discussion using the 'j' symbols), series resonance and parallel resonance half-power frequencies, bandwidth and Q-factor, power in electrical circuits power factor, ac bridges: Anderson's bridge, de Sauty bridge.

**Unit-11:** Filters: High-pass and low-pass filters with LC, LR, and CR combinations, expression for cut-off frequency, band pass filters.

**Unit-12:** Network Theorems: Kirchhoff's laws, Thevenin's theorem, Norton's theorem, Superposition theorem and Maximum power transfer theorem (applications to DC circuits).

### **Reference textbooks:**

1. Tewari K K, *Electricity and Magnetism*, S Chand and Company (2007).
2. Brij Lal, and Subrahmanyam N, *A Text Book of Electricity and Magnetism*, 19<sup>th</sup> Edn., Ratan Prakashan Mandir (2016).
3. Vasudeva D N, *Fundamentals of Magnetism and Electricity*, 9th edn, S.Chand and Company (2013).
4. Laud B B, *Electrodynamics*, Revised 2nd Edn., New Age International (2005).
5. David J Griffiths, *Introduction To Electrodynamics*, 4th Edn., Prentice Hall of India (2017).
6. Hayt W H, and Buck J A, *Engineering Electromagnetism*, 8th Edn., Tata McGraw Hill (2017).
7. Bhattacharya A B, and Bhattacharya R, *Undergraduate Physics Vol. 2*, New Central Book Agency (2008).

### **PHY302: Practical-III**

(Any eight of the following experiments have to be performed)

1. Determination of self-inductance of a coil using Anderson's bridge.

2. Determination of capacitance of combinations of capacitors using de-Sauty's bridge.
3. Study of charging and discharging of a capacitor and determination of its capacitance.
4. Study of growth and decay of current in a LR circuit and determination of inductance.
5. Determination of self-inductance of a coil and Q-factor using series LCR resonance.
6. Determination of self-inductance of a coil and Q-factor using parallel LCR resonance.
7. Study of passive low pass filter and determination of its cut-off frequency.
8. Study of passive high pass filter and determination of its cut-off frequency.
9. Study of variation of capacitive reactance with frequency and determination of capacitance.
10. Applications of CRO: Determination of voltage and frequency.
11. Determination of high resistance by leakage method.
12. Determination of low resistance using potentiometer.

## **SEMESTER-IV: PHY 401-Waves, Optics and Spectroscopy**

### **BLOCK-I:**

**Unit-1:** Simple harmonic motion: Differential equation of SHM and its solutions, kinetic and potential energy, total energy and their time averages.

**Unit-2: Superposition Principle:** Statement, formation of beats and standing waves, comparison of free, damped and forced oscillations.

**Unit-3: Lissajous figures:** Graphical and analytical methods, Lissajous figures with equal and unequal frequencies and their applications.

**Unit-4: Transverse waves:** Stretched string, normal modes of a string, group velocity, phase velocity, plane waves, spherical waves, wave intensity.

### **BLOCK-II:**

**Unit-5: Interference-1:** Electromagnetic nature of light, definition and properties of wave front, Huygens principle, concept of coherent sources- division of amplitude and division of wavefront, Young's double Slit experiment, Lloyd's mirror and Fresnel's biprism.

**Unit-6: Interference-2:** Interference in thin films, Newton's rings, Interference at a wedge, construction and working of Michelson's interferometer (measurement of  $\lambda$  and  $d\lambda$ ).

**Unit-7: Diffraction:** Fresnel and Fraunhofer diffraction, explanation of rectilinear propagation of light, theory of the zone plate, comparison with a convex lens, Fraunhofer diffraction at a single slit, transmission grating theory for the case of normal incidence.

**Unit-8: Polarization:** Double refraction in uniaxial crystals, Huygens's theory, principal refractive indices, Huygens's constructions of O and E wave fronts in a uniaxial crystal (i) optic axis in the plane of incidence and parallel to the crystal surface at normal incidence, (ii) optic axis in the plane of incidence and perpendicular to the crystal surface at normal incidence.

### **BLOCK-III:**

**Unit-9: The electron:** Determination of  $e/m$  of an electron by Thomson's method, determination of charge of an electron by Millikan's oil drop method.

**Unit-10:** A qualitative account of Sommerfeld relativistic atom model, excitation and ionization potentials, Franck-Hertz experiment, Vector atom model, electron spin, space quantization, magnetic moment of an electron due to its orbital motion, Stern-Gerlach experiment.

**Unit-11:** Spin-orbit interaction and the fine structure of spectral lines, quantum number and selection rules, Pauli's exclusion principle, electronic configuration of atoms,  $LS$  and  $JJ$  coupling for multi-electron atoms (qualitative).

**Unit-12: Zeeman effect:** Normal and anomalous effects, experimental details of normal Zeeman effect, classical theory of normal Zeeman effect.

### **References textbooks:**

1. *Bhattacharya A B, and Bhattacharya R, Undergraduate Physics, Vol. 2, New Central Book Agency (2008).*
2. *Subrahmanyam N, Brij Lal, and Avadhanulu M N, A Textbook of Optics, 24<sup>th</sup> Revised Edn., S Chand and Company (2015).*
3. *Satya Prakash, Optics and Atomic Physics, 8th Revised Edn., Ratan Prakashan Mandir (1988).*
4. *Ashok Kumar, Khanna D R, and Gulati H.R, Fundamentals of Optics, 15th Edn., R Chand Publishers (2011).*
5. *Murugesan R, KiruthigaSivaprasath, Optics and Spectroscopy, 17th Revised Edn., S Chand and Company (2011).*
6. *Jenkins F A, and White H E, Optics, 3rd Edn., McGraw-Hill (1957).*

### **PHY402: Practical-IV**

(Any eight of the following experiments have to be performed)

1. Determination of frequency of vibration of a electrically maintained tuning fork.
2. Determination of unknown frequency of a tuning fork using Helmholtz resonator.
3. Determination of radius of curvature of plano-convex lens using Newton's rings.
4. Study of interference due to Fresnel's biprism and determination of fringe width.
5. Determination of thickness of a thin paper or diameter of a thin wire using Air wedge.
6. Determination of wavelength of mercury spectral lines using diffraction grating (minimum deviation method).
7. Determination of Cauchy's constants of material of a prism using a spectrometer.
8. Determination of specific rotation of sugar solution using polarimeter.
9. Determination of Rydberg constant using hydrogen spectrum.

10. Determination of Resolving power of diffraction grating.
11. Determination of Resolving power of a telescope.
12. Verification of Fresnel's equations for reflection and transmission.

## **9.10 ZOOLOGY**

### **SEMESTER – I**

Hard Core 1: Biology of Invertebrates

#### **BLOCK – I**

**Unit-1:** Animal Architecture: An Introduction, Body symmetry: Definition and types- Spherical, radial, biradial and bilateral symmetry

Body organization: Hierarchical organization of animal complexity- protoplasmic level, cellular level, tissue level and organ level of organization.

**Unit-2:** Germ layers: Definition, types-diploblastic condition (apparent and absolute) and triploblastic Condition

Body coelom: Definition, origin and types – acoelom, pseudocoelom, eucoelom (enterocoelom and schizocoelom)

Metamerism: Definition and types – pseudometamerism, true metamerism – homonomous and heteronomous.

**b) Introduction to Kingdom animalia**

**Unit-3:** Phylum Protozoa: General characters of the phylum up to classes with suitable examples

Nutrition: Holozoic, Holophytic, saprozoic, mixotrophic and parasitic with an example for each

**Unit-4:** Locomotion: Locomotory organelle- pseudopodia, cilia, flagella. Modes of locomotion- Ameoboid movement (walking movement and sol-gel theory), flagellar and euglenoid movement, ciliary movement (paddle stroke theory)

Reproduction: budding, Binary fission, conjugation in *Paramecium caudatum*, significance of conjugation.

#### **BLOCK – II**

**Unit – 5:** Phylum Profera: General characters of the phylum up to class with examples

Sycon: morphology, microscopic structure of body wall and sexual reproduction

Canal system and its evolution: Asconoid, Syconoid, Leuconoid and Rhagonoid types

**Unit – 6: Coelenterata and Ctenophora: The Radiate Animals**

General characters of the phylum coelenterate up to classes with examples

**Unit – 7: Aurelia: Morphology, reproduction and life cycle**

Polymorphism: Definition and significance, Examples Halistema

**Unit – 8: Coral reefs: Definition, types and theories of coral reef formation**

Ctenophora: genera organization and affinities with other phylum

**BLOCK – III**

**Unit – 9: Helminthes**

General characters of the phylum Platyhelminthes up to classes with examples. Planaria: Externals, digestive system, excretory system and nervous system, General characters of the phylum Nematoda with examples.

**Unit – 10: Annelida**

General characters of the phylum up to class with examples, Earthworm- Morphology, digestive system, excretory system, reproductive system and development, Parasitology and economic importance of Annelids

i) Occurrence, disease caused, mode of transmission, life cycle and preventive measures of *Entamoeba histolytica* and *Taenia solium*

ii) Parasitic adaptation- Flatworms and Leech. iii) Economic importance of leech iv) vermiculture and vermicompost.

**Unit – 11: Phylum Arthropoda: General Characters and classification up to classes with suitable examples**

i) Vision in Arthropoda: Compound eye in Palaemon and simple eye in Scorpion. ii) metamorphosis in insects types with example

**Unit – 12: Phylum Mollusca**

General characters and classification up to classes with suitable examples. Torsion in Gastropods., Phylum Echinodermata: general characters and classification up to classes and water vascular system in Asteria.

**BLOCK – IV: Animal Taxonomy and systematic**



**Unit – 13:** Introduction to taxonomy- Principles, stages, importance and rise of taxonomy

Taxonomic Procedures-Traditional or evolutionary method, phenetic and Cladistic Methods

**Unit – 14:** Taxonomic collections, identification and description; Taxonomical hierarchy (Linnean hierarchy); Vertical and Horizontal Classification; concepts of Taxon, holotype, paratype topotype etc.,

ICZN regulations and Zoological Nomenclature including use of suffixes “i” ‘orum’, ‘ae’ ‘arum’ ensis and iensis, oidea, idea, inae; Taxonyms, synonyms and Homonyms.

**Unit – 15:** Concept of species- Different Species concepts, sub-species and other intra-specific categories

**Unit – 16:** New trends in taxonomy; Ecological, Ethological, Cytological and Biochemical approaches and Numerical taxonomy.

Molecular basis of animal taxonomy-DNA hybridization, Restriction analysis and sequencing of nucleotides.

## 9.11 KANNADA

### SEMESTER – I

Lang-1.1 ಪ್ರಥಮ ಸೆಮಿಸ್ಟರ್ ಕನ್ನಡ (ಭಾಷಿಕ)

#### ಬ್ಲಾಕ್-1

- ಘಟಕ- ೧ ಹುತ್ತರಿಯ ಹಾಡು - ಪಂಜೆ ಮಂಗೇಶರಾವ್  
ದುಃಖಸೇತು - ಬಿ.ಎಂ.ಶ್ರೀ  
ನೀ ಹೀಂಗ ನೋಡಬ್ಯಾಡ ನನ್ನ - ದ.ರಾ. ಬೇಂದ್ರೆ  
ಶ್ರೀ ಸಾಮಾನ್ಯರ ದೀಕ್ಷಾಗೀತೆ - ಕುವೆಂಪು
- ಘಟಕ - ೨ ಕಣಿವೆಯ ಮುದುಕ - ಪುತಿನ  
ತುಂಗಭದ್ರೆ - ಕೆ.ಎಸ್.ನರಸಿಂಹಸ್ವಾಮಿ  
ವರ್ಧಮಾನ - ಎಂ. ಗೋಪಾಲಕೃಷ್ಣಅಡಿಗ ;  
ದಾಸಿಮಯ್ಯ ಮತ್ತು ಬೆಕ್ಕು - ಸು.ರಂ. ಎಕ್ಕುಂಡಿ
- ಘಟಕ - ೩ ಪುರುಷ ಸೂಕ್ತ - ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ  
ಕಾಲ ನಿಲ್ಲುವುದಿಲ್ಲ - ಚೆನ್ನವೀರಕಣವಿ  
ಗಂಗಾವಾಯಿ - ಚಂದ್ರಶೇಖರಕಂಬಾರ  
ಬದಲಾದಇತಿಹಾಸ - ಡಾ. ರಾಮೇಗೌಡ
- ಘಟಕ - ೪ ನನ್ನಜನಗಳು - ಡಾ. ಸಿದ್ದಲಿಂಗಯ್ಯ  
ಜಾಜಿ ಮಲ್ಲಿಗೆ - ಡಾ. ಸತ್ಯಾನಂದ ಪಾತ್ರೋಟ  
ರಂಗೋಲಿ ಮತ್ತು ಹುಡುಗ - ಡಾ. ನಿಸಾರ್ ಅಹಮದ್  
ರಾಣಿತಿಮ್ಮಿಯಸಿಂಹಾಸನ - ವಿಜಯದಬ್ಬೆ

#### ಬ್ಲಾಕ್-2

ಘಟಕ - ೫ ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ

ಘಟಕ- ೬ ಪತ್ರವ್ಯವಹಾರ : ಸ್ವರೂಪ, ಲಕ್ಷಣ

ಘಟಕ-೭ ಅರ್ಜಿ ನಮೂನೆಗಳು, ಹುದ್ದೆಗಳಜಾಹೀರಾತು, ಅಭ್ಯರ್ಥನ ಪತ್ರ, ನೇಮಕಾದೇಶ  
ಮತ್ತು ಹಾಜರಾತಿ ವರದಿ, ಲೇಖನಚಿಹ್ನೆಗಳು  
ಘಟಕ-೮ ಕಂಪ್ಯೂಟರ್ ಮತ್ತುಕನ್ನಡ ಲೋಕ

## SEMESTER – II

### **COURSE I/II KANNADA**

ಬ್ಲಾಕ್ -3 : ನಾಟಕ (ಸವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ - ೧ : ಹರಿಜನ್ವಾರ : ಶ್ರೀರಂಗ : ಕರ್ತೃ ಪರಿಚಯ, ವಸ್ತು, ವಿಶ್ಲೇಷಣೆ,  
ಪಾತ್ರಚಿತ್ರಣ ಹಾಗೂ ಭಾಷೆ ಮತ್ತುತಂತ್ರ, ಸಾರಾಂಶ.

ಘಟಕ - ೨ : ತೆರೆಗಳು : ಪಿ. ಲಂಕೇಶ ;ಕರ್ತೃ ಪರಿಚಯ, ವಸ್ತು, ವಿಶ್ಲೇಷಣೆ,  
ಪಾತ್ರಚಿತ್ರಣ ಹಾಗೂ ಭಾಷೆ ಮತ್ತುತಂತ್ರ, ಸಾರಾಂಶ.

ಘಟಕ - ೩ : ಟಿಂಗರ ಬುಡ್ಡಣ್ಣ : ಚಂಪಾ : ಕರ್ತೃ ಪರಿಚಯ, ವಸ್ತು, ವಿಶ್ಲೇಷಣೆ,  
ಪಾತ್ರಚಿತ್ರಣ ಹಾಗೂ ಭಾಷೆ ಮತ್ತುತಂತ್ರ, ಸಾರಾಂಶ.

ಘಟಕ - ೪ : ಮನೆ : ಚಂದ್ರಕಾಂತಕುಸನೂರ : ಕರ್ತೃ ಪರಿಚಯ, ವಸ್ತು, ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರಚಿತ್ರಣ ಹಾಗೂ ಭಾಷೆ  
ಮತ್ತುತಂತ್ರ, ಸಾರಾಂಶ.

ಬ್ಲಾಕ್-4 : ಪ್ರಬಂಧ (ಅವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ - ೧ : ಅ. ಮೈಸೂರರುಮಾಲು : ವಿ. ಸೀತಾರಾಮವಯ್ಯ :ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ  
ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

ಆ. ದಿವಾನಖಾನೆಯಅಂದಚಿಂದ :ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್ : ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ,  
ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

ಘಟಕ - ೨ : ಅ. ನಿದ್ರಾಭ್ಯಾಸ :ರಾಕು : ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ,  
ಸಾರಾಂಶ.

ಆ. ವಿರಾಟ್ಪರ್ವದ ಸ್ವಾರಸ್ಯ :ಎನ್. ಪ್ರಹ್ಲಾದರಾವ್ : ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ  
ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

ಘಟಕ - ೩ : ಅ. ನಮ್ಮ ಮನೆಯ ದೀಪ : ಹಾ.ಮಾ. ನಾಯಕ್ :ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ  
ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

ಆ. ನನ್ನಟೋಪಿ : ಬಿ.ಬಿ.ಎಲ್. ಸ್ವಾಮಿ : ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

ಘಟಕ - ೪ : ಅ. ರುಚಿ : ಸುನಂದಾ ಬೆಳಗಾಂವ್‌ಕರ್‌ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ

ಆ. ಸುಲಭದಲ್ಲಿ ಸಜ್ಜನಲಾಗಲಾರಿರಿ : ಭುವನೇಶ್ವರಿ ಹೆಗಡೆ : ಕರ್ತೃ ಪರಿಚಯ, ಪ್ರಬಂಧ ವಿಶ್ಲೇಷಣೆ, ಪಾತ್ರ ಪರಿಚಯ, ಭಾಷೆ, ಆಶಯ, ಸಾರಾಂಶ.

### **SEMESTER – III**

#### **COURSE I/II KANNADA**

##### **ಮೂರನೇ ಸೆಮಿಸ್ಟರ್**

ಬ್ಲಾಕ್- 5 : ಪ್ರಾಚೀನಕನ್ನಡಕಾವ್ಯ (ಸವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ-1 : (ಅ) ಕೃಷ್ಣ ಸಂಧಾನ (ವಿಕ್ರಮಾರ್ಜುನ ವಿಜಯಂ) -ಪಂಪ  
(ಆ) ದುರ್ಯೋಧನ ವಿಲಾಪ (ಸಾಹಸ ಭೀಮ ವಿಜಯಂ) -ರನ್ನ

ಘಟಕ-2 : (ಅ) ಅಮೃತಮತಿ ಪ್ರಸಂಗ (ಯಶೋಧರಚರಿತೆ) -ಜನ್ನ  
(ಆ) ಸಾಮಾಜಿಕ ವಚನಗಳು - ಬಸವಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ

ಘಟಕ-3 : (ಅ) ಅಭಿಮನ್ಯು ಪ್ರಸಂಗ (ಕರ್ನಾಟ ಭಾರತಕಥಾಮಂಜರಿ) -ಕುಮಾರವ್ಯಾಸ  
(ಆ) ಪ್ರಭುದೇವರರಗಳೆ -ಹರಿಹರ

ಘಟಕ-4 : (ಅ) ಭರತ-ಬಾಹುಬಲಿ ಪ್ರಸಂಗ (ಭರತೇಶ ವೈಭವ) -ರತ್ನಾಕರವರ್ಣಿ  
(ಆ) ಧರೆಗೊಬ್ಬದಾನಶೂರಕರ್ಣನೆಂದಾದ ಪರ್ವ - (ಜನಪದ ಮಹಾಭಾರತ)

ಬ್ಲಾಕ್- 6 : ಗದ್ಯ ಸಂಪದ (ಅವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ- 1 : ಅ) ಕರ್ನಾಟಕ ವೈಭವ ವರ್ಣನೆ : -ಆಲೂರು ವೆಂಕಟರಾವ್  
ಆ) ಬಾಳ್ವೆಸ್ವೀಕಾರಕ್ಕಿದೆ, ನಿರಾಕರಣೆಗಲ್ಲ : -ಶಿವರಾಮಕಾರಂತ

ಘಟಕ- 2 : ಅ) ಶ್ರೇಷ್ಠತೆಯ ವ್ಯಸನ : -ಕೆ. ವಿ. ಸುಬ್ಬಣ್ಣ  
ಆ) ವೈಚಾರಿಕ ಪ್ರಜ್ಞೆಗೆಡೆತಡೆಗಳು : -ಎಚ್. ನರಸಿಂಹಯ್ಯ

ಘಟಕ - 3 : ಅ) ಗಿರಣಿಯ ವಿಸ್ತಾರ ನೋಡಯ್ಯಾ : -ಡಿ.ಆರ್.ನಾಗರಾಜ್  
ಆ) ರಾಷ್ಟ್ರೀಯತೆ : ಒಂದು ಮರುಚಿಂತನೆ -ಕೆ.ವಿ. ತಿರುಮಲೇಶ್

ಘಟಕ- 4 : ಅ) ಮಹಿಳಾರಾಜಕೀಯ ಮೀಸಲಾತಿ : -ಡಾ. ಹೇಮಲತಾ ಮಹಿಷಿ  
ಆ) ಹಸಿವು ಮತ್ತು ಸಂತೃಪ್ತಿ : -ಡಾ. ಬಿ.ಎ. ವಿವೇಕರೈ

## SEMESTER – IV

### **COURSE I/II KANNADA**

ನಾಲ್ಕನೇ ಸೆಮಿಸ್ಟರ್

ಬ್ಲಾಕ್ -7: ಸಣ್ಣಕತೆಗಳು (ಸವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ-5 : ಅ) ವೆಂಕಟಶಾಮಿಯ ಪ್ರಣಯ - ಮಾಸ್ತಿ

ಆ) ಧನ್ವಂತರಿಯಚಿಕಿತ್ಸೆ - ಕುವೆಂಪು

ಘಟಕ-6 : ಅ) ಮನುವಿನ ರಾಣಿ - ಕೊಡಗಿನಗೌರಮ್ಮ

ಆ) ಶವದ ಮನೆ - ಚದುರಂಗ

ಘಟಕ-7 : ಅ) ಗಾಂಧಿ - ಬೆಸಗರಳ್ಳಿರಾಮಣ್ಣ

ಆ) ರೊಟ್ಟಿ - ಪಿ. ಲಂಕೇಶ್

ಘಟಕ- 8 : ಅ) ಮಾರಿಕೊಂಡವರು - ದೇವನೂರ ಮಹಾದೇವ

ಆ) ಕೃಷ್ಣಗೌಡನಆನೆ - ಪೂರ್ಣಚಂದ್ರತೇಜಸ್ವಿ

ಬ್ಲಾಕ್ -8: ವಿಮರ್ಶೆ (ಅವಿಸ್ತರ ಪಠ್ಯ)

ಘಟಕ-13 : ಅ) ಕನ್ನಡದಲ್ಲಿ ಬೌದ್ಧರುಗ್ರಂಥಗಳೂರಚಿಸಿದ್ದರೇ? -ಟಿ.ಎಸ್. ವೆಂಕಣ್ಣಯ್ಯ

ಆ) ಜನ್ನನಕಾವ್ಯಗಳಲ್ಲಿ ಪ್ರಣಯ ನಿರೂಪಣೆ : -ತೀ.ನಂ. ಶ್ರೀಕಂಠಯ್ಯ

ಘಟಕ-14 : ಅ) ಪರಂಪರೆ ಮತ್ತುರಾಘವಾಂಕನ ಪ್ರತಿಭೆ : -ಜಿ.ಎಸ್. ಶಿವರುದ್ರಪ್ಪ

ಆ) ಪ್ರಜ್ಞೆ ಮತ್ತು ಪರಿಸರ : -ಯು.ಆರ್. ಅನಂತಮೂರ್ತಿ

ಘಟಕ-15 : ಅ) ಸಾಹಿತ್ಯ ಮತ್ತು ಬದ್ಧತೆ : -ಬರಗೂರುರಾಮಚಂದ್ರಪ್ಪ

ಆ) ಮಲೆಗಳಲ್ಲಿ ಮದುಮಗಳು : -ಎಚ್.ಎಂ. ಚನ್ನಯ್ಯ

ಘಟಕ-16 : ಅ) ಕಾರಂತರಕಾದಂಬರಿಗಳಲ್ಲಿಜೀವನ ಶ್ರದ್ಧೆ ಮತ್ತು ಶೋಧನೆ : -ಜಿ.ಎಚ್. ನಾಯಕ

ಆ) 'ಚಿಕ್ಕೋಳು ಹಿರಿದಿಮ್ಮವ್ವ' -ಒಂದು ಮನೋವೈಜ್ಞಾನಿಕ ವಿಶ್ಲೇಷಣೆ:-ಶಿವರಾಮಕಾಡನಕುಪ್ಪೆ

## **9.12 ENGLISH**

### **SEMESTER – I**

#### **COURSE-I/II ENGLISH**

#### **Lang-1.2 POETRY, PROSE AND LANGUAGE COMPONENT**

#### **OBJECTIVES**

- To familiarize students with artistic and moral imagination through poetry
- To instil in the students a sense of compassionate aesthetics that promotes social conscience through literature
- To have a general idea of the ways in which the forms of poetry evolved in the hands of great poets
- To define prose as a form of literature
- To provide expertise in language and communication skills through English Grammar

#### **BLOCK- I: POETRY**

**William Shakespeare:** Not Marble nor the Gilded Monuments

Let me not to the Marriage of True Minds

**Thomas Gray:** Selections from Gray's Elegy

**William Wordsworth:** The Daffodils. Upon Westminster Bridge

**Alfred Tennyson:** Ulysses

#### **BLOCK –II: PROSE**

**Francis Bacon:** Of Studies, **Joseph Addison:** Ladies' Head-Dress

**O' Henry:** Witches' Loaves, **Guy de Maupassant:** The Necklace

**Nathaniel Hawthorne:** Dr. Heidegger's Experiment

### **BLOCK- III: LANGUAGE COMPONENT**

Expansion of an Idea; Antonyms and Synonyms; Comprehension; Use of Idioms

#### **Suggested Reading:**

- **Boris Ford.***Pelican Guide to English Literature*. Penguin Books.1956.
- **George Samson.***A Concise Cambridge History of English Literature*. Cambridge University Press.1970.
- **Hugh Walker.** *The English Essays and Essayists*. J.M. Dent & Sons, Limited,
- **A.J. Thomson &A.V Martinet.***A Practical English Grammar*. Oxford University Press, 1986.
- **F.T .Wood.***A Remedial English Grammar for Foreign Students*. Trinity Press. 2014
- **Wren and Martin.** *English Grammar &Composition*. Blackie. 2015.

### **SEMESTER – II**

### **COURSE-I/II ENGLISH**

#### **Lang-2.2POETRY, NOVEL AND LANGUAGE COMPONENT**

#### **BLOCK- I: POETRY**

**W.B. Yeats:** The Second Coming

**Robert Frost:** Mending Wall, Stopping by Woods on a Snowy Evening

**W.H. Auden:** The Unknown Citizen

**Nissim Ezekiel:** Night of the Scorpion

**RavichandraP.Chittampalli:** Banalities

#### **BLOCK –II: NOVEL**

**Jane Austen:** *Pride and Prejudice*

### **BLOCK- III: LANGUAGE COMPONENT**

Forms of the Verb, Prepositions, Active and Passive Voice, Precis writing

**Suggested Reading:**

- **Allot, Mariam.***The Complete Poems*. Longman, 1975.
- **Daiches, David.***A Critical History of English Literature*. Supernova. 2011.
- **Rickett, A. Compton.** *A History of English Literature*. FiliquarianLegacy.2012.
- **K.R.Srinivas, Iyengar.***Indian Writing in English*. Macmillan, 1979.
- **M.K.Naik.***Critical Essays on Indian Writing in English*. Sahitya Akademi.1969.
- **F.T .Wood.***A Remedial English Grammar for Foreign Students*. Trinity Press. 2014
- **Wren and Martin.** *English Grammar &Composition*. Blackie. 2015.

**SEMESTER – III****COURSE-I/II ENGLISH****Lang – 2.2 ENGLISH FOR COMMERCIAL PURPOSES AND DRAMA****BLOCK-I: ENGLISH FOR COMMERCIAL PURPOSES -I**

Face to Face Interaction: Spoken English

Distance Communication: Written English

English for Commercial Correspondence (Form of a Business Letter, Purchase and Sales Letter

Letter of Complaints, Claims and Cancellations

**BLOCK-II: DRAMA**

William Shakespeare: *Julius Caesar*

**BLOCK-III: LANGUAGE COMPONENT**

Essay writing; Precis writing; Resume writing with letter of application for a job

**Suggested Reading:**

- **Mccomas.***Modern Business Correspondence*. McGraw Hill Post.1992.
- **F.W.King&D.A.Cree.** *Modern English Business Letters*. Longman, 1977.



- **A.N.Kapoor.***A Guide to Business Correspondence and Communication Skills.*S.Chand.Ltd 2010.
  - **A.J. Thomson &A.V Martinet.***A Practical English Grammar. Oxford University Press,* 1986.
  - **F.T .Wood.***A Remedial English Grammar for Foreign Students.* Trinity Press.2014.
  - **Wren and Martin.** *English Grammar &Composition.* Blackie.2015.
- Wilson Knight. G.***The Crown of Life. The Wheel of Life.* Methuen& Co LTD, 1947

## **SEMESTER – IV**

### **Lang 4.2 English for Commercial Purposes and Novel**

#### **BLOCK- I: ENGLISH FOR COMMERCIAL PURPOSES -II**

Bank Correspondence -I

Bank Correspondence -II

Employment Letters

Business Circulars

Report

#### **BLOCK –II: NOVEL**

**R.K Narayan:***The Financial Expert*

#### **BLOCK-III: LANGUAGE COMPONENT**

Correction of sentences; Degree of comparison; Question Tags; Paragraph writing

#### **Suggested Reading:**

- **Mccomas.***Modern Business Correspondence.* McGraw Hill Post.1992.
- **F.W.King&D.A.Cree.** *Modern English Business Letters.* Longman, 1977.
- **A.N.Kapoor.***A Guide to Business Correspondence and Communication Skills.*S.Chand.Ltd 2010.
- **A.J. Thomson &A.V Martinet.***A Practical English Grammar. Oxford University Press,* 1986.
- **F.T .Wood.***A Remedial English Grammar for Foreign Students.* Trinity Press.2014.

- **Wren and Martin.** *English Grammar & Composition.* Blackie.2015.
- Wilson Knight. G.** *The Crown of Life. The Wheel of Life.* Methuen& Co LTD, 1947.

### **9.13 HINDI**

#### **SEMESTER – I**

##### **BLOCK – I**

##### **Snatak Kavya Sangrah**

- 1) Kavita ka vikas
- 2) Kabirdas
- 3) Soordas
- 4) Meerabai
- 5) Tulsidas
- 6) Bihari
- 7) Rahim
- 8) Ram Naresh Tripathi
- 9) Ayodhyasinghupadhya 'Harioudh'
- 10) Maithili Sharan gupt
- 11) Jayshankar Prasad
- 12) Makhanlal Chaturvedi
- 13) Balkrishna sharma 'Naveen'
- 14) Subhadrakumarichouhan
- 15) HarivamshraiBachhan
- 16) SachhidanandHeeranandVatsyayanAgney
- 17) Naresh Mehta

##### **BLOCK – II**

##### **Hindi Vyakaran aur anuvaad**

- 1) Varnamala
- 2) Uchharan, Vargeekaran
- 3) Shabdh-bedh
- 4) Sangya, roopantar, Ling, Vachan, Karak
- 5) Sarvanamtathauskebhed
- 6) Visheshantathauskebhed
- 7) SandhiAnuvaad

#### **SEMESTER – II**

##### **BLOCK – I**

##### **PratinidhiKahaniyan**

- 1) Premchand
- 2) Shiksha aur apni bhasha- Mahatma Gandhi
- 3) Madhuva- Jayashankar Prasad

- 4) Bittho- mahadeviverma
- 5) Mahadan- Yashpal
- 6) Vasanth aagayahai- Acharya hazariprasaddwiwedi
- 7) Mai nahimarnachahtahoon- Vishnu Prabhakar
- 8) Chief ki dawat- Bheeshmsahni
- 9) Tarchbechnewala- Harishankarparsai
- 10) Haar- Mannu Bhandari
- 11) Samudraguptparakramank- Ramkumar verma

## **BLOCK – II**

### **Hindi Gadya Bharathi**

- 1) Shatranj ke Khiladi- Munshi Premchand
- 2) Aakashdeep- Jayashankar Prasad
- 3) Padhai- Jainendrakumar
- 4) Aadmi ka bacha- SchhidanandHeeranandVatsyayan‘ agney’
- 5) Master sahib- ChandraguptVidyalankar
- 6) Goonge- Rangheyraghav
- 7) Genius- Mohan Rakesh
- 8) Bholaram ka jeev- Harishankarparisai
- 9) Hindi Kahani ka udbhav aur vikas

## **9.14 SANSKRIT**

### **SEMESTER – I**

#### **Modern Poetry and Prose**

##### **Block-I: Poetry**

Unit I: Subhashitaani

Unit II: Dileepasya Rajyaabhaaravarnam

##### **Block-II: Prose**

Unit III: Snaatakopadeshaha

Unit IV: Mahaaswethavrutthanaha

##### **Block-III: Modern Poetry**

Unit V: Veerottejanam

Unit VI: Shivadhanurbhangaha

##### **Block-IV: Grammar**

Unit VII: Akshara Prakaranam

### **SEMESTER – II**

#### **Modern Poetry and Prose**

##### **Block-I: Poetry**

Unit I: Upadesha Shathakam

Unit II: Gumaanikavi Virachitam

##### **Block-II: Prose**

Unit III: Veeravarasya Swaminishta

Unit IV: Vidhya Samuddheshaha

##### **Block-III: Modern Poetry**

Unit V: Mysooru Nagaravarnanam

Unit VI: Baalasaahithyam

##### **Block-IV: Grammar**

Unit VII: Sandhi Prakaranam

### **SEMESTER – III**

#### **Modern Poetry and Prose**

##### **Block-I: Drama**

Unit I: Introduction

Unit II: Introduction to Pratimanaatakam

##### **Block-II: Drama**

Unit III: Pratimanaatakam Act I & II

Unit IV:Pratimanaatakam Ac t III & IV

**Block-III:** Non-Detailed Text

Unit V: Story of Jimutavahana Part I

**Block-IV:** Commercial Sanskrit

Unit VI. Letter Writing

Unit VII. Commercial Letter

#### **SEMESTER – IV**

**Modern Poetry and Prose**

**Block-I:** Drama

Unit I:Pratimanaatakam Act V

Unit II:Pratimanaatakam Act VI

**Block-II:** Drama

Unit III:Pratimanaatakam Act VII

Unit IV:Pratimanaatakam Act VIII

**Block-III:** Non-Detailed Text

Unit V: Story of Jimutavahana Part II

**Block-IV:** Commercial Sanskrit

Unit VI: Office and Public Letter

Unit VII: Essay Writing

## **9.15 TELUGU**

### **SEMESTER – I**

#### **BLOCK- I: Old Poetry**

Unit - 1: Srimad Andhra Mahabharatham- Nannaya

Unit- 2: Basavapuram - palkurikisomana

Unit- 3: Srimad Andhra Mahabharatham - Thikkana

Unit- 4: Srimad Andhra Mahabharatham - Pothana

#### **BLOCK-II: PROSE**

Unit -1: Bharatham lo Karnudu

Unit - 2: Saaleenudu

Unit - 3: Andhrulasangikaacharalu

Unit - 4: Yakshaganam.

### **SEMESTER – II**

#### **BLOCK-I:Short stories**

Unit -1: Gaalivaana- paalagummipadmaraju

Unit - 2: JeevudiIstam - Viswanathasatyanarayana

Unit - 3: MaamidiChettu - Rachakondaviswanthasastry

Unit - 4: O puvvupusindhi - Gudipativenkatachalam

#### **BLOCK-II:Language component**

Unit -1: Vyakaranam

Unit - 2: SaahityaPathrikalu

Unit - 3: Sri Krishna devarayala Sahitya seva

Unit - 4: Janapadasaamethalu- Podupukathalu

## **9.16 URDU**

### **SEMESTER – I**

#### **BLOCK – I:** Part Poetry

##### **Unit - 1**

- a. Hamd
- b. Nath
- c. Munajath
- d. Nazmein

##### **Unit - 2**

- a. AllamaIqbal(Nazmien)
- b. Mirza Ghalib

##### **Unit -3-Ghazliyath**

- a. Meer Taqi Meer
- b. Mirza Ghalib

##### **Unit 4-Ghazliyath**

- c. Bahadur Shah Zafar
- d. Mohammed Ali Jowhar

#### **BLOCK – II:**Prose Part

##### **Unit- 5**

- a. Khaka      Masood Marhoom Ki Zinda Dili      Syed Aabid Hussain
- b. Khaka      Yaldrum Ki Yaad Mein, Rasheed Ahmed Siddiqui

##### **Unit -6**

- a. Mazmoon
- b. Khaka

##### **Unit- 7**

- a. Tanz-O-Mizah
- b. Afasana

##### **Unit- 8**

- a. Drama Naql-e-Makani

## **SEMESTER – II**

### **Unit -9**

- a. Urdu Novel Ka Irteqa
- b. Urdu Novel keAjzayeTarkeebi

### **Unit -10**

PremchandShakhsiath Aur fun

### **Unit -11**

Prem Chand keNovelun Mein Nirmala ka Muqam  
Novel Nirmala ka tanqeediJayeza.

### **Unit -12**

Premchand ki Kirdar Nigari  
(Novel Nirmala keHawale se)

### **Book Urdu Qawaid (Grammar) Maulvi Abdul Huq**

#### **Unit 13**

Urdu Qawaid (Grammar) Maulvi Abdul Huq

- a. Urdu Qawaidektaaroof
- b. Ism ki tareef aur iskeAqsam

**Unit -14** -Sifath ki Tareef Aur iskeAqsam

**Unit-15** -Zameer ki Tareef aur iskiQismein

**Unit- 16-** a. Fail ki tareef aur iskiQismein  
b. Huroof ki Tareef Aur iskiqismein

## **SEMESTER – III: Poetry and prose**

### **BLOCK – I: Poetry**

Unit-1:

- a. Hamd
- b. Nath
- c. Qaseeda
- d.

Unit-2:

- a. Masnavi (Gulzar-e-Naseem)
- b. Nazmein (Nazeer Akbar Abadi)

Unit-3:

- a. Nazmein(Majaz)



- b. Ghazliyath(Wali)

Unit-4:

- a. Ghazliyath(Akbar)
- b. Ghazliyath (Nasir Kazmi)
- c. Ghazliyath (Hameed Almaas)

**BLOCK II: Prose**

Unit -5

- a. Mazhab Science aur Falsafa
- b. Gawah

Unit-6

- a. Maulana Mohammed Hassan qadri, (khaka)
- b. Chowthi ka Joda

Unit-7

- a. Twiter,
- b. Safar Mysore

Unit-8

- a. Surab-e- Hayath
- b. Saheb Bathroom Mein

**SEMESTER – IV:Drama, & Translation**

**BLOCK-I:Drama**

**Aazar Ka Khwab**

**Unit 9-** Urdu Drame Ka Aghaz

**Unit 10-** Urdu DramekeAjzayeTarkeebi

**Unit -11-**Khudsiya Zaidi Hayath Aur Kasamam

**Unit -12-**Khudsiya Zaidi Drama Navesi

**BLOCK-II:Translation**

**Drama Aur Tarjuma Nigari**

**Unit -13** Drama Aazar Ka KhwabekJayeza

Pehle Act Ka Matan Aur Tajziya

**Unit -14**Dosre Act Ka Matan Aur Tajziya

Teesre Act Ka Matan Aur Tajziya

**Unit-15-** Choutha Act Ka Matan Aur Tajziya

Panchve Act Ka Matan Aur Tajziya  
**Unit -16.** Urdu Mein Tarjumanigari Ka Fun,  
Tarjuma Nigari Ki Ahmiath Aur Usool

## **9.17 INDIAN CONSTITUTION AND HUMAN RIGHTS**

**COURSE CODE: AECC - 1**

**CREDITS: 4**

### **BLOCK -I: INDIAN CONSTITUTION**

- UNIT-1** Constitution – Meaning and Importance Historical development of the Indian Constitution Reorganisation of States and National Integration and Zonal Councils
- UNIT -2** Framing of the Indian Constitution and Preamble, Salient features of Indian Constitution, Procedures of amending the Constitution and its limitations
- UNIT-3** Fundamental Rights and Duties, Special Privileges for SC/Sts, Backward classes, Woman, Children and Religious and Linguistic Minorities
- UNIT-4** Directive principles of State Policy, values and limitations, differences between Fundamental Rights and Directive Principles of State Policy.

### **BLOCK -II: HUMAN RIGHTS**

- UNIT-5** Human Rights – Meaning and Importance. Universal Declaration of Human Rights. Development of Human Rights and Fundamental Rights, International law and position in India.
- UNIT-6** Social and Gender discrimination. Torture and Genocide's, two human Rights Covenants. European Charter to Human Rights-Amnesty International.
- UNIT-7** People's Union for Civil Liberty (PUCL) and People's Union for Democratic Rights (PUDR).
- UNIT-8** Human Rights Commission and Minorities Commission Remedies against violation of Human Rights.

#### ***Reference:***

1. *Theory and Practice of Modern Governments- Herman Finer, Methuen and Ltd 1954*
2. *Modern Constitution, K.C. Wheare, Oxford University Press 1966*
3. *Indian Constitution – J.C. Johari, Delhi Vishal 2001*
4. *Right to be Human, Chakkravarthy M, Lancer International, New Delhi 1987*

## **9.18 ENVIRONMENTAL SCIENCE**

**COURSE CODE:AECC - 2**

**CREDITS: 4**

### **BLOCK -I: ENVIRONMENT STUDIES**

- UNIT -1** Environmental Studies - Meaning, Scope and Importance Components, Physical, Cultural, Natural and Man made
- UNIT -2** Concepts of Ecology, Structure and Functions of Ecosystem.
- UNIT-3** Biotic and Abiotic Factor, Environmental Interactions
- UNIT-4** Biological Resources - Plants, Animals and Micro organism

### **BLOCK –II: ENVIRONMENT AND SUSTAINABLE DEVELOPMENT**

- UNIT-1** Social Issues - Human population and Environment, Environment & Sustainability.
- UNI -2** Environmental Pollution - Air, Water, Soil and Sound types and Control Measures, Conservation and Preservation of Environment.
- UNIT-3** The Concept of Sustainable Development. The Definition of Sustainable Development as an Ambiguous Compromise, The Triple P, An Introduction to Economic Growth, Questions about Sustainable Development, Timeline for Sustainable Development.
- UNIT- 4** Climate Change, Energy and Sustainable Development • Climate Change: A Threat to Sustainable Development • Adaptation to Current and Future Climate Regimes • The cause: The greenhouse effect • The consequences: crop failure • Solutions technology and lifestyle changes| Mitigating Climate Change • Political & economic instruments

**Reference textbooks:**

1. *Textbook for Environmental Studies – ErachBharucha, Institute of Environmental Education and Research 2004*
2. *Fundamental of Ecology- Odum E.P.- E.B. Saunders and Co 1971*
3. *Understanding Environment- Kiran B Chhokkar- 1995*  
*Environmental Studies , Nandini Sapna Book House 2015*

## **10. EMERGENCY CONTACT DETAILS**

### **1. Dr.Chaithanya S. M.Sc., Ph.D.**

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