

**GANDHI INSTITUTE OF TECHNOLOGY AND MANAGEMENT (GITAM)**  
**(Deemed to be University)**  
**VISAKHAPATNAM \* HYDERABAD \* BENGALURU**

**Accredited by NAAC with A<sup>+</sup> Grade**



**CURRICULUM AND SYLLABUS**

**of**

**B.Sc. Biotechnology**

**(w.e.f. 2021-22 admitted batch)**

## **Academic Regulations**

Applicable for the Undergraduate programmes in the Faculties of  
**Engineering, Humanities, Management and the Sciences**

<https://www.gitam.edu/academic-regulations>

## **PROGRAMME EDUCATIONAL OBJECTIVES (PEO's)**

1. To educate and train the students with major emphasis on Biotechnology
2. To make the student learn and explore his /her chosen areas of minor subjects.
3. To help the students explore their academic and other forms of their talent with exposing them wide areas of subjects
4. As the program encompasses wide array of academic courses, the student can enhance their academic and research skills which help in excelling in his chosen area of interest.
5. To make the students useful for medical, pharma and other industrial sectors by enhancing their academic and research skills.

<b>Programme Outcomes</b>	
•	To acquire the knowledge on important classes of biological macromolecules and understand how biochemical homeostasis is regulated by metabolism
•	To gain fundamental knowledge on computers and other Information technology tools and their application in biological sciences.
•	To enhance skills of communication for better personal interaction and ability to analyze content of the subject efficiently.
•	To gain knowledge in reasoning abilities and enhance the emotional stability.
•	To enhance the understanding of multi-disciplinary nature of environment and its impact on natural processes that sustain life.
•	To equipped with theoretical and practical knowledge of microbiology and microbial genetics, its significance in the onset of infectious diseases.
•	To understand the role of microbes in medical, fermentation, food and dairy, ecology and agriculture.
•	To understand the basic concepts of enzymology and immunology along with gaining practical knowledge in various techniques.
•	To comprehend the basic concepts and practical implications of cell biology and genetics.
•	To understand the basics of molecular biology and its advances in rDNA technology and its implications in in the fields of plant, animal, fermentation, marine and industrial biotechnology.
•	To critically understand about ethics and Gandhian values and their significance.
•	To understand, analyze, and gain knowledge in Plant and animal physiological mechanisms.
•	To identify various marine resources and understand methodologies to apply in different methods for exploring marine resources for various therapeutic and other purposes.
•	To improve the interactive skills which helps to promote sustainability within multi-disciplinary teams.
•	To underscore the concepts relating to the pathophysiology of Viruses and their interaction with hosts.
•	To identify, understand and analyze various biological and therapeutically concepts involving Molecular Diagnostics
•	To identify and understand various industrial scaling up methods and processes involved in the product development.
•	To understand, analyze and comprehend various food resources and the associated technologies for their production and preservation.

<b>Program Specific Outcomes (PSOs)</b>	
•	To conceptualize and apply the basic principles of biological sciences and chemical sciences to provides an essential platform to understand the modern biotechnological processes designed according to the current needs of the society
•	To understand and evaluate the various cellular processes and underlying mechanisms along with development of a diverse technologies
•	To provide a platform for encompassing research with proficient and ethical responsibilities towards meeting societal needs

## CURRICULUM STRUCTURE OF B.Sc. BIOTECHNOLOGY

(2021-22 ADMITTED BATCH)

### University Core (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools <sup>^</sup>	0	0	2	0	0	1*
LANG1001	1	Communication Skills in English - Beginners	0	0	4	0	0	2*
LANG1011	1	Communication Skills in English	0	0	4	0	0	2
LANG1021	1	Advanced Communication Skills in English	0	0	4	0	0	2
CLAD1001	1	Emotional Intelligence & Reasoning Skills (Softskills 1)	0	0	2	0	0	1
CLAD1011	1	Leadership Skills & Quantitative Aptitude (Softskills 2)	0	0	2	0	0	1
CLAD1021	1	Verbal Ability & Quantitative Ability (Softskills 3)	0	0	2	0	0	1
CLAD1031	1	Practicing Verbal Ability & Quantitative Aptitude (Softskills 4)	0	0	2	0	0	1
VEDC1001	1	Venture Development	0	0	0	2	0	2
DOSP10XX	1	Sports 1#	0	0	0	2	0	2*
DOSL10XX	1	Club Activity#	0	0	0	2	0	2*
POLS1001	1	Indian Constitution and History	2	0	0	0	0	2*
PHPY1001	1	Gandhi for the 21st Century	2	0	0	0	0	2*
DOSL10XX	1	Community Service#	0	0	0	0	2	2*
ENVS1001	1	Environmental Studies <sup>^</sup>	3	0	0	0	0	3*
MFST1001	1	Health and Welbeing#	0	0	2	0	0	1*
CLAD20XX	2	Softskills 5A/5B/5C	0	0	2	0	0	1
CLAD20XX	2	Softskills 6A/6B/6C	0	0	2	0	0	1
FINA3001	3	Personal Financial Planning#	0	0	2	0	0	1*

\* Pass/Fail courses

# Opt any three courses among the five

<sup>^</sup> Online/Swayam/NPTEL Courses

### Softskills courses 5 and 6

Course code	Level	Course title	L	T	P	S	J	C
CLAD2001	2	Preparation for Campus Placement - 1 (Softskills 5A)	0	0	2	0	0	1
CLAD2011	2	Preparation For Higher Education (GRE/ GMAT) - 1 (Softskills 5B)	0	0	2	0	0	1
CLAD2021	2	Preparation for CAT/ MAT - 1 (Softskills 5C)	0	0	2	0	0	1
CLAD2031	2	Preparation For Campus Placement - 2 (Softskills 6A)	0	0	2	0	0	1
CLAD2041	2	Preparation For Higher Education (GRE/ GMAT) - 2 (Softskills 6B)	0	0	2	0	0	1
CLAD2051	2	Preparation for CAT/ MAT - 2 (Softskills 6C)	0	0	2	0	0	1

### Sports courses

Course code	Level	Course title	L	T	P	S	J	C
DOSP1001	1	Badminton	0	0	0	2	0	2
DOSP1011	1	Chess	0	0	0	2	0	2
DOSP1021	1	Carrom	0	0	0	2	0	2
DOSP1031	1	Football	0	0	0	2	0	2
DOSP1041	1	Volleyball	0	0	0	2	0	2
DOSP1051	1	Kabaddi	0	0	0	2	0	2
DOSP1061	1	Kho Kho	0	0	0	2	0	2
DOSP1071	1	Table Tennis	0	0	0	2	0	2
DOSP1081	1	Handball	0	0	0	2	0	2
DOSP1091	1	Basketball	0	0	0	2	0	2
DOSP1101	1	Tennis	0	0	0	2	0	2
DOSP1111	1	Throwball	0	0	0	2	0	2

### Club Activity courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1001	1	Club Activity (participant)	0	0	0	2	0	2
DOSL1011	1	Club Activity (Member of club)	0	0	0	2	0	2
DOSL1021	1	Club Activity (Leader of Club)	0	0	0	2	0	2
DOSL1031	1	Club Activity (Competitor)	0	0	0	2	0	2

### Community Service courses

Course code	Level	Course title	L	T	P	S	J	C
DOSL1041	1	Community Services - Volunteer	0	0	0	0	2	2
DOSL1051	1	Community Services - Mobilizer	0	0	0	0	2	2

### Faculty Core (FC)

Course code	Level	Course title	L	T	P	S	J	C
CHEM1011	1	Chemistry-I	3	0	0	0	0	3
CHEM1031	1	Chemistry-II	3	0	0	0	0	3
CSCI1001	1	Basics of Information Technology	3	0	0	0	0	3
CHEM1021	1	Chemistry -I Lab	0	0	2	0	0	1
CHEM1051	1	Chemistry-III	3	0	0	0	0	3
PHYS1091	1	Biophysics	3	0	0	0	0	3
CHEM1041	1	Chemistry - II Lab	0	0	2	0	0	1
PHYS1101	1	Biophysics Lab	0	0	2	0	0	1

**Programme Core/ Major Core (PC/MaC)**

Course code	Level	Course title	L	T	P	S	J	C
BTSC1001	1	Molecules of Life	3	0	0	0	0	3
BTSC1011	1	Molecules of Life Lab	0	0	2	0	0	1
BTSC1021	1	Cell Biology	3	0	0	0	0	3
BTSC1031	1	Cell Biology Lab	0	0	2	0	0	1
BTSC2001	2	Enzymology & Metabolism	3	0	0	0	0	3
BTSC2011	2	Bioanalytical Techniques	3	0	0	0	0	3
BTSC2021	2	Enzymology & Metabolism Lab	0	0	2	0	0	1
BTSC2031	2	Bioanalytical Techniques Lab	0	0	2	0	0	1
BTSC2041	2	Molecular Biology & rDNA Technology	3	0	0	0	0	3
BTSC2051	2	Molecular Biology & rDNA Technology Lab	0	0	2	0	0	1
BTSC3001	3	Plant and Animal Biotechnology	3	0	0	0	0	3
BTSC3011	3	General Immunology	3	0	0	0	0	3
BTSC3021	3	Plant and Animal Biotechnology Lab	0	0	2	0	0	1
BTSC3031	3	General Immunology Lab	0	0	2	0	0	1
BTSC3041	3	Industrial Biotechnology	3	0	0	0	0	3
BTSC3051	3	Industrial Biotechnology Lab	0	0	2	0	0	1

**Programme Elective (PE)\***

Course code	Level	Course title	L	T	P	S	J	C
BTSC2071	2	General Microbiology	3	0	0	0	0	3
BTSC2081	2	Classical Genetics	3	0	0	0	0	3
BTSC2091	2	General Microbiology Lab	0	0	2	0	0	1
BTSC2101	2	Classical Genetics Lab	0	0	2	0	0	1
BTSC2061	2	Plant and Animal Physiology	3	0	0	0	0	3
	2	Marine Biotechnology	3	0	0	0	0	3
BTSC2121	2	Medical Biotechnology	3	0	0	0	0	3
BTSC3051	3	Stem Cell Biology	3	0	0	0	0	3
BTSC3061	3	Bioinformatics	3	0	0	0	0	3
BTSC3071	3	Fundamentals of Virology	3	0	0	0	0	3
BTSC3081	3	Molecular Diagnostics	3	0	0	0	0	3
BTSC3091	3	Food Biotechnology	3	0	0	0	0	3

**Note 1:** Students should acquire a minimum of 16 credits from the program elective courses

**Note 2:** Theory and corresponding lab course are co-requisites (For example if a student opts to study BTSC2071 then he/she has to study BTSC2091 in the same semester)

**Open Elective (OE)\***

\* Opt eligible Programme Elective (PE) courses from other programmes as an open elective courses and earn 18 credits



**Eligible MINOR courses to be offered to the students of B.Sc Biotechnology Program**

Stream	Major course	Minor course (Select one)
Life sciences	Biotech	Biochemistry
		Bioinformatics
		Microbiology
		Food Science & Technology
		Environmental Science

Minor Courses in Biochemistry*								
Course code	Level	Course title	L	T	P	S	J	C
BCBI1021	1	Protein Chemistry and Enzymology	3	0	0	0	0	3
BCBI1031	1	Protein Chemistry and Enzymology Lab	0	0	2	0	0	1
BCBI2001	2	Metabolism and Bioenergetics	3	0	0	0	0	3
BCBI2021	2	Biochemical Techniques	3	0	0	0	0	3
BCBI2041	2	Molecular Biology	3	0	0	0	0	3
BCBI2051	2	Molecular Biology Lab	0	0	2	0	0	1
BCBI3001	3	Genetic Engineering	3	0	0	0	0	3
BCBI3021	3	Clinical Biochemistry	3	0	0	0	0	3
BCBI3031	3	Clinical Biochemistry Lab	0	0	2	0	0	1
BCBI3041	3	Immunology	3	0	0	0	0	3
<b>* Offered to other than BSc Biochemistry</b>								

**Minor Courses in Bioinformatics**

Course code	Level	Course title	L	T	P	S	J	C
BCBI1081	1	Computational Biology	3	0	0	0	0	3
BCBI1091	1	Computational Biology Lab	0	0	2	0	0	1
CSCI1261	1	Basics of Python Programming	3	0	0	0	0	3
BCBI2241	2	Immunology and Immunoinformatics	3	0	0	0	0	3
CSCI2341	2	Fundamentals of Database Management System	3	0	0	0	0	3
BCBI2251	2	Genomics and Proteomics	3	0	0	0	0	3
BCBI2261	2	Genomics and Proteomics Lab	0	0	2	0	0	1
BCBI3151	3	Molecular Modeling and Structural Bioinformatics	3	0	0	0	0	3
BCBI3161	3	Molecular Modeling and Structural Bioinformatics Lab	0	0	2	0	0	1
BCBI3171	3	Drug Designing	3	0	0	0	0	3

### Minor Courses in Microbiology

Course code	Level	Course title	L	T	P	S	J	C
MFST1051	1	Introductory Microbiology	3	0	0	0	0	3
MFST1061	1	Introductory Microbiology Practical	0	0	2	0	0	1
MFST1071	2	Microbial Genetics	3	0	0	0	0	3
MFST2061	2	Cell and Molecular Biology	3	0	0	0	0	3
MFST2071	2	Microbial Physiology and Biochemistry	3	0	0	0	0	3
MFST2081	2	Microbial Physiology and Biochemistry Practical	0	0	2	0	0	1
MFST3061	2	Immunology	3	0	0	0	0	3
MFST3071	3	Industrial Microbiology	3	0	0	0	0	3
MFST3091	3	Industrial Microbiology lab	0	0	2	0	0	1
MFST3101	3	Medical Microbiology	3	0	0	0	0	3

\* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Biotechnology/Food Science & Tech/Environmental Science/Chemistry

### Minor Courses in Food Science and Technology\*

Course code	Level	Course title	L	T	P	S	J	C
MFST1001	1	Principles of Food Science	3	0	0	0	0	3
MFST1011	1	Principles of Food Science Practical	0	0	2	0	0	1
MFST1021	1	Fundamentals of Food Technology	3	0	0	0	0	3
MFST2001	2	Technology of Plantation Crops	3	0	0	0	0	3
MFST2011	2	Food Processing and Preservation Technology	3	0	0	0	0	3
MFST2031	2	Food Processing and Preservation Technology Practical	0	0	2	0	0	1
MFST2041	2	Food Microbiology	3	0	0	0	0	3
MFST3001	3	Technology of Animal Foods	3	0	0	0	0	3
MFST3021	3	Technology of Animal Foods Practical	3	0	0	0	0	3
MFST3011	3	Food Biochemistry	3	0	0	0	0	3

\* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Microbiology/ Biotechnology/ Environmental Science/Chemistry

### Minor courses in Environmental Science

Course code	Level	Course title	L	T	P	S	J	C
ENVS1011	1	Understanding Environment & Ecology	3	0	0	0	0	3
ENVS1021	1	Understanding Environment & Ecology Lab	0	0	2	0	0	1
ENVS1031	1	Environmental Chemistry	3	0	0	0	0	3
ENVS2021	2	Geological Sciences and its resources	3	0	0	0	0	3
ENVS2001	2	Air Pollution and Control	3	0	0	0	0	3
ENVS2041	2	Environmental Microbiology	3	0	0	0	0	3
ENVS2011	2	Air Pollution and Control Lab	0	0	2	0	0	1
ENVS3001	3	Solid Waste Management and Soil Pollution	3	0	0	0	0	3

ENVS3011	3	Solid Waste Management and Soil Pollution Lab	0	0	2	0	0	1
ENVS3041	3	Industrial Safety	3	0	0	0	0	3
* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/Microbiology/Food Science & Tech/Biotechnology/Chemistry								

**Allocation of credits for 3-year B.Sc Program**

Type of Course	Credits	% of Program (in credits)
University Core	12	10%
Faculty Core	18	15%
Major Core	32	26%
Major Electives	16	14%
Program Minor	24	20%
Open elective	18	15%
Total	120	100%

# CSEN1001: IT Productivity Tools

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1*</b>

This course introduces all software tools that improve the productivity of a student in enhancing his learning experience with all the activities taken up as part of his coursework.

## Course Objectives

- to enable the learner, the skill in preparing technical documents of professional quality using docs, sheets and forms.
- to involve the student in designing and creating of websites and acquaint the student with the skill of processing audio, images, documents etc.
- to create awareness in analysing data using pivot tables, query manager etc.
- to create awareness in composing emails, mail merge, e-mail merge etc.
- to provide the exposure to work with collaborative tools.

## List of Experiments

1. Create a typical document consisting of text, tables, pictures, multiple columns, with different page orientations.
2. Create a technical paper / technical report consisting of table of contents, table of figures, table of tables, bibliography, index, etc.
3. Compose and send customized mail / e-mail using mail-merge.
4. Create / modify a power point presentation with text, multimedia using templates with animation.
5. Create spreadsheet with basic calculations with relative reference, absolute reference and mixed reference methods.
6. Simple report preparation using filtering tool / advanced filtering commands / pivot tables in spreadsheet application.
7. Analyse the results of a examination studentwise, teacherwise, coursewise, institute-wise.
8. Collecting and consolidating data using collaborative tools like google docs, sheets, forms.
9. Create charts / pictures using online tools like: [www.draw.io](http://www.draw.io) or smartdraw
10. Create a website of his interest.

## Text Books:

1. Katherin Murray, 'Microsoft Office 365 Connect and collaborate virtually anywhere, anytime', Microsoft Press, ISBN: 978-0-7356-5694-9
2. EXCEL 2021 The Comprehensive Beginners to Advanced Users Guide to Master Microsoft Excel 2021. Learn the Essential Functions, New Features, Formulas, Tips and Tricks, and Many More
3. <https://drawio-app.com/tutorials/video-tutorials/>
4. Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics Fourth Edition ISBN-13: 978-1449319274

## References/Online Resources

1. <https://www.coursera.org/learn/introduction-to-computers-and-office-productivity-software>
2. <https://www.coursera.org/projects/analyze-data-pivot-tables-crosstabs-google-sheets>
3. <https://www.coursera.org/learn/excel-advanced#syllabus>
4. <https://www.coursera.org/learn/how-to-create-a-website>
5. <https://support.microsoft.com/en-us/office>
6. <https://www.diagrams.net/>
7. <https://edu.google.com/>

## Course Outcomes

- Create / alter documents / Technical Paper / Project report with text, pictures, graphs of different styles.
- Create / modify power point presentations with text, multimedia and to add animation using / creating templates.
- Perform basic calculations / retrieve data / create pivot tables / chart using a spreadsheet application.
- Create simple diagrams / charts using online tools like: [www.draw.io](http://www.draw.io) .
- Manage documents, presentations, spreadsheets and websites in collaborative mode.

# LANG1001: Communication Skills in English - Beginners

L	T	P	S	J	C
0	0	4	0	0	2*

Communication Skills in English (Beginner) is the first of the three-level courses for a developmental enhancement of learners' communication skills in English. This course focuses on giving learners exposure to factual level of comprehension (listening and reading) and application of the learning (Speaking/Writing) with an awareness for social and personality-based variations in communication. In addition to the LSRW skills, the focus of the course is on schematic thinking skills. This course is activity-based and practice-oriented in terms of procedural knowledge of vocabulary and grammatical structure. This syllabus is carefully developed to enable learners to engage in communication in English avoiding errors and be prepared for next level of learning English.

## Course Objectives

- Train learners to listen actively, follow what is spoken in standard English, and answer questions to demonstrate their understanding of the main points of the speech, repeat part of what someone has said to confirm mutual understanding, though occasionally, there may be a need to ask for repetition or clarification. (Bloom's Taxonomy Level/s: 2 & 3)
- Equip learners with the skills to read and comprehend straightforward texts and simple argumentative writing to identify the topic, the desired/relevant information, the main points of the argument, and the major conclusion/s. (Bloom's Taxonomy Level/s: 2 & 4)
- Help learners apply their knowledge and language skills to make mini oral presentations, and produce short coherent written texts using appropriate cohesive devices, suitable vocabulary and grammatical structures. (Bloom's Taxonomy Level/s:3)
- Enable learners to communicate with reasonable accuracy in familiar contexts with adequate fluency and generally good control by equipping them with a repertoire of frequently used vocabulary, structures, and speech patterns. (Bloom's Taxonomy Level/s: 2 & 3)

## List of Activities & Tasks for Assessment

1. Listening to others and getting to know their experiences, interests and opinions
2. Introducing oneself: Salutation, basic information, relating to the context
3. Starting a conversation: Salutation, expressing purpose, expressing gratitude
4. Sharing one's experiences, interests and opinions
5. Reading short newspaper articles for gist
6. Picking new words from an article and working on them to know the meaning and usage
7. Using the new (unknown) words in own sentences
8. Sharing news with others - initiate, sustain and conclude
9. Understanding the relevance of intonation to meaning from recorded conversations, and applying the learning in pair work (role play)
10. Writing a summary of a story/personal narrative after listening to it twice and making individual notes
11. Reading graphs, charts and maps for specific information, making note of the important information and talking briefly about it within a small peer group
12. Writing a paragraph about oneself: a brief profile including major successes, failures, and goals. Giving compliments/gratitude to others

13. Writing a paragraph (descriptive, complimentary) about others (Family, friends, role model, etc.)
14. Correcting each other's drafts: errors in language - word choice, structure, and conventions/etiquette
15. Writing a short structured descriptive/narrative essay in 3 paragraphs, reading others' essays and sharing feedback

### References

1. V. Sasikumar, P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Listening and Speaking - Foundation Books Cunninham, S. & Moor, P. (nd). New Cutting Hedge (Intermediate). Longman
2. Cambridge Academic English: An Integrated Skills Course for EAP (Intermediate) By Craig Thaine, CUP (2012)
3. Rutherford, Andrea J. (2007). Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education.
4. McCarthy, M., O'Dell, F., Mark, G. (2005). English Vocabulary in Use. Spain: Cambridge University Press.
5. New Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-1 by Sarah Philpot. OUP
6. Philpot, S. & Curnick, L. ( 2017). Headway: Academic Skills: Reaing, Writing, and Study Skills. Introductory Level. OUP.
7. Thaine, C. (2012). Cambridge Academic English: An Integrated Skills for EAP . Intermediate. CUP.

### Online References

- [www.teachingenglish.org.uk](http://www.teachingenglish.org.uk)
- [learnenglishteens.britishcouncil.org](http://learnenglishteens.britishcouncil.org)
- <https://eslflow.com/>
- <https://www.englishclub.com/>
- <https://www.oxfordlearnersdictionaries.com/>
- <https://dictionary.cambridge.org/>
- [learnenglishteens.britishcouncil.org](http://learnenglishteens.britishcouncil.org)
- <https://freerice.com/categories/english-vocabulary>

### Course Outcomes

- Listen actively, understand and extract the essential information from short talks/conversations/discussions that are delivered in clear, standard speech. (Bloom's Taxonomy Level/s: 2 & 3)
- Read, understand, and extract specific information from straightforward factual and simple argumentative texts on general topics and subjects of interest. (Bloom's Taxonomy Level/s: 2 & 3)
- Speak clearly with some confidence on matters related to his/her interests and academic work, and make short structured oral presentations on topics of personal interest. (Bloom's Taxonomy Level/s: 3)
- Write short straightforward connected texts on a range of familiar/general topics using appropriate linking devices to achieve a clear sequence of ideas. (Bloom's Taxonomy Level/s: 3)
- Acquire sufficient language competency to express oneself in speech and writing with some confidence, using appropriate vocabulary and simple grammatical structures though lexical limitations and/or difficulty with formulation might be evident at times. (Bloom's Taxonomy Level/s: 2 & 4)

## LANG1011: Communication Skills in English

L T P S J C  
0 0 4 0 0 2

Communication Skills in English (Intermediate) is the second of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the beginner level syllabus, this course focuses on giving learners more exposure to the use of language for communicative purposes and equip them with next level skills (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course also includes inferential level of comprehension (listening and reading) that involves analysis and application of the language skills and decision-making skills while speaking/writing with an awareness for social and personality-based variations in communication. This course emphasizes guided writing through adequate tasks with pre and post context building. The focus is on stimulation and application of critical thinking in addition to schematic thinking for communication in real-life situations.

### Course Objectives

- Train learners to actively listen to short audio texts with familiar content; guided activity like question-making and responding to others' questions based on the audio text would help learners engage in transactional dialogue; extended activities like extrapolating/critiquing the responses would help learners enhance their schematic thinking. (Bloom's Taxonomy Level/s: 2 & 4)
- Equip learners with strategies to read actively and critically and understand the writers' viewpoints and attitude by providing reading comprehension tasks using authentic texts such as op-ed articles from newspapers, and reports on contemporary problems. (Bloom's Taxonomy Level/s: 4 & 5)
- Help learners understand various aspects and techniques of effective presentations (group/individual) through demonstration and modelling, and enabling them to develop their presentation skills by providing training in using the tips and strategies given. Learners would be encouraged to observe and express opinion on teacher-modelling. Reflection on issues like anxiety, stage-fear, confidence, and levels of familiarity with topic and audience would be addressed. Practice would be given on tone, pitch, clarity and other speech aspects. Detailed peer feedback and instructor's feedback would cover all the significant aspects. (Bloom's Taxonomy Level/s: 2 & 4)
- Enable learners to become aware of the structure and conventions of academic writing through reading, demonstration, scaffolding activities, and discussion. Corrective individual feedback would be given to the learners on their writing. (Bloom's Taxonomy Level/s: 2 & 3)

### List of Tasks and Activities

S. No.	Tasks	Activities
1	Listening to subject related short discussions/ explanations/ speech for comprehension	Pre-reading group discussion, Silent reading (Note-making), Modelling (questioning), Post-reading reflection /Presentation
2	Asking for information: asking questions related to the content, context maintaining modalities	Group role-play in a context (i.e. Identifying the situation and different roles and enacting their roles)



3	Information transfer: Verbal to visual (familiar context), demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pair work for discussion & feedback, Presentations, question-answer
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation and feedback	Pre-reading game/modelling, discussion in small groups, individual writing, and feedback
5	Introducing officials to peers and vice versa - Formal context	AV support, noticing, individual performance (3-4), pair work (in context), teacher modelling, group work for Introducing self and others in a formal context
6	Introducing friends to family and vice versa - Informal context	Teacher modelling/AV support, noticing structure & note-taking, Introducing friends and family in an informal context
7	Vocabulary in context: Find clues in a text and use them to guess the meaning of words/phrases. Apply the newly learnt vocabulary in communication (speaking and writing).	Comprehending verbal communication: Identifying the contextual clues in oral and written texts; guessing the meaning of words/phrases in context while reading texts and listening to discussions/talks
8	A five-day journal (diary) writing based on learners reading from newspaper on a single relevant/current social issue. Individual oral presentation and feedback from peers and instructor.	Note-making (group work), Discussion, Feedback
9	Follow the essentials of lectures, talks, discussions, reports and other forms of academic presentations and make individual and group presentations aided with images, audio, video, tabular data, etc.	Making power point presentation aided with images, audio, video, etc. with a small group by listening to academic lectures/talks/ discussions, etc.
10	Self-reflection: Re-reading one's own drafts, identifying errors, correcting the errors, and giving rationalize the changes	Pre-task discussion/modelling, Editing the texts by careful reading and identifying the errors, peer-exchange (Pair work), feedback/consolidation
11	Collaborative work (speaking and writing) in small groups of 3 or 4 learners: discussing a general/discipline-specific topic: creating outline, assigning specific roles to members of the group; and group presentation followed by peer and instructor feedback	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), feedback
12	Independent reading of different text types using appropriate reference sources by adapting suitable reading styles and speed. Focus on active reading for vocabulary: low-frequency collocations and idiomatic expressions.	Brain-storming, mapping of key terms (content specific), reading and note-making (individual), oral questioning, discussion
13	Role-play (specific social and academic situations): planning (making notes), understanding nuances of speaking in context, coordinating with situational clues and fellow speakers/participants	Peer discussion for outline, A-V support, observing (teacher modelling), role play (guided), role-play (free), feedback
14	Writing instructions: Guidelines - Flowcharts - Procedures to be followed	Pre-task reading, pair work, teacher/peer-discussion, feedback
15	Speaking spontaneously on topics of interest and writing short structured essays on the same topics adopting appropriate academic conventions and grammatical accuracy.	Reading for task preparation, note-making, speaking, reflection and corrective peer and teacher feedback

## Reference Books

1. P. Kiranmayi Dutt, Geetha Rajeevan. (2007). Basic Communication Skills. Foundation Books. CUP
2. Harmer, J. (1998). How to teach English. Longman
3. Sanjay Kumar & Pushp Lata. (2018). Communication Skills: A Workbook. OUP.
4. Cambridge IGCSE: English as a Second Language Teacher's Book Fourth Edition. By Peter Lucantoni. CUP (2014).
5. Cambridge Academic English: An Integrated Skills Course for EAP (Upper Intermediate) By Martin Hewings, CUP (2012)
6. Richards, J.C. and Bohlke, D. (2012). Four Corners-3. Cambridge: CUP.
7. Headway Academic Skills: Reading, Writing, and Study Skills Student's Book, Level-2 by Sarah Philpot. OUP
8. Latham-Koenig, C. & Oxenden, C. (2014). American English File. Oxford: OUP.
9. McCarthy, M. & O' Dell. F. (2016). Academic Vocabulary in Use. Cambridge: CUP

## Online Resources

1. <https://www.grammarly.com/blog/>
2. <https://www.nationalgeographic.org/education/>
3. <https://www.bbc.co.uk/teach/skillswise/english/zjg4scw>
4. <https://www.englishclub.com/>
5. <https://www.oxfordlearnersdictionaries.com/>
6. <https://dictionary.cambridge.org/>
7. [learnenglishteens.britishcouncil.org](http://learnenglishteens.britishcouncil.org)
8. <https://freerice.com/categories/english-vocabulary>
9. <http://www.5minuteenglish.com/>
10. <https://breakingnewsenglish.com/>
11. <https://www.digitalbook.io/>
12. <https://librivox.org/>

## Course Outcomes

- Understand the speaker's point of view in fairly extended talks on general or discipline-specific topics, and follow simple lines of argument in discussions on familiar contemporary issues. (Bloom's Taxonomy Level/s: 3)
- "Read and demonstrate understanding of articles and reports on limited range of contemporary issues in which the writers adopt particular stances. Also provide samples of written communication containing fairly complex information and reasons for choices/opinions/stances. (Bloom's Taxonomy Level/s: 2 & 3)"
- Make short presentations on a limited range of general topics using slides, and engage in small group discussions sharing experiences/views on familiar contemporary issues and give reasons for choices/opinions/plans. (Bloom's Taxonomy Level/s: 3 & 4)
- Write clear, fairly detailed text (a short essay) on a limited range of general topics, and subjects of interest, and communicate clearly through email/letter to seek/pass on information or give reasons for choices/opinions/plans/actions. (Bloom's Taxonomy Level/s: 3)
- Reflect on others' performance, give peer feedback on fellow learners' presentations, responses to writing tasks and reading comprehension questions. (Bloom's Taxonomy Level/s: 5)

## **LANG1021: Advanced Communication Skills in English**

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>2</b>

Communication Skills in English (Advanced) is the third of the three-level graded courses for a developmental enhancement of communication skills in English. Based on the learning outcomes set in the upper-intermediate syllabus, this course focuses on giving learners exposure to higher level of skills/input processing (ref. Bloom's taxonomy) and practice in terms of complexity and cognitive engagement. This course includes advanced level of comprehension i.e. analytical, evaluative and extra-polative processing (listening and reading) and involves problem-solving, logical reasoning and decision-making skills in terms of application of the learning (speaking/writing) with an awareness for social and personality based variations in communication. This course provides opportunities with activity-based practice of advanced oral and written communicative skills besides building awareness on the finer nuances of language use for various purposes. This course emphasizes free writing through meaningfully engaging tasks with a pre and post context building. There is ample scope for application of critical thinking through simulated activities for effective communication in real life situations.

### **Course Objectives**

1. Enable learners to listen actively become aware of tone and attitude in speech, and demonstrate their comprehension of fairly complex lines of argument presented by a variety of speakers in talks/presentations/discussions. (Bloom's Taxonomy Level/s: 2 & 4)
2. Enable learners to become aware of tone and attitude in written texts, and demonstrate their comprehension of fairly complex lines of argument and points of view presented in a variety of texts by equipping them with upper intermediate to advanced level reading skills and strategies. (Bloom's Taxonomy Level/s:2 & 3)
3. Make effective presentations, engage in formal group discussions, and write structured essays/ short reports to highlight the significance of actions/decisions/experiences, and sustain views by providing relevant evidence and argument. (Bloom's Taxonomy Level/s: 3 & 4)
4. Equip learners with the skills and strategies to communicate effectively in speech and writing using the language with a degree of fluency, accuracy and spontaneity, and fairly good grammatical control adopting a level of formality appropriate to the context. Encourage learners to apply their knowledge of language and their communication skills in real life situations. (Bloom's Taxonomy Level/s:3 & 5)

## List of Activities & Tasks for Assessment

S.No.	Tasks	Activities	CO
1	Evaluative and extrapolative reading of a long text/short texts on a current topic related to technology and society, identifying and questioning the author's intention, post-reading discussion in small groups, maintaining group dynamics, arriving at a consensus	Pre-reading group discussion, silent reading (Note-making), modelling (questioning), post-reading reflection and brief presentation of thoughts/ideas/opinions on the theme of the text	3
2	Debate in pairs based on listening to two recorded contemporary speeches by well-known leaders in different fields. Peer feedback and instructor feedback.	Pre-recorded audio/video for listening, student checklist for noticing key words/concepts, pre-task orientation (by teacher), pair work, feedback	1
3	Information transfer: Verbal to visual (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification and feedback before the final version is done	Pair work for discussion and feedback, presentations, question-answer	2
4	Information transfer: Visual to verbal (unfamiliar context); demonstration by teacher, learners' task (guided with scaffolding), learners' task (free), presentation, question-answer(among students), modification, editing, proofreading, and feedback before the final version is done	Pre-reading game/modelling, discussion in small groups, independent writing and feedback	4
5	Expressing opinion on a short argumentative text (e.g. a journal article or a newspaper editorial) and justifying one's opinion/stance; focus on the use of appropriate conventions of formal and polite speech, and managing bias	Listening to group discussions/debates, reading news-paper articles on the current issues and expressing opinions in favour or against the topic (in GDs, debates or writing argumentative essays).	3
6	Role-play (complex social and academic/professional situations): Focus on significant aspects of delivery including clarity, tone, and use of contextually appropriate vocabulary and conventions, observation, reflective discussion, and self-reflective writing	Reading newspaper/magazine articles/blog posts on current social issues, listening to talks/discussions/debates etc. and participating in role-plays using expressions appropriate to the context.	1
7	Collaborative writing in groups of 3 -4 on topics that would require data collection and reading followed by recorded peer-reflection and peer-feedback, group presentation and feedback	Pre-task modelling (peer), general discussion on structure, group work (collaboration), presentation, peer feedback, Open-class discussion	5
8	Formal Group Discussion on topics of current interest and relevance; focus on effective participation, reflection on control over argument/counter argument, and adherence to the conventions of formal GD	Noticing strategies from AV modelling, teacher scaffolding through open-house discussion, Note-making (Group work), Group Discussion (free), post performance discussion, Feedback	2

9	Mind-mapping for advanced reading, making correlations across texts, extending author's point of view	Reading texts on abstract topics and comprehending the author's perspective by inferring the unknown words' meaning in the context and making notes using mind-map strategy and presenting it orally.	3
10	Handling question and answer sessions after presentations: justifying arguments, taking counter-arguments, agreeing and disagreeing with rationale	Listening to some lectures, talks, and presentations in the academic seminars and adapting some strategies to handle the Q&A sessions using polite and formal expressions to agree or disagree with the statements.	1
11	Modelling an interview: with a panel of four judges (peers)	Pre-task activity for orientation/strategies (controlled/guided), Model interview (AV support), Group work (role play), interview in pair (one-to-one), Interview in group (many -to-one), oral corrective feedback (peer/teacher)	2
12	Writing a short reflective report of an event - incident/meeting/celebration	Writing a report on meetings/celebrations/events etc. by actively involving in such events and giving a short oral presentation on the same.	4
13	Speaking on abstract and complex topics beyond his/her own area of interest/field of study, using the language flexibly and effectively.	Reading texts on abstract topics and comprehending the author's perspectives. Similarly, listening to talks and discussions on an abstract topic of other discipline and making short oral presentation by sharing views and opinions.	3
14	Self-reflection on own speech in context(recorded): tone, pitch, relevance, content; extending the reflections/ideas to others	Listening to selected general discussions (audios and videos) and observing the language production. Recording own speech on some general topic and providing a critical review (self-reflection) on it by focusing on the tone, expressions and relevance of the content, etc.	1
15	Collaborative and individual task: planning, preparing (preparing an outline, structure, setting objectives and presenting the plan of action) and executing a mini-project, and submitting a brief report on the same peer and instructor feedback after the planning stage and on completion of the mini project	Pre-task modelling (peer/teacher), general discussion on structure, group work (collaboration), oral corrective, task distribution, presentation, feedback	5

### Reference Books

1. Latham-Koenig, C. & Oxenden, C. (2014). American English File-5. Oxford: OUPRichards,
2. J.C. and Bohlke, D. (2012). Four Corners-4. Cambridge: CUP.
3. Cambridge Academic English: An Integrated Skills Course for EAP (Advanced) By Martin Hewings and Craig Thaine, CUP (2012)

4. Berlin, A. (2016). 50 Conversation Classes: 50 Sets of Conversation Cards With an Accompanying Activity Sheet Containing Vocabulary, Idioms and Grammar. Poland: CreateSpace Independent Publishing Platform
5. Zemach, D. E., Islam, C. (2011). Writing Paragraphs: From Sentence to Paragraph. Germany: Macmillan Education.
6. Stewart, J. P., Fulop, D. (2019). Mastering the Art of Oral Presentations: Winning Orals, Speeches, and Stand-Up Presentations. United Kingdom: Wiley.
7. Kroehnert, Gary. (2010). Basic Presentation Skills. Sidney: McGraw Hill.
8. Cunningham, S. & Moor, P. (nd). Cutting Edge (Advanced) With Phrase Builder. Longman Publishers. CUP
9. McCarthy, M & O'Dell, F. (2017). English Idioms in Use (Advanced). Cambridge: CUP.

### **Online Resources**

1. <https://www.grammarly.com/blog/>
2. <https://www.nationalgeographic.org/education/>
3. <https://www.bbc.co.uk/teach/skillswise/english/zjg4scw>
4. <https://www.englishclub.com/>
5. <https://www.oxfordlearnersdictionaries.com/>
6. <https://dictionary.cambridge.org/>
7. [learnenglishteens.britishcouncil.org](http://learnenglishteens.britishcouncil.org)
8. <https://freerice.com/categories/english-vocabulary>
9. <http://www.5minuteenglish.com/>
10. <https://breakingnewsenglish.com/>
11. <https://www.digitalbook.io/>
12. <https://librivox.org/>

### **Course Outcomes**

- Listen to extended lectures, presentations, and discussions on a wide range of contemporary issues and demonstrate understanding of relatively complex lines of argument. (Bloom's Taxonomy Level/s: 2)
- Make presentations using suitable AV aids and engage in formal group discussions on a wide range of topics of contemporary interest, demonstrating awareness of standard/widely accepted conventions. (Bloom's Taxonomy Level/s: 3)
- Read and demonstrate understanding of the writer's stance/viewpoint in articles and reports on a wide range of contemporary issues and discipline-specific subjects. (Bloom's Taxonomy Level/s: 2 & 4)
- Write analytical essays on a wide range of general topics/subjects of interest, and engage in written communication (emails/concise reports) to exchange relatively complex information, giving reasons in support of or against a particular stance/point of view. (Bloom's Taxonomy Level/s: 3 & 4)
- Complete a mini project that necessitates the use of fairly advanced communication skills to accomplish a variety of tasks and submit a report in the given format. (Bloom's Taxonomy Level/s: 4 & 5)

## **CLAD1001: Emotional Intelligence & Reasoning Skills (Soft Skills 1)**

**L   T   P   S   J   C**  
**0   0   2   0   0   1**

### **Course Description:**

Emotional intelligence is a set of skills that are thought to contribute to the appraisal of emotions in oneself and others. It can also help contribute to the effective regulation of emotions as well as feelings (Salovey & Mayer, 1990). In terms of emotional intelligence, self-awareness and self-management have to do with our ability to relate to ourselves. Social awareness and relationship management have to do with our ability to relate to others. Similarly, the ability to solve questions on Analytical Reasoning and Data Sufficiency is a critical area tested in almost all competitive examinations and admission tests. Upon completion, students should be able (1) to deal with their own emotions as well as the emotions of others and relate better with both. Using better knowledge of EI, students will also be able to set more meaningful goals for themselves, choose suitable time management techniques that work best for them and work in teams more effectively. (2) to apply different concepts, ideas and methods to solve questions in reasoning and data sufficiency

### **Course Objectives:**

1. Use EI to relate more effectively to themselves, their colleagues and to others. Apply self awareness and self assessment (SWOT) to better understand and manage their own emotions. Apply social awareness to empathize with others and build stronger relationships with others.
2. Set meaningful goals based on their strengths and weaknesses and apply time management techniques, such as Q4 organizing to put first things first.
3. Manage conflicts and work in teams in an emotionally intelligent manner.
4. Solve questions on non-verbal and analytical reasoning, data sufficiency and puzzles

<b>Unit</b>	<b>Topics</b>	<b>Hours</b>
1	Self Awareness & Self Regulation: Introduction to Emotional Intelligence, <i>Self Awareness</i> : Self Motivation, Accurate Self Assessment (SWOT Analysis), Self Regulation: <i>Self Control, Trustworthiness &amp; Adaptability</i>	3
2	Importance, Practising Social Awareness, Building Relationships, Healthy and Unhealthy Relationships, Relationship Management Competencies- Influence, Empathy, Communication, Types of Conflicts, Causes, Conflict Management	3
3	Social Media: Creating a blog, use of messaging applications, creating a website to showcase individual talent, creation of a LinkedIn Profile	2
4	Goal Setting & Time Management: Setting SMART Goals, Time Wasters, Prioritization, Urgent Vs Important, Q2 Organization	3
5	Teamwork: Team Spirit, Difference Between Effective and Ineffective Teams, Characteristics of High Performance Teams, Team Bonding, Persuasion, Team Culture, Building Trust, Emotional Bank Account	4
6	Verbal Reasoning: Introduction, Coding-decoding, Blood relations, Ranking, Directions, Group Reasoning	6
7	Analytical Reasoning: Cubes and Dices, Counting of Geometrical figures	3
8	Logical Deduction: Venn diagrams, Syllogisms, Data Sufficiency, Binary logic	4
9	Spatial Reasoning: Shapes, Paper Cutting/Folding, Mirror images, Water images and Rotation of figures	2
	<b>Total Hours</b>	30

### Course Outcomes

- Students will be able to relate more effectively to themselves, their colleagues and to others
- Students will be able to set their short term and long term goals and better manage their time
- Students will be able to manage conflicts in an emotionally intelligent manner and work in teams effectively
- Students will be able to solve questions based on non-verbal and analytical reasoning, data sufficiency and puzzle

### References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications



## CLAD1011: Leadership Skills & Quantitative Aptitude (Soft Skills 2)

L T P S J C  
0 0 2 0 0 1

### Course Description:

Communication Skills is having the ability to convey information to others so that messages are understood and outcomes delivered. Some essential qualities of Communication Skills include understanding the needs of others, clearly communicating messages, adapting the communication style, and using a range of communication methods. Presentation Skills is having the ability to confidently deliver an engaging message to a group of people which achieves the objectives. Some essential qualities of Presentation Skills include a thorough preparation of content, structuring content logically, managing nerves, engaging your audience, delivering presentation objectives, positively influencing the audience, and responding to audience needs. Tackling questions based on numbers, arithmetic, data interpretation and puzzles requires the application of different rules and concepts of numerical computation, numerical estimation, and data estimation.

### Course Objectives:

1. Learn and apply, through different individual and group activities, different ideas and skills to communicate in a positive and impressive manner.
2. Apply the goal setting process (based on SWOT) and Q2 organizing for effective time management.
3. Apply different concepts in numbers, numerical computation and numerical estimation to solve questions that often appear in various competitive examinations and admission tests.
4. Apply different concepts for tackling questions based on data interpretation, progression and series that are frequently given in various competitive examinations and admission tests.

Unit	Topics	Hours
1	Communication Skills: <i>The Communication Process</i> , Elements of Interpersonal Communication, <i>Non-Verbal Communication</i> : Body Language, Posture, Eye Contact, Smile, Tone of Voice, <i>Barriers to Communication</i> . Effective Listening Skills: Active Listening, Passive Listening, Asking Questions, Empathizing, Being Non Judgemental, Being Open Minded, Mass Communication: Design of Posters, Advertisements, notices, writing formal and informal invitations	5
2	Focus on Audience Needs, Focus on the Core Message, Use Body Language and Voice, Start Strongly, Organizing Ideas & Using Visual Aids: SPAM Model, Effective Opening and Closing Techniques, Guy Kawasaki's Rule (10-20-30 Rule), Overcoming Stage Fear, Story Telling	3
3	Problem Solving & Decision Making: Difference Between the Two, Steps in Rational Approach to Problem Solving: Defining the Problem, Identifying the Root Causes, Generating Alternative Solutions, Evaluating and Selecting Solutions, Implementing and Following-Up, Case Studies	3

4	Group Discussion: Understanding GD, Evaluation Criteria, Nine Essential Qualities for Success, Positive and Negative Roles, Mind Mapping, Structuring a Response, Methods of Generating Fresh Ideas	4
5	Number Theory: Number System, Divisibility rules, Remainders and LCM & HCF	3
6	Numerical Computation and Estimation - I : Chain Rule, Ratio Proportions, Partnerships & Averages, Percentages, Profit-Loss & Discounts, Mixtures, Problems on Numbers & ages	6
7	Data Interpretation: Interpretation and analysis of data in Tables, Caselets, Line-graphs, Pie-graphs, Box-plots, Scatter-plots and Data Sufficiency	3
8	Mental Ability: Series(Number, Letter and Alphanumeric), Analogy(Number, Letter and Alphanumeric) and Classifications	3
	<b>Total Hours</b>	30

### Course Outcomes

- Students will be able to communicate 'one-on-one' and 'one-on-many' confidently using both verbal and non-verbal messages and deliver impressive talks/ presentations to a group both with and without the use of PPTs and create posters, advertisements, etc.
- Students will be able to apply the the rational model of problem solving and decision making in their problem solving and decision making efforts.
- Students will be able to solve questions based on numbers and arithmetic given in various competitive examinations
- Students will be able to solve questions based on data interpretation, progressions and series.

### References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

## CLAD1021: Verbal Ability & Quantitative Ability (Soft Skills 3)

L	T	P	S	J	C
0	0	2	0	0	1

### Course Description:

Vocabulary is an important part of verbal ability. An understanding of word formation, prefixes, suffixes and roots is necessary to remember and use a vast repository of words. Approaching words through word families and other ways of groupings is an effective way of gaining mastery over vocabulary. Understanding and getting acquainted with the different rules and exceptions in the use of grammar and structure, especially from the relevant examination point of view, is crucial to cracking questions given in many competitive tests. Similarly, improving reading comprehension skills and test taking abilities in this area takes time and effort, especially given the fact that most students do not possess strong reading habits. In so far as quantitative aptitude is concerned, students need to develop a strong foundation on the basic mathematical concepts of numerical estimation, geometry, mensuration, data sufficiency, etc. to be able to crack different round 1 tests of major recruiters and admission tests of top Indian and foreign universities.

### Course Objectives:

1. List and discuss the different word formation methods, word denotation, connotation, collocation, etc. and introduce selected high frequency words, their antonyms, synonyms, etc
2. Apply different advanced reading skills to solve questions based on author's tone, main ideas and sub-ideas, inferences, parajumbles, etc. that are frequently asked in various competitive exams and admission tests.
3. Solve different types of questions based on vocabulary, such as word analogy; structure, grammar and verbal reasoning; introduce common errors and their detection and correction.
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude. This includes questions on time and work, time and distance, pipes and cisterns, lines and angles, triangles, quadrilaterals, polygons and circles, 2 & 3 dimensional mensuration.

1. **Vocabulary Builder:** Understanding Word Formation, Prefixes, Suffixes and Roots, Etymology, Word Denotation, Connotation and Collocation, Synonyms and Antonyms
2. **Reading Comprehension:** Advanced Reading Comprehension: Types of RC passages, Types of Text Structures, Types of RC Questions: Distinguishing Between Major Ideas and Sub Ideas, Identifying the Tone and Purpose of the Author, Reading Between the Lines and Beyond the Lines, Techniques for Answering Different Types of Questions
3. **Para Jumbles:** Coherence and Cohesion, Idea Organization Styles, Concept of Mandatory Pairs and Its Application: Transitional Words, Antecedent-Pronoun Reference, Article Reference, Cause and Effect, Chronological Order, General to Specific, Specific to General, Idea-Example, Idea-Explanation, Etc.

4. **Grammar Usage:** Rules Governing the Usage of Nouns, Pronouns, Adjectives, Adverbs, Conjunctions, Prepositions and Articles
5. **Numerical Computation and Estimation - II:** Time and Work, Pipes and Cisterns, Time and Distance, Problems on Trains, Boats and Streams, Races and Games of Skill, Simple Interest & Compound Interest
6. **Geometry:** Lines and Angles, Triangles, Quadrilaterals & Polygons, and Circles
7. **Mensuration:** 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), 3-Dimensional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)

**Course Outcomes:**

1. List and discuss word formation methods, selected high frequency words, their antonyms, synonyms, etc.
2. Analyze reading passages and quickly find out the correct responses to questions asked, including para jumbles, by using reading skills like skimming, scanning, reading between the lines, etc.
3. Solve different types of questions based on vocabulary, structure, grammar and verbal reasoning
4. Solve questions on numerical estimation, mensuration, data sufficiency based on quantitative aptitude

**References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

## **CLAD1031: Practicing Verbal Ability & Quantitative Aptitude (Soft Skills 4)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>

### **Course Description:**

A sound knowledge of the rules of English grammar, structure and style and its application in detecting errors in writing are important areas of Verbal Ability frequently tested as a part of the written test in many competitive examinations and admission tests of major recruiters and universities respectively. This module focuses on all important areas of grammar and structure commonly asked in major tests, such as GMAT, CAT, XLRI, CRT, etc. Similarly, in the area of Quantitative Aptitude, different kinds of questions are asked from Combinatorics (Permutations & Combinations, Probability], Cryptarithmic & Modular Arithmetic (Cryptarithmic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7), and Mental Ability (Number series, Letter series & Alpha numeric series, Analogies ( Numbers, letters), Classifications, Algebra (Exponents, Logarithms, Problems related to Equations, Special Equations, and Statistics) . This module focuses on all these areas by building on what the students already learnt in their earlier studies.

### **Course Objectives:**

1. Apply the rules of grammar to solve questions in Error Detection, Sentence Correction and Sentence Improvement.
  2. Apply the rules of structure to solve questions in Error Detection, Sentence Correction and Sentence Improvement, Fill-in-blanks and Cloze Passages.
  3. Explain methods of solving problems in Combinatorics (Permutations & Combinations, Probability], Cryptarithmic & Modular Arithmetic (Cryptarithmic, Application of base system (7, 24), Clocks (Base 24), Calendars (Base 7)]
  4. Explain how to solve questions in Mental Ability ( Number series, Letter series & Alpha numeric series, Analogies, Numbers, letters, Classifications] and Algebra ( Exponents, Logarithms, Problems related to Equations, Special Equations, Statistics)
- 
1. Error Detection: Pronouns, Conjunctions, Prepositions and Articles
  2. Error Detection: Tenses and their Uses
  3. Sentence Correction: Subject-Verb Agreement, Antecedent-Pronoun Agreement, Conditional Clauses
  4. Sentence Correction: Modifiers (Misplaced and Dangling) & Determiners, Parallelism & Word Order, and Degrees of Comparison
  5. Combinatorics: Permutations & Combinations, Probability

6. Crypt arithmetic & Modular Arithmetic: Crypt arithmetic, Application of Base System (7, 24), Clocks (Base 24), Calendars (Base 7)
7. Algebra: Exponents, Logarithms, Word-problems related to equations, Special Equations, Progressions, Statistics

**Course Outcomes:**

1. Identify and correct errors in English grammar and sentence construction
2. Identify and correct errors in Structure, Style and Composition
3. Solve problems in Combinatorics, Cryptarithmic, and Modular Arithmetic
4. Solve problems in Mental Ability and Algebra

**References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

# VEDC1001: Venture Development

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2</b>

## Course Description

In this course, you will discover your deeper self in terms of how you might contribute to society by creating exciting new products and services that can become the basis of a real business. Your efforts, creativity, passion, and dedication to solving challenging problems are the future of our society, both in your country and worldwide.

The course is divided into four sections:

1. Personal discovery of your core values and natural skills
2. Ideation and improving the impact
3. Business model design for the innovation
4. Presenting your idea in a professional manner suitable for a new venture pitch

Each section has key frameworks and templates for you to complete, improving your idea step by step until the final presentation.

First, you will discover your personal values and emerging areas of knowledge that are the foundations of any successful company. Next, you will learn how to develop insight into the problems and desires of different types of target customers and identify the design drivers for a specific innovation. Then, you will learn specific design methods for new products and services. And as important as the product or service itself, it is a strategy for monetizing the innovation – generating revenue, structuring the operating costs, and creating the operating profit needed to support the business, hire new employees, and expand forward.

This project is intended to be for teams of students. Innovation and entrepreneurship are inherently team-based. This course will give you that entrepreneurial experience.

This is the beginning of what might be the most important journey of personal and career discovery so far in your life, one with lasting impact. This is not just a course but potentially an important milestone in your life that you remember warmly in the years to come.

## Course Objectives

Students will have the opportunity to:

- Discovery who you are – Values, Skills, and Contribution to Society
- Understand how creativity works and permeates the innovation process
- Learn the basic processes and frameworks for successful innovation.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

## Course Materials

- Meyer and Lee (2020), Personal Discovery through Entrepreneurship, The Institute for Enterprise Growth, LLC. Boston, MA., USA
- Additional readings

- Additional videos, including case studies and customer interviewing methods.

***Expectations of you in the classroom:*** Each student is expected to be prepared to discuss the readings/exercises assigned for each class. It's not optional! Students will be randomly asked to discuss and summarize the material. Your learning – and your success—in this course are heavily dependent upon your willingness to participate actively in class discussion. Your class participation will be assessed on the quality and consistency of your effort in each and every class.

***Late assignments:*** Late assignments are subject to grade penalty. Lateness will only be considered for grading if prior notice was given to the instructor before the due date.

***Presentation:*** Achieving success with an innovative idea requires you to package and present the idea in a crisp, creative, and powerful manner. The activity of presenting helps you to internalize your idea -- as you talk about it and obtain feedback – and improve upon it. There would be two major presentations during the course, plus a series of other smaller unscheduled presentations of work in progress or course material. Prepare, practice, and succeed!

***Time spent outside of class:*** The course is hands-on and requires students to conduct field research through direct interactions with people (interviews/surveys) and online/in the library. Specifically, the course requires that students conduct studies with potential target users and stakeholders. You must be prepared to go out of your comfort zone to dig for information. You will need to search for information online and arrange to meet or talk to relevant people who may have the information you need.

### **Group Project Overview**

This is a semester length project and the cornerstone component of the course. The group project will give you the opportunity to apply the course concepts to a real situation. You will learn about the entrepreneurship for your own business or your work in organizations. Even if you are not going to be an entrepreneur, you need to know how to identify the opportunities, who to persuade people, and how to create economic and social values in many different contexts.

Talking to customers is one of the most important steps in investigating your business because your entrepreneurial vision must correspond to a true market opportunity. With your group, select 5-6 potential customers willing to be interviewed. They should represent a cross-section of our target market and should provide information that helps you refine your opportunity. This is not a simple survey: you are seeking in-depth understanding of the lifestyle and behaviors of your customer that can help you shape your opportunity. Please remember, you are not simply looking to confirm you have a great idea, but to shape your idea into a great opportunity. You will maximize your chances for success and your ability to execute your business cost-effectively by making early (rather than later) changes to your concept.

“Design” is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

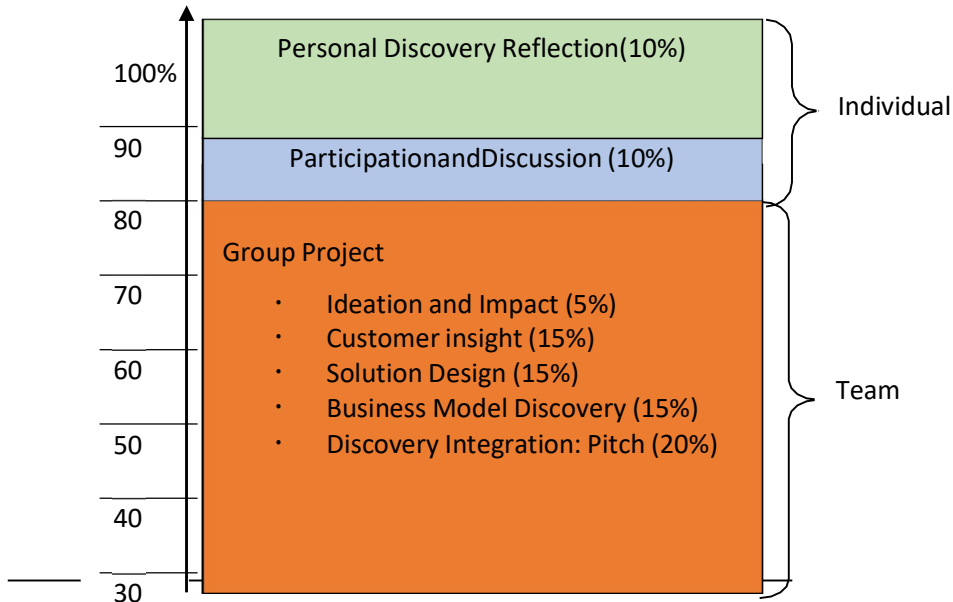
Business modeling is not as hard as it might sound. This is the design of your business – how it charges customers, what is spent producing and selling products or services, and the money that can be made for each unit sold. We keep it simple – so should you.

For the final outcome, you will be required to come up with Pitch that can be used as the basis for actually starting a company based on an impactful innovation. Once again, we provide a specific format and tools for creating a compelling Pitch. We also want you to think about an exciting proposition that is more than just making money, but rather, one that helps society. This will give



you innovation and venture concept greater lift with customers – and it will also make you feel better, deep inside.

**Project Components and Grading**



20	STEP 04	STEP 07	STEP 08	STEP 09	STEP 10	STEP 11				
Solution Discovery	Ideation & Impact	User Insight	Concept Design	Product Line Strategy	Prototyping Solutions	Reality Check				
10						Business Model Design				
STEP 05						Mission Statement	STEP 12			
STEP 04						Define Purpose	STEP 13			
STEP 03						Build a Team	STEP 14			
STEP 02						Excite & Excel	STEP 15			
STEP 01						Personal Values	STEP 16			
Personal Discovery GO!						STEP 20	STEP 19	STEP 18	Discovery Integation	STEP 17
						Tell Your Story	Create Value	Define Company Impact	Validate Business Model	Define Customer Journey

[20 Steps and activities in this course]

**Deliverables**

There are a number of different deliverables for the course that follow the templates presented in the book, as applied to your own venture idea. Do your best to keep up with the timeline of the

class; do not fall behind! Later templates build on the learnings from prior templates. Make the most of your team! Everyone needs to pitch in. In no case, should one person be taking the lead on all templates. Rather, different team members should take the lead on specific deliverables. Coordinate well. Let your teacher know if a team member is not carrying his or her load.

## **Specific Deliverables**

**Ideation and Impact** Hand-in Package: 5% of total grade  
clearly written, with a one-page explanation for the team's decision

- Problem to Solve Templates, Step 4, Page 62 and 63 (with a page of additional explanation if needed)
- Idea Impact Template, Step 6, Page 69 (with a page of explanation)

**Customer Interviews and Insight** Hand-in Package: 15%  
(1<sup>st</sup> Round of Customer Interviews)

- Customer Interviews Template, Step 7, Pages 75-78, plus add additional template forms for each additional customer interview. The more, the better.
- Idea Reshaping Template, Step 7, Pages 84 and 85. Integration into overall conclusions. How have you improved your original idea through customer research?
- Latent Needs Template, Step 7, Page 93 – what are the frustrations of users that are not solved by current products or services?
- Full Use Case Template, Step 7, Page 99 – how do your customers' needs change over the full use case, and what innovative ideas can you propose at each step of the way?

**Concept Design (and Test)** Hand-in Package: 15%

- Customer Value Proposition Template: Step 8, Page 107. This becomes the landing point for what you learned in your customer interviews.
- Competitive Analysis Template: Step 8, Page 109. (Use the Web or actual stores/dealers)
- Product Vision and Subsystem Design Templates: Step 10, Pages 121 and 126 (You can add additional pages with design illustration and explanations of your bubble chart)
- Reality Check Survey Template and Results: Step 11, Page 141, 143-144 (You can use more than 2 pages for reporting the results.)

**Business Model Design** Hand-in Package: 15%

- Industry Analysis Templates: Step 12, Pages 153 and 154
- Illustrate the Business Model Template: Step 13, Page 170 (Use different colours or line patterns to show the flows of product, money, and information)
- Revenue Model Template: Step 14, Page 177
- Operating Model Template: Step 15, Page 187
- Customer Journey Template: Step 16, Page 195
- Validating the Business Model Template: Step 17, Pages 199 and 200

**Discovery Integration** Hand-in Package: 20%

- Business and Social Vision Impact Statement Template: Step 18, Page 210.
- Per Unit Profitability Template: Step 19, Page 229
- Your Venture Story Pitch: Step 20 (PowerPoint)
- Overall Pitch Design Template: Page 264



Assemble the templates from all your work above, plus any others that you found particularly meaningful, and from these, create your Team's Innovation Pitch. The book has lists specific templates that fit for each part of the final presentation.

Do not just regurgitate the templates in your pitch; rather, take the key points from them to create your own, unique presentation. The templates help you think – but most are too complex to present to outside people who have not taken the course. Therefore, design this pitch as if you presenting to a new set of investors.

And don't forget to add an attractive title page with your team members names and email addresses! You can also add an Appendix at the very back with particularly interesting information, such as industry data or the results of your customer interviews and Reality Check.

### **Individual Innovation Assignments**

You will be required to submit two Reflection Journals as well as a maximum two pages double spaced Synthesis, Integration and Application paper by email at the Week 4 and Week 14 respectively. Please note, this exercise is not about regurgitating the course concepts.

#### **(1) Personal Discovery Reflection Journal (10%)**

At the beginning of this semester, you will have a time to think about your self (who you are, what you are good at, what areas you want to contribute on) using a couple of templates. After that sessions, you will have a quiet moment to think about yourself, your career, and your happiness in your life. Please write 2-page reflectional journal what you feel and learning through the personal discovery sessions.

#### **(2) Insight Learning Reflection Journal (10%)**

At the end of this semester, you are to prepare a short reflection of impressive sessions as well as related activities outside the classroom. Specially, (1) reflect on the key points from lectures, reading, discussion, guest speakers, and interviews, (2) apply this to your own situation, and (3) outline ways that you intend to use this knowledge in the future.

## Course Schedule

<b>Week</b>	<b>Session</b>	<b>Topics and Steps</b>	<b>Key CONCEPTS Introduced in Class</b>	<b>Class Focus Activity</b>
1	1	<b>Course Overview</b>	<ol style="list-style-type: none"> <li>1. Why is entrepreneurship important?</li> <li>2. What is Personal Discovery through Entrepreneurship?</li> <li>3. Four Stages; Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration</li> <li>4. Preparation (finding interesting areas)</li> </ol>	<b>Lecture and Discussion</b>
	2	<b>Personal Discovery</b> (Step 01, Step 02)	<ol style="list-style-type: none"> <li>1. Personal Values</li> <li>2. Strength and Weakness</li> </ol>	<b>Individual:</b> <ul style="list-style-type: none"> <li>• Work with the templates provided on pages:</li> <li>• Core values: 22, 23</li> <li>• Skills: 27, 28, 29, 30, 31</li> <li>• Societal Contribution: 33, 34</li> </ul>
2	3	<b>Find Teammates</b> (Step 03)	<ol style="list-style-type: none"> <li>1. Review Problem Area Template at the beginning of the book to find classmates who want to work on the same problem area.</li> <li>2. Findteammates               <ol style="list-style-type: none"> <li>(1) Shared values</li> <li>(2) Levels of commitment</li> <li>(3) Skills and experiences (Same or Different?)</li> </ol> </li> </ol>	<b>Problem template: Page 9</b> <ul style="list-style-type: none"> <li>• Talk to your classmates and find teammates. See who wants to work on in the same problem space, with a shared vision of solutions, and complementary skill sets.</li> <li>• Sit back and assess: Team templates on Pages 44, 45, and 46.</li> <li>• Prepare to present your team, the problem it is going to tackle, and its collective skills.</li> </ul>
	4	<b>Define Purpose</b> (Step 04) <b>Create Mission</b> (Step 05)	<ol style="list-style-type: none"> <li>1. Methods for defining and refining a venture's purpose</li> <li>2. Defining a Venture's Purpose</li> <li>3. Creating a Vision Statement</li> </ol>	<b>Team:</b> <ul style="list-style-type: none"> <li>• Purpose and Mission Templates: Pages 49 and 52</li> <li>• Be prepare to present to the class.</li> <li>• Personal Discovery Reflection Journal Due</li> </ul>

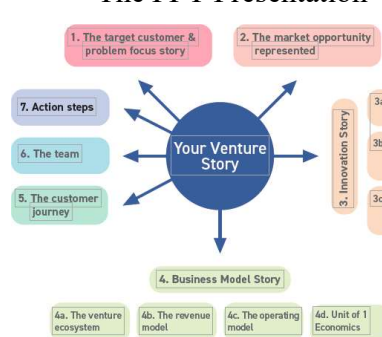
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
3	5	<b>Ideation &amp; Impact</b> (Step 06)	Ideation Methods <ul style="list-style-type: none"> <li>An in-class ideation exercise</li> </ul>	Team: <ul style="list-style-type: none"> <li>Problem to Solve Templates, Step 4, Page 62, and 63</li> </ul>
	6		Increasing the Impact of an Idea. (The Eat-Your-Coffee Video – a good example of ideation)	Team: <ul style="list-style-type: none"> <li>Idea Impact Template, Step 6, Page 69</li> </ul>
4	7	<b>User Insights Frameworks</b> (Step 07)	<ul style="list-style-type: none"> <li>Identify and find the right target users.</li> <li>Interview style and methods</li> <li>The Customer Interview template.</li> </ul>	Team: <ul style="list-style-type: none"> <li>Customer Interviews Template, Step 7, Pages 75</li> <li>Edit interview template for your project.</li> </ul>
	8		Laddering methods for interviews	Team: <ul style="list-style-type: none"> <li>Latent Needs Template, Step 7, Page 93</li> </ul>
5	9	<b>User Insights Customer Interviews</b> (Step 07)	<ul style="list-style-type: none"> <li>Finding latent needs</li> <li>Field work check-in</li> </ul>	Team: <ul style="list-style-type: none"> <li>Latent Needs Template, Step 7, Page 93</li> <li>Field work – customer interviewing</li> </ul>
	10		<ul style="list-style-type: none"> <li>Think about innovation across the entire use case</li> <li>Field work check-in</li> </ul>	Team: <ul style="list-style-type: none"> <li>Full Use Case Template, Step 7, Page 99</li> <li>Field work – customer interviewing</li> </ul>
6	11	<b>User Insights Interpreting Results</b> (Step 07)	<ul style="list-style-type: none"> <li>Interpreting customer interview results</li> <li>Field work check-in</li> </ul>	Team: <ul style="list-style-type: none"> <li>Field work – customer interviewing</li> <li>Also talk to retailers/dealers if appropriate</li> </ul>
	12		<ul style="list-style-type: none"> <li>Idea Reshaping based on Customer Interviews</li> <li>Field work check-in</li> </ul>	Teams prepare results of results from customer interviews and how the original ideas have been reshaped & improved.
7	13	<b>User Insights Interpreting Results</b> (Step 07)	<ul style="list-style-type: none"> <li>Customer Research Reports</li> <li>Implications for product and service design</li> </ul>	<ul style="list-style-type: none"> <li>Teams prepare PPTs for class presentation</li> <li><b>Customer Insight Template Hand-in Package</b></li> </ul>
	14			

<b>We ek</b>	<b>Sess ion</b>	<b>Topics and Steps</b>	<b>Key CONCEPTS Introduced in Class</b>	<b>Class Focus Activity</b>
8	15	<b>Concept Design</b> (Step 08)	<ul style="list-style-type: none"> <li>• Defining Customer Value</li> <li>• Understanding Customer Value Proposition</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Customer Value Proposition</li> <li>• Template: Step 8, Page 107</li> <li>• Draft the CVP</li> </ul>
	16		<ul style="list-style-type: none"> <li>• Presentation and review of CVPs</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Complete CVP</li> </ul>
9	17	<b>Competitive Analysis and Positioning</b> (Step 08)	<ul style="list-style-type: none"> <li>• Understanding of Competitive Matrix</li> <li>• Competitive positioning: creating your separate space</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Identify major competitors, and dimensions for analysis</li> <li>• Template: Step 8, Page 109</li> </ul>
	18		<ul style="list-style-type: none"> <li>• Presentations of Competitive Analyses and Positionings</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Perform the competitive analysis and present results, including positioning</li> </ul>
10	19	<b>Product Line Strategy</b> (Step 09)	<ul style="list-style-type: none"> <li>• Product line framework: good, better, best on underlying platforms, plus application to Services.</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Identify good, better, best variations based on the underlying concept.</li> <li>• Product line template: Page 115</li> </ul>
	20	<b>Product Visioning Subsystem Design, and Prototype Sketch</b> (Step 10)	<ul style="list-style-type: none"> <li>• The structured bubble chart, showing implementation options and the team's choices</li> <li>• Prototype sketching (The Bluereo Video is a good example of iterative prototyping driven by customer discovery.)</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Prototype sketch, and for Web apps, a wireframe. For physical products, an initial bill of materials.</li> <li>• Underlying bubble chart showing your decision process.</li> <li>• Product Vision and Subsystem Design Templates: Step 10, Pages 121 and 126</li> </ul>
<b>We ek</b>	<b>Sess ion</b>	<b>Topics and Steps</b>	<b>• Key CONCEPTS Introduced in Class</b>	<b>Team or Individual Activity</b>
11	21	<b>Reality Check</b> (Step 11)	<ul style="list-style-type: none"> <li>• The purpose of the Reality Check, testing the product concept, channel preferences, and much other.</li> </ul>	Team: <ul style="list-style-type: none"> <li>• Reality Check Survey Template and Results: Step 11, Page 141, 143-144</li> </ul>

	22		<ul style="list-style-type: none"> <li>• Guidance on the number or additional customers for the reality check survey</li> <li>• How to analyze and interpret the results</li> </ul>	<ul style="list-style-type: none"> <li>• Customize the Reality Check template for your venture.</li> <li>• Do a quick round of customer surveying. Aim for 12 more interviews.</li> </ul>
12	23	<b>Industry Analysis</b> (Step 12)	<ul style="list-style-type: none"> <li>• Team reports on Reality Check Results</li> <li>• Examine major components of an Industry Analysis</li> <li>• Review Templates</li> </ul>	<p>Team:</p> <ul style="list-style-type: none"> <li>• Prepare and present the results of your reality check, plus any pivots you wish to make.</li> <li>• <b>Concept Design (and Test) Hand-in Package</b></li> <li>• Industry Analysis Templates: Step 12, Pages 153 and 154s</li> </ul>
	24	<b>Business Model</b> (Step 13)	<ul style="list-style-type: none"> <li>• Defining the Business Model:</li> <li>• Lecture on basic structure and different types.</li> <li>• Illustrating it as the flow of product, money, and information.</li> </ul>	<p>Team:</p> <ul style="list-style-type: none"> <li>• Business Model Illustration Template, Step 13, Page 170</li> </ul>

<b>Week</b>	<b>Session</b>	<b>Topics and Steps</b>	<b>· Key CONCEPTS Introduced in Class</b>	<b>Team or Individual Activity</b>
13	25	<b>Business Model</b> (Steps 14, 15, 16, 17)	<ul style="list-style-type: none"> <li>• Revenue and Expenses</li> <li>• The key decision points in the Revenue Model</li> <li>• The key decision points in the Operating Model</li> <li>• Designing the Customer Journey</li> <li>• Validating the Business Model (The Polka Dog Bakery Video: an example of creating a new retail experience, plus new products.)</li> </ul>	<b>Team</b> <ul style="list-style-type: none"> <li>• Step 14, Page 177</li> <li>• Step 15, Page 187</li> <li>• Step 16, Page 195</li> <li>• Step 17, Pages 199 and 200</li> <li>• Validate the Revenue and Operating Model by trying to have phone calls with a few Sellers and Manufacturers to validating pricing, channels, and costs.</li> </ul>
	26			
14	27	<b>Impact Visioning</b> (Step 18)	<ul style="list-style-type: none"> <li>• Develop clear statements for business and societal impact.</li> <li>• Look at good existing examples of companies that do both.</li> </ul>	<b>Team:</b> <ul style="list-style-type: none"> <li>• Start integrating your research and templates towards the final presentation, provided in Step 20, Page 264</li> <li>• <b>Business Model Design Hand-in Package</b></li> </ul>
	28	<b>Creating Value</b> (Step 19)	<ul style="list-style-type: none"> <li>• Develop a project of the profitability in make low volumes for a product, a service, and a Web app.</li> <li>• Discuss applications of the framework to your venture.</li> </ul>	<b>Team:</b> <ul style="list-style-type: none"> <li>• Develop and present Unit of 1 Economics Template, Step 19, Page 229</li> <li>• Keep working on the Final presentation</li> </ul>



Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Team or Individual Activity
15	29	<b>Tell Your Story</b>	<ul style="list-style-type: none"> <li>• Presentation Format and Style</li> <li>• Format:               <ol style="list-style-type: none"> <li>(1) Title Slide with names and contact information</li> <li>(2) The Target Customer and the Problem to be Solved</li> <li>(3) The Market Opportunity</li> <li>(4) The Innovation Story</li> <li>(5) The Business Model Story</li> <li>(6) The Customer Journey</li> <li>(7) The Team</li> <li>(8) The Proposed Action Steps.</li> <li>(9) Appendices (if needed or desired)</li> </ol> </li> <li>• If you have built a prototype during the class, please bring it and show it to us!</li> </ul> <p>(The Fortify Video is a good example of how a good technical idea can translate into a business model, and next, into a well-funded venture.)</p>	<p>Team:</p> <ul style="list-style-type: none"> <li>• The PPT Presentation</li> </ul>  <ul style="list-style-type: none"> <li>• Practice, practice, practice!</li> <li>• Not too many words on one slide</li> <li>• Use pictures</li> <li>• Use template to develop your thinking, but try to create slides that are not just the templates.</li> </ul>
	30			<p>Due on the Monday after the weekend of the final class meeting.</p>
<b>Final Course Deliverables</b>				

### Course Outcomes

5. Identify one's values, passions, skills and their will to contribute to society
6. Formulate an idea and validate it with customers
7. Demonstrate prototyping and analyze the competition for the product
8. Create business models for revenue generation and sustainability of their business
9. Come up with a pitch that can be used as the basis for actually starting a company based on an impactful innovation and societal impact

## **DOSP1001: Badminton**

**L T P S J C**  
**0 0 0 2 0 2\***

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

### **Course Objectives:**

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

### **Course Outcomes:**

1. Learn to play Badminton
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

### **List of Activities:**

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

### **Instructional Plan:**

1. Introduction to Badminton - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Badminton: Grips - Racket, shuttle
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Badminton Gameplay: Service, Forehand, Backhand
7. Preparatory Drills and Fun Games
8. Game Variations: Singles/ Doubles/ Mixed

### **Reference:**

1. Handbook of the Badminton World Federation (BWF)

# DOSP1011: Chess

**L T P S J C**  
**0 0 0 2 0 2\***

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Chess
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Chess - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Chess: Pieces & functions, basic play
4. Chess board moves & terminology
5. Chess Gameplay: Openings, castling, strategies & tactics
6. Preparatory Drills and Fun Games
7. Game Variations & Officiating

## Reference:

1. International Chess Federation (FIDE) Handbook

# DOSP1031: Football

L T P S J C  
0 0 0 2 0 2\*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Football
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Football - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Kicking, heading, ball control, Keeping
4. Movement, throwins, tackling, defense, scoring, defense
5. Gameplay- Formations, passing, FKs, CKs, PK, tactics
6. Preparatory Drills and Fun Games
7. Game Variations: Small sided games, 7v7, 11v11

## Reference:

1. FIFA Laws of the Game

# DOSP1041: Volleyball

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2*</b>

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Volleyball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Volley - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Striking, Ball control, Lifting
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Jumps, strikes, layoffs, attack, defense

## Reference:

1. FIVB - Official Volleyball Rules

# DOSP1051: Kabaddi

**L T P S J C**  
**0 0 0 2 0 2\***

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Kabaddi
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Kabaddi - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Raiding, catching
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Chain system movement

## Reference:

1. Amateur Kabaddi Federation of India (AKFI) - Official Rules
2. Rules of Kabaddi - International Kabaddi Federation

# DOSP1091: Basketball

L	T	P	S	J	C
0	0	0	2	0	2*

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Basketball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Basketball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Passing, Receiving, Dribbling
4. Sports Specific fitness and warmup drills
5. Stances and footwork: Jumps, dribbles, catching, throws
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, attack, defense

## Reference:

1. FIBA Basketball Official Rules

# DOSP1111: Throwball

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2*</b>

This course provides instruction and the opportunity for participation in sports and physical fitness activities. Skills, strategies, rules, and personal wellness goals are included as appropriate. This course will provide students with an understanding of the fundamental concepts of the physiological functions and training principles associated with the chosen sport.

## Course Objectives:

1. Understand training principles used in the sport
2. Demonstrate knowledge of the game in a recreational /competitive play setting
3. Organize an event around the sport
4. Demonstrate concepts of warm up, game conditioning, training plans

## Course Outcomes:

1. Learn to play Throwball
2. Understanding of the fundamental concepts such as rules of play, game variations
3. Understanding of the governing structure and administration of the sport
4. Understand the event management of the sport
5. Apply sport concepts into an active physical lifestyle

## List of Activities:

1. Watch a sport documentary / training video / game history
2. On field coaching and demonstration session
3. Guided practice and play
4. Event management & game officiating
5. Friendly competitions and structured matches

## Instructional Plan:

1. Introduction to Throwball - History and development
2. Rules of the Game, Play Area & dimensions
3. Fundamental Skills - Throwing, Receiving
4. Sports Specific fitness and warmup drills
5. Stances and footwork
6. Preparatory Drills and Fun Games
7. Gameplay: Shots, throws, movements, control

## Reference:

1. World Throwball Federation - Rules of the Game



## DOSL1001: Club Activity – Participant

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>2*</b>

This course recognizes student participation in multiple activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to engage in and identify and pursue their personal interests and hobbies.

### Course Objectives

- Create opportunities for students to participate in a variety of non-academic experiences
- Interact with and learn from peers in a setting without an external performance pressure
- Allow exploration of interesting activities and reflection about these experiences
- Learn to manage time effectively

### List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

### List of Activities

1. Participation in various club based activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

### Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

**References**

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

**Course Outcomes**

Upon successful completion of the course, student will be able to

- Identify personal interest areas
- Learn from diverse perspectives and experiences
- Gain exposure to various activities and opportunities for extra-curricular activities
- Learn to manage time effectively
- gain confidence

## DOSL1011: Club Activity – Member of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and acknowledges student members' work in organizing events and activities organized by various student organizations that pursue specific co-curricular and extra-curricular interests. These activities allow students to actively learn from the process of conceptualizing and organizing such activities as part of a team.

### Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

### List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multi media, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

### List of Activities

1. Be a member of a club and organize activities in that particular interest area
2. Learn from diverse perspectives and experiences
3. Learn to design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

### Text Books

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

**References**

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

**Course Outcomes**

Upon successful completion of the course, student will be able to

- Be a member of a club and organize activities in that particular interest area
- Learn from diverse perspectives and experiences
- Learn to design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

## DOSL1021: Club Activity – Leader of the Club

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

### Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

### List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

### List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

**Text Books**

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

**References**

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

**Course Outcomes**

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies

## DOSL1031: Club Activity – Competitor

L	T	P	S	J	C
0	0	0	2	0	2*

This course encourages and recognizes student members' work in leading the student organizations through various leadership roles. As leaders they work not just to organize events and activities in specific co-curricular and extra-curricular interests, but also lead the teams that form the core members of the clubs. These activities allow students to learn and practice leadership and management skills through real world experience.

### Course Objectives

- Create opportunities for students to learn from organizing club activities
- Learn teamwork, leadership, planning and management of events and activities
- Learn to appreciate multiple perspectives, cultures, and individual capabilities
- Learn to manage time effectively

### List of Student Club Activities

1. Music (vocals, instruments, technical, recording, mixing, production, management)
2. Dance (Indian classical, western, jazz, latin, contemporary, folk, production, event management)
3. Theatre (classical, experimental, one-act, street, production, direction, casting, etc.)
4. Arts (fine arts, painting, calligraphy, sketching, caricaturing, etc)
5. Craft (origami, model making, sculpture, pottery, etc)
6. Cooking (home-style, baking, confectionery, Indian, intercontinental, etc.)
7. Graffiti (street, mural, collage, multimedia, etc)
8. Workshops, quizzes, debates, elocution, etc
9. Filmmaking (adventure, drama, film appreciation, documentary, etc)
10. Photography (conventional, immersive (360), landscape, portrait, technical, editing, etc.)
11. College Fests
12. Designing (graphic design, landscape, interior, etc)
13. Competitive coding
14. Recreational sports activities
15. Other club activities organized by student clubs

### List of Activities

1. Be the leader of the club and implement the charter, vision and mission of the club
2. Learn from diverse perspectives and experiences
3. Learn to lead the team, design and execute extra-curricular activities
4. Develop management skills through hands on experience
5. Explore different managerial roles and develop competencies

**Text Books**

1. Small move: big Change (Caroline Arnold)
2. How to Win at College: Surprising Secrets for Success from the Country's Top Students (Cal Newport)

**References**

1. Making the most of college: Students speak their minds (author - Richard Light)
2. Failing Forward: Turning Mistakes into Stepping Stones for Success (John C Maxwell)
3. The Last Lecture (Randy Pausch)
4. Lean in (Sheryl Sandberg)
5. Youtube- Introduction to various club activities

**Course Outcomes**

Upon successful completion of the course, student will be able to

- Be the leader of the club and implement the charter, vision and mission of the club
- Learn from diverse perspectives and experiences
- Learn to lead the team, design and execute extra-curricular activities
- Develop management skills through hands on experience
- Explore different managerial roles and develop competencies



## POLS1001: Indian Constitution and History

L	T	P	S	J	C
2	0	0	0	0	2*

### Course Description:

This course analyzes the basic structure and operative dimensions of the Indian Constitution. It explores various aspects of the Indian political and legal system from a historical perspective highlighting the various events that led to the making of the Indian Constitution. The course also deals with various challenges faced by the constitution and its coping mechanisms. Broadly, the students would understand and explain the working of different institutions and political debates ensuing from the operation of the Indian constitution in action.

### Course Objectives:

1. To introduce constitutional history of India.
2. To explain the process of making Indian constitution
3. To analyze Fundamental of Rights, Duties and other principles in constitution
4. To create familiarity with political developments which shaped the constitution.

### Course Outcomes:

On the successful completion of the course students would be able to:

1. Demonstrate an understanding of the Constitution of India and how constitutional governance is carried out in India
2. Interpret knowledge of the Fundamental Rights and Duties of the Citizens as well as the Obligation of the state towards its citizens
3. Correlate familiarity with key political developments that have shaped the Constitution and amended it from time to time.
4. Equip themselves to take up other courses in law after having done a foundation course on Indian Constitution

### Unit I: India as a Nation

6 hrs

Khilani, S. (2004). *Introduction, The Idea of India*, Chapter 1. New Delhi: Penguin Books, pp. 1-15.

Rowat, D. (1950). 'India: The Making of a Nation', *International Journal*, 5(2), 95-108. doi:10.2307/40194264

Brass, P. (2018). 'Continuities and Discontinuities between pre- and post-Independence India', Chapter 1. *The Politics of Idea since independence*, New Delhi: Cambridge University Press. pp. 1-30.

### Module Learning Outcomes

1. Understand ideas of India
2. Explain the story behind making constitution and its future.
3. Articulate the differences between pre and post-colonial governments.

## Unit 2: Understanding the Constitution

6 hrs

Mehta, U.S. (2011). 'Constitutionalism' in *The Oxford Companion to Politics in India*, (ed) by Nirja Gopal Jayal, and Pratap Bhanu Mehta, New Delhi: Oxford University Press. pp. 15-27.

Austin, G. (2016), 'The Constituent Assembly: Microcosm in Action' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp. 1-25.

Beteille, Andre (2008): "Constitutional Morality," *Economic and Political Weekly*, Vol 43, Issue No 40

Prahladan, Vivek (2012): "Emergence of the Indian Constitution," *Economic and Political Weekly*, Vol 47, Issue No 07.

### Module Learning Outcomes

Understand the concept of constitutionalism. Demonstrate strength or weakness of constitutional morality in India

Evaluate constituent assembly debates in framing Indian Constitution.

## Unit 3: The Preamble, Fundamental Rights and Directive Principles of State Policy 6 hrs

Bhakshi, P.M. (2011). 'Preamble' in *The Constitution of India*, New Delhi: Universal Law. Pp. 1-5.

Laxmikanth, M. (2017). 'Chapter IV: Preamble of the Constitution' in *Indian Polity*, Chennai: McGraw Hills.

Kumar, Virendra (2007): "Basic Structure of The Indian Constitution: Doctrine of Constitutionally Controlled Governance [From Kesavananda Bharati to I.R. Coelho]" *Journal of the Indian Law Institute*, Vol 49, No 3, pp 365-398.

Austin, G (2016), ' ' in *The Indian Constitution: Cornerstone of a Nation*, New Delhi: Oxford University Press, pp.63-105.

Reddy, S (1980). Fundamental Ness of Fundamental Rights and Directive Principles in the Indian Constitution. *Journal of the Indian Law Institute*, 22(3), pp. 399-407.

Bhatia, Gautam (2017): "The Supreme Court's Right to Privacy Judgement," *Economic and Political Weekly*, Vol 52, Issue No 44

### Module Learning Outcomes

1. Explain the relationship between 'Preamble' and 'The constitution'.
2. Interpret the key concepts of preamble
3. Analyzes the dynamic nature of Indian constitution
4. Understanding Fundamental Rights
5. Evaluate Directive Principles of State Policy
6. Interpret case studies on Fundamental Rights.

## Unit 4: Citizenship

6 hrs

Jayal, N.G. (2019). 'Reconfiguring citizenship in contemporary India' in *South Asia Journal of South Asian Studies*, pp.33-58.

Roy, Anupama. (2010). 'Chapter I: Enframing the citizen in contemporary times' in *Mapping Citizenship in India*, New Delhi: Oxford University Press.

Das, Veena (2010): "State, Citizenship and the Urban Poor," *Citizenship Studies*, Vol 15, pp 319-333.

Valerian Rodrigues

### Module Learning Outcomes

1. Explain different dimensions of citizenship in Indian context
2. Evaluate the basis of citizenship
3. Compare 'claim' and 'status' of citizenship

### **Unit 5: Separation and Distribution of Powers**

**6 hrs**

Pal, Ruma. (2016). 'Separation of Powers' in *The Oxford Handbook of the Indian Constitution*, (ed) by Sujit Choudhry, Madhav Khosla, and Pratap Bhanu Mehta, Delhi: Oxford University Press.

Bakshi, P. (1956). 'Comparative Law: Separation of Powers in India'. *American Bar Association Journal*, 42(6), 553-595.

Rao, P. (2005). 'Separation of Powers in a Democracy: The Indian Experience'. *Peace Research*, 37(1), 113-122.

Kumar, Ashwani (2019): "Constitutional Rights, Judicial Review and Parliamentary Democracy," *Economic and Political Weekly*, Vol 51, Issue 15

Tillin, Louise. (2015). 'Introduction' in *Indian Federalism*. New Delhi: Oxford University Press. pp. 1-30.

Chakrabarty, Bidyut and Rajendra Kumar Pandey. (2008). *Federalism' in Indian Government and Politics*, New Delhi: Sage Publications. pp. 35-53.

Arora, B. and Kailash, K. K. (2018). 'Beyond Quasi Federalism: Change and Continuity in Indian Federalism', in *Studies in Indian Politics*, pp. 1-7.

Agrawal, Pankhuri (2020): "COVID-19 and dwindling Indian Federalism," *Economic and Political Weekly*, Vol 55, Issue No 26

### Module Learning Outcomes

1. Explain the importance of separation of powers in a democracy
2. Understand the relation between three organs of the government
3. Evaluate the system of 'checks and balances'
4. Understand the difference between unitary and federal political systems
5. Critically analyze the Indian model of Federalism
6. Evaluate the distribution of responsibilities between union and state governments.

### **Recommended Readings:**

De, Rohit. (2018). *A People's Constitution – The Everyday Life of Law in the Indian Republic*, USA: Princeton University Press.

Granville Austin, *The Indian Constitution: Cornerstone of a Nation*, Oxford University Press, Oxford, 1966.

Lahoti, R.C. (2004). *Preamble: The Spirit and Backbone of the Constitution of India*. Delhi: Eastern Book Company.

Rajeev Bhargava (ed), *Ethics and Politics of the Indian Constitution*, Oxford University Press, New Delhi, 2008.

Subhash C. Kashyap, *Our Constitution*, National Book Trust, New Delhi, 2011.

Tillin, Louise. (2015). *Indian Federalism*. New Delhi: Oxford University Press.

Zoya Hassan, E. Sridharan and R. Sudarshan (eds), *India's Living Constitution: Ideas, Practices, Controversies*, Permanent Black, New Delhi, 2002.

# PHPY1001: Gandhi for the 21st Century

L	T	P	S	J	C
2	0	0	0	0	2*

## Course Description

This course provides the students with basic knowledge on Gandhi's early life, transformations in South Africa and his entry into India's national movement. While going through the social-political, economic and educational philosophies of Gandhi, the course analyses how his ideologies are relevant even in the 21st century.

## Course Objectives

The objectives of the course are;

1. To provide the students with the basic knowledge on Gandhi's life and his philosophies
2. To understand the early influences and transformations in Gandhi
3. To analyse the role of Gandhi in India's national movement
4. To apply Gandhian Ethics while analysing the contemporary social/political issues
5. To appreciate the conflict resolution techniques put forward by Gandhi and its significance in the current scenario.

## Module I : MK Gandhi: Childhood and Education

M K Gandhi, Formative Years (1869-1893): Early childhood - study in England - Indian influences, early Western influences.

## Module II: From Mohan to Mahatma-South African Experiences

Gandhi in South Africa (1893-1914): South African Experiences - civil right movements in South Africa - invention of Satyagraha - Phoenix settlement- Tolstoy Farm - experiments in Sarvodaya, education, and sustainable livelihood.

## Module III: Gandhi and Indian National Movement

Gandhi and Indian National Movement (1915-1947): Introduction of Satyagraha in Indian soil -non-cooperation movement - call for women's participation - social boycott - Quit-India movement - fighting against un-touchability - Partition of India- independence.

## Module IV: Gandhi and Sustainable Development

Gandhian Constructive Programs-Eleven Vows-Sarvodaya-Seven Social Sins-Gandhian Economics and Sustainable Development

## Module V: Gandhi and Contemporary Issues

Conflict Resolution Techniques of Gandhi-Ecological Challenges and Gandhian solutions-Gandhian Ethics-An Analysis

## Learning Outcomes

1. To understand the life of Gandhi
2. To understand the role of Gandhi in Indian national movement
3. To analyse the origin and significance of Satyagraha
4. To understand the eleven vows of Gandhi which he followed through-out his life.

5. To examine the significance of constructive programs today

### **Course Outcomes**

After the successful completion of the course the students will be able to;

1. Understand the life of Gandhi
2. Appreciate the role of Gandhian non-violence and Satyagraha in India's freedom struggle.
3. Critically examine the philosophy of Gandhi on Education, Sarvodaya, and Satyagraha
4. Analyse the contemporary significance of Gandhian constructive programmes and eleven vows
5. Examine the possible solutions for some of the contemporary challenges like environmental issues, moral degradation and ethical dilemmas.

### **References**

1. Gandhi, M K. (1941). *Constructive Programme*. Ahmadabad: Navjivan Publishing House
2. Gandhi, M. K. (1948). *The Story of My Experiments with Truth*. Ahmadabad: Navjivan Publishing House
3. Gandhi, M K. (1968). *Satyagraha in South Africa*. Ahmadabad: Navjivan Publishing House.
4. Khoshoo, T N (1995). *Mahatma Gandhi: An Apostle of Applied Human Ecology*. New Delhi:TERI
5. Kripalani, J.B. (1970). *Gandhi: His Life and Thought*. New Delhi: Publications Division.
6. Narayan, Rajdeva (2011). *Ecological Perceptions in Gandhism and Marxism*. Muzaffarpur: NISLS
7. Pandey, J. (1998). *Gandhi and 21st Century*. New Delhi: Concept.
8. Weber, Thomas (2007). *Gandhi as Disciple and Mentor*. New Delhi: CUP

## DOSL1041: Community Services - Volunteer

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2*</b>

This course recognizes student participation in Community service activities organized by various student organizations and other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop empathy, citizenship behavior and community values.

### Course Objectives

- To help students develop empathy and citizenship behavior
- Enable students to develop an altruistic attitude and community development sensibility
- Allow exploration of community service activities and reflect about these experiences
- Learn to work in small and large teams for achieving community objectives

### List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

### List of Activities

1. Participation in various community service activities
2. Weekly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

### Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd

**References**

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and Sheryl WuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)

**Course Outcomes**

- Experience of volunteering in a variety of Community service activities
- Gaining empathy for lesser privileged sections of society by experience
- Understanding the process of generating community awareness
- Understanding Disaster management and relief through training and experience
- Developing environmental and sustainability awareness

## DOSL1051: Community Services - Mobilizer

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>2*</b>

This course recognizes student leadership in mobilizing community service activities as members of various student organizations or other Government and non-government organizations that exist for providing service to communities. These activities allow students to develop leadership, management skills, empathy, citizenship behavior and community values.

### Course Objectives

- To help students understand leadership in a community environment
- Enable students to develop an altruistic attitude and community development sensibility
- Allow deep understanding of community service through practical experience
- Learn to lead small and large teams for achieving community objectives

### List of Community Service Activities

1. Community Health Services
2. Swachh Bharat Abhiyan and other Cleanliness drives
3. Tree Plantation and similar environmental conservation initiatives
4. Rain water harvesting awareness and implementation
5. Fundraising and visits to Orphanages, Old-age homes, etc.
6. Health and disease awareness programs
7. Working with NGOs
8. Disaster mitigation and management training and relief work
9. Rural Upliftment projects
10. Campus awareness and action projects (cleanliness, anti-ragging, blood donation, etc)
11. Community investigations and surveys for development research
12. Educational support for underprivileged (remedial classes, coaching, training, etc)
13. Service camps
14. Advocacy and information literacy initiatives
15. Other activities serving local communities

### List of Activities

1. Organizing and leading teams in various community service activities
2. Fortnightly reflection paper
3. Portfolio (on social media using an instagram account)
4. Two learning papers (one per semester)

### Text Books

1. Soul of a citizen: living with conviction in Challenging times (author: Paul Rogat Loeb)
2. Community Services intervention: Vera Lloyd



**References**

1. A path appears: Transforming lives, creating opportunities (Nicholas Kristof and Sheryl WuDunn)
2. The story of My Experiments with Truth (author: M. K. Gandhi)
3. List of student run and other Government and non-government community service organizations organizations

**Course Outcomes**

- Experience of mobilizing and executing Community service activities
- Providing opportunities for community service volunteering for other fellow students
- Understanding the process of mobilizing cash, kind and volunteer support
- Building leadership and management skills
- Building empathy and citizenship behavior

# ENVS1001: Environmental Studies

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>3*</b>

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation led to pollution. This course helps in finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

## Course Objectives

1. To impart knowledge on natural resources and its associated problems.
2. To familiarize learners about ecosystem, biodiversity, and their conservation.
3. To introduce learners about environment pollution.
4. To acquaint learners on different social issues such as conservation of water, green building concept.
5. To make learners understand about the present population scenario, its impacts and role of informational technology on environment and human health.
6. To make learners understand about the importance of field visit.

## Course Outcomes

After the completion of the course student will be able to

1. List different natural resources and their uses
2. Summarize the structure and function of terrestrial and aquatic ecosystems.
3. Identify causes, effects, and control measures of pollution (air, water & soil).
4. Function of green building concept.
5. Adapt value education

### UNIT – I **Multidisciplinary nature of environmental studies & Natural Resources:**

No of Hours:  
10

Multidisciplinary nature of environmental studies Definition, scope and importance. Need for public awareness. Natural resources and associated problems. Uses and over exploitation of Forest resources, Water resources, Mineral resources, Food resources, Energy resources. Role of an individual in conservation of natural resources.

Activity:

1. Planting tree saplings
2. Identification of water leakage in house and institute-Rectify or report
3. Observing any one day of a week as Car/bike/vehicle free day.

### UNIT – II **Ecosystem and biodiversity**

No of Hours:  
10

**Ecosystem:** Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession.

**Biodiversity:** Definition, Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching, man wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ

Activity”

1. Visit to Zoological Park-Noting different ecosystem
2. Biodiversity register- Flora and fauna in the campus

**UNIT – Environmental Pollution**  
**III**

No of Hours:  
10

Definition Causes, effects, and control measures of: -Air pollution. Water pollution. Soil pollution. Marine pollution. Noise pollution. Nuclear hazards. Solid waste Management: Causes, effects, and control measures. Role of an individual in prevention of pollution. Pollution case studies.

Activity

1. Visit to treatment plant and documentation.
2. Documentation of segregation of solid waste-Dry and Wet

**Learning Outcomes:**

After completion of this unit, the student will be able to

**UNIT – IV Social Issues and the Environment**

No of Hours:  
10

From Unsustainable to Sustainable development Urban problems related to energy. Water conservation, rainwater harvesting, watershed management. Environmental ethics: Issues and possible solutions. Green building concept.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.

Activity:

1. Observing zero hour at individual level-documentation.
2. Eco friendly idols.
3. Rainwater harvesting-creating storage pits in nearby area.

**UNIT – V Human Population and the Environment and Environment Protection**  
**Act and Field work**

No of Hours:  
10

Population growth, variation among nations. Environment and human health. HIV/AIDS, Human rights. Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health. Environment Legislation. Air (Prevention and Control of Pollution) Act. Water (Prevention and Control of Pollution) Act. Wildlife Protection Act. Environmental Protection Act, Issues involved in enforcement of environmental legislation.

Activity:

1. Visit to a local polluted site-industry/agriculture
2. Identifying diseases due to inappropriate environmental conditions

**Text Book(s)**

1. Erach Bharucha. Textbook of environmental studies for undergraduates courses-Universities Press, India Private Limited. 2019.
2. Kaushik A and Kaushik C.P. Perspectives in Environmental Studies. New Age International Publishers Edition-VI. 2018.
3. Dave D Katewa S.S. Textbook of Environmental Studies, 2<sup>nd</sup> Edition. Cengage Learning India. 2012.

**Additional Reading**

1. Benny Joseph. Textbook of Environmental Studies 3<sup>rd</sup> edition, McGraw Hill Publishing company limited. 2017.

**Reference Book(s):**

1. McKinney M.L., Schoch R.M., Yonavjak L. Mincy G. Environmental Science: Systems and Solutions. Jones and Bartlett Publishers. 6<sup>th</sup> Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5<sup>th</sup> edition. 2005.

**Journal(s):**

1. <https://www.tandfonline.com/loi/genv20>
2. <https://library.lclark.edu/envs/corejournals>

**Website(s):**

<https://www.ugc.ac.in/oldpdf/modelcurriculum/env.pdf>

[From Climate Science to Action | Coursera](#)

	Programme Objectives (POs)												PSO's		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2												2		
CO2		2				1							2		
CO3			1						1					1	
CO4				2							2				1
CO5	1													1	
CO6					2							1			1

1-Low, 2-Medium and 3-High Correlation

# MFST1001: Health & Wellbeing

L	T	P	S	J	C
0	0	2	0	0	1*

The course provides the students a better understanding of the role of a proper diet in maintenance of human health. This course emphasizes the composition of the food, and will help to understand how to exercise, the role of sports and physical fitness in development of a good health. The course also focuses on the importance of emotional well-being and mindfulness. This course helps in teaching the role of yoga in maintenance of physical balance.

## Course Objectives

- To provide an understanding of the relationship between food and nutrition
- To emphasize the role of exercise, sports and physical fitness in obtaining a good health
- To explain about the mindfulness and emotional well being
- To teach the role of yoga and meditation in maintaining the body balance

## UNIT-I

Understand the relationship between Food and Nutrition and how food composition affects nutritional characteristics. Knowledge about regulatory principles in determining diets and recommended daily allowances. Understand how to create personalised diet/nutrition plans.

## UNIT-II

Understand how exercise, activity and sports helps in developing good health. Experiential exposure to the role of proper, specific nutritional interventions along with structured activities on developing proper physical health. Practical exercises and assignments in sports and exercise regimes.

## UNIT-III

Introduction to emotional wellbeing and mindfulness. Teaching of mindfulness practices to reduce stress, increase relaxation and improve mental wellbeing.

## UNIT-IV

Introduction to Yoga theory and how Yoga helps in maintaining balance in the body. Practice of Yoga and meditation to improve overall emotional and physical balance. Practical yoga exercises and meditation techniques

## Course outcomes:

By the end of the course, student will

- Learn the role of nutrition and diet in maintaining a good health
- Will understand how the exercise, sports and physical activities will improve health
- Will learn mindfulness practices for reducing stress
- Will know the importance of yoga and meditation

# CLAD2001: Preparation for Campus Placement-1

## (Soft Skills 5A)

L	T	P	S	J	C
0	0	2	0	0	1

### Course Description:

The course addresses all relevant areas related to campus placements and readies them to ace their upcoming/ ongoing recruitment drives. Specifically, it focuses on students' career preparedness, interview skills, test preparedness, etc.

### Course Objectives:

Prepare the students for their upcoming/ ongoing campus recruitment drives.

1. Career Preparedness: Resume & Cover Letter Writing, Interview Skills: Elevator Pitch, Making the First Impression, Being Other-Oriented, Being Positive and Curious, communicating with Confidence and Poise, Frequently Asked Questions & How to Answer Them, Pitfalls to Avoid, Etc. Etiquette: Hygiene, Courtesy, Culture differences, Workplace, use of cell phone, Profanity, Slang, Protocol.
2. Verbal Ability: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning.
3. Quantitative Aptitude: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
4. Reasoning: Logical and Verbal Reasoning

### Course Outcomes:

1. Write a power resume and covering letter
2. Answer interview questions with confidence and poise
3. Exhibit appropriate social mannerisms in interviews
4. Solve placement test questions on verbal ability, quantitative aptitude and reasoning

**References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

# **CLAD2011: Preparation for Higher Education (GRE/ GMAT)-1 (Soft Skills 5B)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>

## **Course Description:**

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests and includes fully solved mock tests as well.

## **Course Objectives:**

1. Prepare the students to solve questions from all four broad areas of GRE/ GMAT
  2. Orient the students for GRE/ GMAT through mock tests
- 
1. Verbal Reasoning: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
  2. Quantitative Reasoning: Arithmetic, Algebra, Geometry, Data Analysis
  3. Analytical Writing Assessment: Issue/ Argument
  4. Integrated Reasoning

## **Course Outcomes:**

1. Solve questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

## **References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications



## **CLAD2021: Preparation for CAT/ MAT - 1 (Soft Skills 5C)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>

### **Course Description:**

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests and includes fully solved mock tests as well.

### **Course Objectives:**

1. Prepare the students to solve questions from all four relevant areas of CAT/ XAT/ MAT, etc.
  2. Orient the students for CAT/ XAT, etc. through mock tests
- 
1. Quantitative Ability: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
  2. Data Interpretation: Data Interpretation and Data Sufficiency
  3. Logical Reasoning: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
  4. Verbal Ability: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

### **Course Outcomes:**

1. Solve questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

### **References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

# CLAD2031: Preparation for Campus Placement-2

## (Soft Skills 6A)

L	T	P	S	J	C
0	0	2	0	0	1

### Course Description:

This course builds on the previous course and focuses on all four major areas of campus placements, including career preparedness, mock interviews, verbal ability, quantitative aptitude and logical reasoning.

### Course Objectives:

1. To comprehensively prepare all eligible and aspiring students for landing their dream jobs.
  2. To sharpen the test-taking skills in all four major areas of all campus drives
- 
1. Career Preparedness II: Mock Interviews, Feedback and Placement Readiness
  2. Verbal Ability II: Practising Reading Comprehension, Error Detection, Sentence Completion, MCQs, FIBs, Para jumbles, Cloze Test, Critical Reasoning
  3. Quantitative Aptitude II: Number Systems, Algebra, Geometry, Data Handling, Data Sufficiency, Word Problems
  4. Reasoning II: Logical and Verbal Reasoning

### Course Outcomes:

1. Demonstrate career preparedness and confidence in tackling campus interviews
2. Solve placement test questions of a higher difficulty level in verbal ability, quantitative aptitude and logical reasoning.
3. Practice test-taking skills by solving relevant questions accurately and within time.

### References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay

2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

# CLAD2041: Preparation for Higher Education (GRE/ GMAT)-2

## (Soft Skills 6B)

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>

### Course Description:

1. The course offers a special track for students who aspire to go abroad in pursuit of their higher education for which a GRE/ GMAT score is a prerequisite. It covers all four topical areas of these tests at a higher difficulty-level and includes fully solved mock tests as well.

### Course Objectives:

1. Prepare the students to solve higher level questions from all four broad areas of GRE/ GMAT
  2. Orient the students for GRE/ GMAT through mock tests
- 
1. Verbal Reasoning II: Reading Comprehension, Sentence Equivalence, Text Completion, Sentence Correction, Critical Reasoning
  2. Quantitative Reasoning II: Arithmetic, Algebra, Geometry, Data Analysis
  3. Analytical Writing Assessment II: Issue/ Argument
  4. Integrated Reasoning II

### Course Outcomes:

1. Solve higher level questions from all four broad areas of GRE/ GMAT
2. Practice answering several mock tests

### References:

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

## **CLAD2051: Preparation for CAT/ MAT - 2 (Soft Skills 6C)**

<b>L</b>	<b>T</b>	<b>P</b>	<b>S</b>	<b>J</b>	<b>C</b>
<b>0</b>	<b>0</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>1</b>

### **Course Description:**

The course offers a special track for UG students who aspire to go for higher education in business management in India for which cracking CAT/ MAT/ other related test is mandatory. It covers all four topical areas of these tests at a higher level of difficulty and includes fully solved mock tests as well.

### **Course Objectives:**

1. Prepare the students to solve all types of questions from all four relevant areas of CAT/ XAT/ MAT, etc.
  
1. Quantitative Ability II: Arithmetic, Algebra, Geometry, Mensuration, Calculus, Trigonometry
2. Data Interpretation II: Data Interpretation and Data Sufficiency
3. Logical Reasoning II: Data Management, Deductions, Verbal Reasoning and Non-Verbal Reasoning
4. Verbal Ability II: Critical Reasoning, Sentence Correction, Para Completion, Para Jumbles, Reading Comprehension

### **Course Outcomes:**

1. Solve higher difficulty level questions from all four relevant areas of CAT/ MAT as listed above
2. Practice test-cracking techniques through relevant mock tests

### **References:**

1. Verbal Ability & Reading Comprehension by Arun Sharma and Meenakshi Upadhyay
2. Study material for CAT, SAT, GRE, GMAT by TIME, CareerLauncher and IMS etc.
3. Quantitative Aptitude by R S Agarwal S Chand Publications
4. Quantitative Aptitude by Pearson Publications

# FINA3001: Personal Financial Planning

L	T	P	S	J	C
0	0	2	0	0	1*

## Course Overview

Personal Financial Planning is one of the most significant factors in our lives. It is essential that funds are available as and when required at various stages of life. Unavailability of funds at critical stages of our life leads to financial distress and leads to many medical and non-medical problems. There are certain planned and unplanned events in our life. On the one hand, education of our children, their marriage, our retirement etc. are some of the planned events of our life, but at the same time, some medical urgency, accident or death of an earning member might be some unplanned events. Many of these events are beyond our control, but the availability of funds can be planned to avoid any financial distress. In other words, we cannot stop the rain but can plan for an umbrella.

This course looks at the many challenges an individual faces in a complex financial environment and the rising uncertainties of one's life. It focuses on achieving long-term financial comfort of individual and family through goal setting, developing financial and life strategies, acquiring personal financial planning knowledge and managing risk throughout one's life.

## Course Objectives:

1. To build students' ability to plan for long-term financial comfort of individual and family through goal setting, developing financial and life strategies.
2. To provide students with knowledge on terms, techniques to evaluate investment avenues.
3. To build the skill set of the student to enable them to file their tax returns.

## Course Outcome:

1. Describe the financial planning process and application of time value of money
2. Application of life and non-life insurance products in financial planning
3. Understand the investment avenues and analysis of investment returns
4. Understand the retirement planning and its application
5. Describe and analysis the Tax Planning

## Unit 1: Basics of Financial Planning

Financial Planning Meaning, Need, Objectives, Financial Planning Process, Time Value of Money and its application using excel (NP)

## Unit 2: Risk and Insurance Management

Need for insurance, Requirement of insurance interest, Role of insurance in personal finance, Steps in insurance planning, Life and Non-life insurance products, Life insurance needs analysis (NP)

## Unit 3: Investment Products and Measuring Investment Returns

*Investment Products:* Small Saving Instruments, Fixed Income Instruments, Alternate

Investments, Direct Equity

**Measuring Investment Returns:** Understanding Return and its concept, Compounding concept, Real vs Nominal Rate of Return, Tax Adjusted Return, Risk-Adjusted Return (NP)

#### **Unit 4: Retirement Planning**

Introduction to the retirement planning process, estimating retirement corpus, Determining the retirement corpus, Retirement Products (NP)

#### **Unit: 5 Tax Planning**

**Income Tax:** Income tax principles: Heads of Incomes, Exemptions and Deductions, Types of Assesses, Rates of Taxation, Obligations for Filing and Reporting, Tax aspects of Investment Products, Wealth Tax

#### **Text Books**

1. National Institute of Securities Management (NISM) Module 1 & XA
2. Madhu Sinha, Financial Planning, 2 Edition, McGraw Hill India
3. Simplified Financial Management by Vinay Bhagwat, The Times Group

#### **Reference Books**

1. Personal Financial Planning (Wealth Management) by S Murali and K R Subbakrishna, Himalaya Publishing House.
2. Mishra K.C., Doss S, (2009). Basics of Personal Financial Planning 1e. National Insurance Academy, New Delhi: Cengage Learning.
3. Risk Analysis, Insurance and Retirement Planning by Indian Institute of Banking and Finance.



## CHEM 1011: CHEMISTRY-I

**Preamble:** The students of undergraduate program in science in chemistry need to be conversant with the various fields of chemistry. Therefore, one module each on in general, physical and organic chemistry is introduced which helps the student familiarize with the concepts of chemistry essential for allied and interdisciplinary fields of science.

### Course objectives:

1. Introduce students to Schrodinger wave equation, quantization of energy and electronic configuration of atoms and ions.
2. Explain three types of chemical bonding – Ionic, covalent, and metallic and understand \ energetics of bond formation.
3. Introduce properties of organic compounds with emphasis on inductive effect, hyper conjugation and resonance effects.
4. Understand electrophilicity and nucleophilicity and impact of functional groups on reactions
5. Understand stereochemistry of compounds
6. Explain important reactions and reaction mechanisms.

### UNIT - I Inorganic Chemistry-1

Atomic Structure: Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of  $\psi$  and  $\psi^2$ , Schrödinger equation for hydrogen atom. Graphical representation of 1s, 2s, 2p, 3s, 3p and 3d orbitals. Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy.

### UNIT - II Inorganic Chemistry-1

Chemical Bonding and Molecular Structure

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

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

### UNIT - III Organic Chemistry-1

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyper conjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Aromaticity: Benzenoids and Hückel's rule.

### UNIT - IV Organic Chemistry-1

**Stereochemistry**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis-trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

## UNIT - V

## Organic Chemistry-1

### Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied.

**Alkanes:** (Upto 5 Carbons).Preparation: Catalytic hydrogenation, Wurtz reaction, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

**Alkenes:** (Upto 5 Carbons)Preparation: Elimination reactions: Dehydration of alkenes and dehydro halogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).

**Reactions:** cis-addition (alk.  $\text{KMnO}_4$ )and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition).

**Alkynes:** (Upto 5 Carbons)Preparation: Acetylene from  $\text{CaC}_2$ and conversion into higher alkynes;

**Reactions:** formation of metal acetylides, addition of bromine.

### Recommended Books:

1. Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. &Gaus, P.L. Basic Inorganic Chemistry, 3rd ed., Wiley.
3. Huheey, J.E., Keiter, E.A., Keiter, R.L. &Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
4. McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed.Cengage Learning India Edition, 2013.
5. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi, (1988).
6. Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education,2000.
7. Finar, I.L. Organic Chemistry (Vol. I & II), E.L.B.S.
8. Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
9. Bahl, A. &Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010

## CHEM 1031: CHEMISTRY-II

**Preamble:** The students of undergraduate program in science need to be conversant with the various aspects of solution chemistry, phase equilibrium, electrochemistry and Functional group chemistry forms the foundation for training a undergraduate students as analytical and synthetic chemist.

### Course objectives:

- To introduce the concept of solution and phase chemistry in physical chemistry
- To introduce functional group chemistry in organic chemistry
- To impart knowledge on the essential functional groups in organic chemistry.
- To impart knowledge on the essential functional groups reactions
- To impart knowledge on the essential functional groups properties

### UNIT - I

#### Section A: Physical Chemistry-1

##### Solutions

Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions. Distillation of solutions. Leverage. Azeotropes.

##### Phase Equilibrium

Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria.

### UNIT – II

##### Conductance

Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.

Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid base).

### UNIT - III

#### Section B: Organic Chemistry-3

Carboxylic acids and their derivatives-Carboxylic acids (aliphatic and aromatic) Preparation: Acidic and Alkaline hydrolysis of esters. Reactions: Hell – Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (Upto 5 carbons)- Preparation: Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. Reactions: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction.

Amines and Diazonium Salts- Amines (Aliphatic and Aromatic): (Upto 5 carbons)

Preparation: from alkyl halides, Hofmann Bromamide reaction.

Reactions: Carbylamine test, Hinsberg test. Electrophilic substitution (case aniline): nitration, bromination, sulphonation.

### UNIT - IV

#### Amino Acids, Peptides and Proteins

Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis, Zwitterion, Isoelectric point and Electrophoresis.

Reactions of Amino acids: ester of –COOH group, acetylation of –NH<sub>2</sub> group, ninhydrin test.

Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins.

Synthesis of simple peptides (up to dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & Activating groups and Merrifield solid-phase synthesis.

## UNIT - V

Carbohydrates: Classification, and General Properties, Glucose and Fructose (open chain and cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disaccharides (sucrose, cellobiose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

### Recommended Books:

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
2. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Nelson, D. L. & Cox, M. M. Lehninger's, Principles of Biochemistry 7thEd., W. H. Freeman.
6. Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2002.

## CSC I1001: BASICS OF INFORMATION TECHNOLOGY

### UNIT – I

**Data and Information:** Introduction, Types of data, Simple model of a computer, Data processing using a computer, Desktop computer.

**Acquisition of Numbers and Textual Data:** Introduction, input units, internal representation of numeric data, Representation of characters in computers, Error Detecting codes.

**Acquiring Image Data:** Introduction, acquisition of textual data, acquisition of pictures, storage formats for pictures, Image compression fundamentals, Image acquisition with a digital camera.

### UNIT – II

**Acquiring Audio Data** - Basics of Audio Signals, Acquiring and storing Audio Signals, Compression of Audio Signals.

**Acquisition of Video:** Computing a moving Scene with a video camera, Compression of Video Data, MPEG Compression standard.

**Data storage:** Introduction, Storage cell, Physical devices used as storage cells, Random access memory, Read only memory, Secondary storage, Compact disk read only memory (CDROM), Archival store.

### UNIT – III

**Central Processing Unit:** Introduction, Structure of a central processing unit, Specifications of a CPU, Interconnection of CPU with memory and I/O units, Embedded processors.

**Output Devices:** Video Display Devices, Touch Screen, E-ink display, Printers, AudioOutput.

### UNIT – IV

**Computer Networks:** Introduction, Local Area Network (LAN), Applications of LAN, Wide Area Network (WAN), Internet, Naming computers connected to Internet, Future of Internet Technology.

**Computer Software:** Introduction, Operating system, Programming languages, Classification of programming languages, Classification of Programming Languages based on applications.

### UNIT-V

**Data organization:** Introduction, Organizing a database, Structure of a database, Database Management System, Example of database design, Non-text databases, Archiving databases.

**Processing Numerical Data:** Introduction, Use of spreadsheets, Numerical computation examples.

**Some Internet Applications:** Introduction, Email, World Wide Web, Information Retrieval from the WWW, Other facilities provided by Browsers, Audio on the internet, Accessing pictures and video via internet

### Recommended Books:

- 1.Introduction to Information Technology by V. Rajaraman, PHI Learning Pvt.Ltd. 2013.
2. Computing Fundamentals by Peter Norton, Tata Mc. Graw Hill, 6<sup>th</sup> edition,2006.
3. Fundamentals of Computers by E.Balagurusamy, Tata McGraw Hill,2009

## CHEM 1021: CHEMISTRY -I LAB

The students of undergraduate program in science in Chemistry need to be conversant with the various basic methodologies of chemistry. Therefore, one module each on in inorganic, physical and organic chemistry is introduced which helps the student familiarize with the techniques essential for developing the foundation of practical chemistry.

### Course Objectives

1. Estimate various components in a mixture.
2. Estimation of oxalic acid, water of crystallization in Mohr's salt, Fe(II) ions and Cu(II) ions by volumetric analysis.
3. Detect various elements in organic compounds.
4. Separate mixture by various types of chromatography.
5. To make student develop the fundamental skill required for quantitative and qualitative analysis in inorganic and organic chemistry.

### Section A: Inorganic Chemistry - Volumetric Analysis

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Estimation of oxalic acid by titrating it with  $\text{KMnO}_4$ .
3. Estimation of water of crystallization in Mohr's salt by titrating with  $\text{KMnO}_4$ .
4. Estimation of Fe (II) ions by titrating it with  $\text{K}_2\text{Cr}_2\text{O}_7$  using internal indicator.
5. Estimation of Cu (II) ions iodometrically using  $\text{Na}_2\text{S}_2\text{O}_3$ .

### Section B: Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the  $R_f$  value in each case (combination of two compounds to be given).
3. Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
4. Identify and separate the sugars present in the given mixture by paper chromatography.

### Reference book(s):

1. Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
2. Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

# CHEM1051: CHEMISTRY – III

L T P S J C  
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This course enables the students to apply the various statistical tools in the analysis and acquire the basic principles of atomic, molecular techniques, Electro-analytical methods and separation methods and their applications. The knowledge gained in this course can be applied to the latest developments in technology.

## Course objectives

- To familiarize the students with various types of basic statistical tools.
- To study about the basic principles of atomic, molecular techniques and separation methods.
- To emphasize the importance of UV Vis spectroscopy and atomic spectroscopy in quantitative determination of Metal ions.
- To impart knowledge on the basic concepts of pH metry and conductometry.
- To compare the different separation methods like chromatography and solvent extraction.

## Course outcomes

After the completion of the course, the student will be able to

- list various types of statistical tools and the instruments for chemical analysis. (L-1)
- explain the role of various parts of instrumentation of atomic and molecular techniques (L-2)
- identify suitable analytical technique for chemical analysis. (L-3)
- distinguish atomic and molecular techniques (L-4)

<b>UNIT – I</b>		
<b>Evaluation of analytical data:</b> errors, accuracy and precision. Types of errors and Methods for minimization of errors. Significant figures		
Statistical test of data: F, Q and t test, rejection of data, and confidence intervals.		
<b>Learning Outcomes:</b>		
After the completion of the Unit I, the student will be able to		
•	list out different types of errors in chemical analysis.	
•	explain the different types of errors in chemical analysis	
•	compare the accuracy and precision.	
•	illustrate the type of errors in Chemical Analysis.	
•	application of different statistical tools in the chemical analysis.	
<b>UNIT - II</b>		
<b>UV-Visible spectrophotometry:</b> Interaction of radiation with matter. fundamental laws of spectroscopy: Beer-Lambert's law and its validity.: source of radiation, wavelength dispersion: monochromator: gratings, prisms, interference filters. Detection of signal: photocells, photomultipliers, diode arrays. Schematic diagrams of Single and Double Beam instruments. applications in the quantitative determination of cations ( $\text{Fe}^{2+}$ , $\text{Ni}^{2+}$ ) and anions ( $\text{PO}_4^{3-}$ , $\text{NO}_3^-$ ).		
<b>Learning Outcomes:</b>		
After the completion of the Unit II, the student will be able to		

•	list out the different part of the instrumentation of UV Vis Spectrophotometry
•	illustrate the procedure for the determination of various anions and cations
•	explain the importance of double beam UV Vis Spectrophotometry.
•	assess the differences between single beam and double beam spectrophotometry (L-2)
<b>UNIT – III</b>	
<b>Flame Emission and Flame Absorption Spectrometry:</b> Basic principle and instrumentation: source of excitation, atomization, nebulizer, types of burner, monochromator and detector. Interferences: Physical, Chemical and spectral. Quantitative estimation of metal ions in water samples by Flame emission and Flame absorption spectroscopy.	
<b>Learning Outcomes:</b>	
After the completion of the Unit III, the student will be able to	
•	state the principle of AAS and AES.
•	explain the basic principle and working of AAS and AES
•	compare the functioning the AAS and AES
•	identify the significance of each part of AAS and AES Instruments.
•	apply the knowledge of this concept in the analysis of samples.
<b>UNIT – IV</b>	
<b>Electroanalytical methods:</b> Basic principle, Instrumentation and applications of pH metric, potentiometric and conductometric titrations.	
<b>Learning Outcomes:</b>	
After the completion of the Unit IV, the students will be able to	
•	state the principles of pH metry, potentiometry and conductometry
•	explain the working of pH meter, potentiometer and conductivity bridge.
•	identify the suitable electrodes for pH meter, potentiometer and conductivity bridge. (L-3)
•	apply the knowledge of these instruments in various types of chemical analysis.(L-3)
<b>UNIT – V</b>	
<b>Separation techniques</b>	
Solvent extraction: Principle of solvent extraction and efficiency of the technique. Technique of extraction: batch, continuous and counter current extractions. Solvent extraction systems: Metal chelates and ion association systems.	
<b>Chromatography:</b> Principle and classification of the technique. Mechanism of separation: adsorption and partition. Development of chromatograms	
<b>Learning Outcomes:</b>	
After the completion of the Unit V, the students will be able to	
•	explain the process of chromatography and solvent extraction techniques(L-3)
•	identify suitable method for the separation of mixture of components. (L-3)
•	distinguish between mechanism of different chromatographic and solvent extraction methods.
•	compare various types of solvent extraction and chromatographic methods (L-4)
<b>Textbook(s):</b>	
1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis 6th Ed., Pearson, 2009.	
2. Christian, G.D. Analytical Chemistry, 6th Ed. John Wiley & Sons, New York, 2004.	
3. Harris, D.C.: Exploring Chemical Analysis, 9th Ed. New York, W.H. Freeman, 2016.	
4. Khopkar, S.M. Basic Concepts of Analytical Chemistry. New Age International Publisher, 2009.	
5. Skoog, D.A. Holler F.J. & Nieman, T.A. Principles of Instrumental Analysis, Cengage Learning India Ed.	



## PHYS 1091: BIOPHYSICS

### UNIT I

#### **Radiation Biophysics**

Ionising radiation, Interaction of radiation with matter, Measurement of Radiation, Radioactive isotopes. Types of Radioactivity-Natural, Artificial and induced Radioactivity and radioactive decay law. Measurement of Radioactivity -Geiger Muller counter, proportional counter and scintillation counter. Biological effects of radiation and radiation protection and therapy.

### UNIT II

**Transport process:** Light scattering, Diffusion –factors effecting diffusion, Fick’s law, diffusion of electrolytes, accelerated diffusion and biological significance sedimentation, osmosis, viscosity, chromatography and electrophoresis and optical activity .Biophysical phenomena in biochemical studies-pH meter - principle, electrode system and factors effecting in its measurement.

### UNIT III

#### **Physical Techniques in structure determination**

Ultraviolet and Visible spectroscopy, fluorescence and phosphorescence methods, Infrared spectroscopy- bending, near, mid and far infrared region. Raman spectra- principle and instrumentation. NMR, ESR Instrumentation.

### UNIT IV

#### **Microscopies**

Optical microscope, Electron microscopy, emerging trends in microscopy. X ray diffraction-diffraction of x rays, structure determination, phase determination procedures. Laser-characteristics, population inversion, stimulated and spontaneous and relation (no derivation) and Holography

### UNIT V

#### **Biomolecular structures, Bioenergetics and Biological systems**

Biomolecular structures-Concepts of classical physics and limitations, quantum principles of atomic structure. Bioenergetics-Thermodynamics-reversible thermodynamics and irreversible thermodynamics. Photo bioenergetics and chemo bioenergetics. Biological systems: Neuro biophysics-Molecular transport across cell membrane and nerve impulse generation.

#### **Recommended Books:**

1. Essentials of Biophysics: P.Narayanan.New Age India Intl.
2. Handbook of Radiobiology by KT Jaypee Brothers, Medical Publishers Pvt. Ltd.
3. An Introduction to radiation protection by A Martin & SA Harbison, 4<sup>th</sup> Edition, Springer Publishers.
4. Laser Tissue Interactions: Fundamentals and Applications by MH Niemz, Springer Publishers.
5. Understanding biophotonics- Fundamentals, Advances and Applications by K Tsia, 1<sup>st</sup> Edition, CRC press.

## CHEM 1041: CHEMISTRY- II LAB

The students of undergraduate program in science in Chemistry need to be conversant with the various basic methodologies of chemistry. Therefore, one module each on inorganic, physical and organic chemistry is introduced which helps the student familiarize with the techniques essential for developing the foundation of practical chemistry

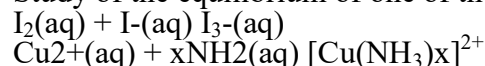
### Course Objectives

1. To introduce practical application of solution, phase and electrochemistry for quantitative analysis
2. To familiarize students with construction of the phase diagram.
3. To impart knowledge concerning the conductance and potentiometric titrations.
4. To demonstrate heat capacities of calorimeter.
5. To purification of organic compounds by crystallisation and distillation.

### Section A Physical Chemistry

#### Distribution

Study of the equilibrium of one of the following reactions by the distribution method:



#### Conductance

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

#### Potentiometry

Perform the following potentiometric titrations:

- i. Strong acid vs. strong base
- ii. Weak acid vs. strong base
- iii. Potassium dichromate vs. Mohr's salt

### Section B Organic Chemistry

#### I

Systematic Qualitative Organic Analysis of Organic Compounds possessing mono functional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

#### II

1. Separation of amino acids by paper chromatography
2. Determination of the concentration of glycine solution by formylation method.
3. Titration curve of glycine
4. Action of salivary amylase on starch
5. Effect of temperature on the action of salivary amylase on starch.
6. Differentiation between a reducing and a nonreducing sugar.

#### Text book(s):

1. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., Text book of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press

## **PHYS1101: BIOPHYSICS LAB**

1. Plateau characteristics of radioactive source
2. Intensity variation of radioactive material
3. Wavelength of colors using spectrometer
4. Determination of wavelength of LASER
5. Optical activity
6. X-ray diffraction – determination of interplanar spacing from X-ray spectra
7. Analysis of infrared spectra - Identification of various groups
8. Analysis of UV spectra -Identification wavelength corresponding to absorption

### **Recommended Books:**

1. Radiation Biophysics, Second Edition - by Edward L. Alpen
2. Physical Chemistry: Principles and Applications in Biological Sciences by Tinoco. I. et al..
3. Physics of the Life Sciences by Newman, J.Drenth, J. (2010) Principles of Protein X-ray Crystallography, Spri

## BTSC 1001: MOLECULES OF LIFE

**Preamble:** This course has been designed to enrich the students' knowledge about the macromolecules of life like carbohydrates, amino acids, fatty acids, nucleic acids. The course shall make the students' aware of the classification of all macromolecules and the structures of complex carbohydrates, proteins, structures of nucleic acids.

### **Course Objectives:**

1. To build the knowledge about the macromolecules of life
2. To familiarize the classification of all macromolecules.
3. To impart knowledge on structures of complex carbohydrates, proteins and structures of nucleic acids.

### **UNIT-I**

Structure and Properties of water, intra and intermolecular forces, non-covalent interactions- electrostatic, hydrogen bonding, Vander Waals interactions, hydrophobic and hydrophilic interactions. Disulphide bridges.

### **UNIT-II**

Classification and biological functions of carbohydrates, structure and properties of monosaccharides (Glucose and Fructose). Disaccharides (sucrose, maltose, lactose), polysaccharides (starch, cellulose and chitin). Glycosaminoglycans (chondroitin sulfate and Hyaluronic acid)

### **UNIT-III**

Classification, structure and properties of amino acids, Primary structure of protein- determination of amino acid composition and sequence. Secondary structure- $\alpha$ -helix,  $\beta$ -pleated sheet, collagen triple helix. Tertiary and quaternary structures. Solid phase peptide synthesis. Glycoproteins.

### **UNIT-IV**

Classification, structure, properties and functions of fatty acids, triglycerides, phospholipids, sphingolipids. Cholesterol, Eicosanoids. Structure and functions of vitamins (A,D,E,K, B complex and C).

### **UNIT-V**

Purine and pyrimidine nitrogen bases, Nucleosides and nucleotides, Structure and properties of DNA. Alternative forms of DNA -A, B, Z. Structure and properties of RNA, different types of RNA- mRNA and non-coding RNA – tRNA, rRNA, siRNA, miRNA.

### **Course outcomes:**

After completion of this unit, the student will be able to

- Explain why water's solvent properties are important in undertaking events taking place inside cells.
- Describe how hydrogen bonding in water affects its capacity, melting, evaporation and cohesion.
- Distinguish between hydrophilic and hydrophobic interactions using examples.
- Understand the structures and properties of monosaccharides, disaccharides, polysaccharides and glycosaminoglycans.
- Understand the biological importance of monosaccharides, disaccharides, polysaccharides and glycosaminoglycans.

- Describe how amino acids differ in their side chains
- Describe how amino acids are joined to form a peptide bond
- Distinguish primary, secondary, tertiary, quaternary structures and predict how a protein's structure will be affected by a change in an amino acid and its primary structure.
- Understand the structure, properties and functions of fatty acids and triglycerides.
- Describe the structure, properties and functions of phospholipids, sphingolipids and cholesterol
- Understand the structure and functions of Eicosanoids
- Understand the structure and functions of fat-soluble & water-soluble vitamins
- Understand the concepts of Nitrogen bases, structural differences between Nucleosides and nucleotides.
- Explain the structure and properties of DNA and different types of DNA (A, B, and Z).
- Explain the structure and properties of RNA and different types of RNA (mRNA and non-coding RNA).

### **Recommended Books:**

1. Lehninger Principles of Biochemistry by Nelson D and Cox D – 7<sup>th</sup> Edition. Mcmillan Pub.
2. Biochemistry by L.Stryer– 8<sup>th</sup> Edition. (Freeman-Tappan).
3. Biochemistry by D.Voet and J.G.Voet– 4<sup>th</sup> Edition. (John Wiley).
4. Biochemistry by Garrett and Grisham – 6<sup>th</sup> Edition. (Cengage Learning).
5. Biochemistry Concepts and Connections by Mathews et.al. – Global Edition.
6. Principles of Biochemistry by David Rawn et.al. – 5<sup>th</sup> Edition (Pearson).
7. Essentials of Glycobiology, 3<sup>rd</sup> Edition (CSHL press).
8. Harper's Biochemistry by Robert K. Murray et.al. – 30<sup>th</sup> Edition (Langeman).
9. Biochemistry by U.Satyanarayana – 4<sup>th</sup> Edition.

## **BTSC1021: CELL BIOLOGY**

**Preamble:** This course is designed to introduce the students to the core concepts in cell biology, understanding the organisms based on cell structure, cell structure and function, cells in their social contexts- cell interaction (recognition) and adhesion.

### **Course Objectives:**

- 1.To introduce the students to the basic concept and the definition of life or life forms, asserting cell as basic structural and functional unit of life.
- 2.To familiarize students about the structural details of cell(s) of different organisms, cell division and regulation.
- 3.To introduce the students to the mechanisms of cellular transport-types, modes, and structural details of transporters.

### **UNIT-I**

History of cell biology, Evolution of the cell: endosymbiotic theory, tree of life. Structural organization of prokaryotic and eukaryotic cell. Ultra structure of nucleus, mitochondria, endoplasmic reticulum, golgi complex.

### **UNIT-II**

Chemical composition, structure and functions of cell wall and plasmodesmata. Biochemistry and significance of vacuoles. Ultra structure of chloroplast. Lysosomes and Peroxisomes

### **UNIT-III**

Extracellular matrix – Collagen, Elastin, Fibrillin, Fibronectin, Laminin, Proteoglycans, Integrins. Cytoskeleton – microtubules and microfilaments. Cell-cell interactions - Gap junction, Tight Junction, Desmosomes. Exocytosis and Endocytosis.

### **UNIT-IV**

Different membrane models, Ultra structure of plasma membrane. Membrane asymmetry. Fluidity of membranes. Membrane biogenesis. Membrane channels and pumps. Membrane transport mechanisms.

### **UNIT-V**

Cell division by mitosis/meiosis. Cell cycle and its regulation. Abnormal cell division: cancer - hallmarks of cancer and role of oncogenes and tumour suppressor genes in cancer development - Programmed cell death (Apoptosis).

### **Course outcomes:**

1. The student will be able to compare the general mechanisms that allow some newly synthesized proteins to be released into the cytoplasm, whereas others are directed into other cellular compartments
2. The student can explain how cells regulate the directional flow of secreted components from the endoplasmic reticulum (ER) to the Golgi apparatus to the plasma membrane.
3. The student can describe the general functions of directional microtubule motor proteins and how they work.
4. The student can discuss how cell cycle, chromosome condensation, and transcription mechanisms

### **Recommended Books:**

1. Molecular Biology of the Cell by B Alberts *et.al.*, 5<sup>th</sup> Edition, Garland publications
2. Principles of Development by Lewis Wolpert, 4<sup>th</sup> Edition, Oxford University press.
3. Molecular Cell Biology by Harvey Lodish *et.al.*, 7<sup>th</sup> Edition, W.H. Freeman and Co.,
4. Cell and Molecular Biology by DeRoberties&DeRoberties, 8<sup>th</sup> Edition, S Chand & Co.
5. The Cell: A molecular approach by GM Cooper & RE Hausman, 6<sup>th</sup> Edition, Ingram Publishers
6. Molecular Cell Biology by J Darnell, 4<sup>th</sup> Edition, Scientific American Books.
7. Harper's Biochemistry by RK Murray *et.al.*, 30<sup>th</sup> Edition, McGraw-Hill Lange Publishers.
8. Biochemistry of Signal Transduction and Regulation by G Krauss, 5<sup>th</sup> Revised Edition, Wiley-VCH publishers.

## BTSC 1011: MOLECULES OF LIFE LAB

### Course Objectives

The main objective of this course is to train students in the practical aspects of macromolecules so that they can perform different experiments targeted towards qualitative and quantitative assays of the biomolecules.

1. To familiarize the students with qualitative assay of the different macromolecules.
2. To help the students gain expertise in quantitative estimation of different macromolecules.
3. To train the students on the basic concept of chromatography with special reference to paper chromatography.

### Experiments:

1. Qualitative analysis of amino acids
2. Qualitative analysis of carbohydrates
3. Determination of isoelectric point of glycine
4. Estimation of protein by Lowry's method
5. Separation of amino acids by paper chromatography
6. Ultra violet absorption spectra of protein and nucleic acids

### Course outcomes:

By the end of this course, the student will be able to:

- Perform qualitative analysis of biomolecules such as carbohydrates, amino acids and proteins.
- Perform quantitative analysis of various biomolecules using different methods.

### Recommended Books:

1. Modern experimental Biochemistry by Rodney Boyer – 3rd Edition (Benjamin Cummings)
2. Biochemical methods By Sadasivam and Manikam – 3rd Edition (New Age International Pvt. Ltd., Publishers)
3. An introduction to practical biochemistry by D.T.Plummer – 2nd Edition (McGraw Hill)
4. Biochemistry - a laboratory courses by J.M.Beckar – 2nd Edition (Academic Press)
5. Introductory practical Biochemistry by S.K.Sawhney and Randhir Singh – 2<sup>nd</sup> ed, (Narosa)



## BTSC1031: CELL BIOLOGY LAB

### Course Objectives

- Learn fundamental aspects of experimental design.
- Apply concepts and theory to a hands-on research project
- Learn the purposes of the experimental methods they use

### Experiments:

1. Microscopic examination of thallus in Algae.
2. Microscopic examination of fruiting bodies of Fungi.
3. Identification of different stages of mitosis (onion root tips) by squash method.
4. Identification of different Meiotic stages by smear method (in onion flower buds).
5. Isolation of subcellular organelles by centrifugal techniques (Nucleus / Mitochondria / Chloroplast)
6. Microscopic examination of nucleus by Feulgen staining method.

### Course outcomes:

By the end of this course, the student will be able:

1. To learn differences in external thallus morphology, internal anatomy of algae
2. To learn and familiarize in the anatomy of fruiting bodies of fungi under compound microscope.
3. To understand the process and different stages of mitosis and to visualize different phases of mitosis
4. To understand the process and different stages of mitosis and to visualize different phases of meiosis.
5. To learn how to isolate each cellular organelle and identify them

### Recommended Books:

1. Handbook of Microbiological Media by Atlas RL.
2. Manual of Clinical Microbiology by Lennette EH.
3. Manual of Clinical Microbiology by Murray PR.
4. A Laboratory manual of Microbiology: Microbes in action.
5. Molecular Biology of the Cell by B Alberts *et al.*
6. Handling of Chromosomes by Darlington & Lacor.

## BTSC2001: ENZYMOLOGY AND METABOLISM

### Preamble:

This course is designed to introduce the students to the core concepts in Enzymology, in-depth understanding of metabolism. In this course students will be learning about the enzymes, properties and learn about the method of classifying the enzymes, and study about enzyme kinetics. They also learn about the classification of metal containing enzymes, metalloenzymes-classification, and mechanism of their enzymatic actions. In the second part of this course, they will learn about the different metabolic pathways that occur in the cells and the enzymatic reactions of those pathways and their regulation.

### Course Objectives:

1. To familiarize students about the fundamental concepts enzymes and enhance the basic knowledge and to understand about the enzyme kinetics.
2. To enhance the basic knowledge and to understand about the enzyme inhibition and regulation processes.
3. To acquaint the students to the metabolism of carbohydrates in terms of synthesis and degradation, and diseases pertaining to the glycogen storage.
4. To enhance the knowledge and to understand about the secondary source of energy to the cell and the important structural components of cells, fatty acids and their metabolism etc.
5. To familiarize the students to the concepts metabolism of nitrogen based biomolecules and related inborn errors of metabolism.

### UNIT –I

Nomenclature and classification of enzymes, Factors effecting enzyme activity: enzyme concentration, substrate concentration, pH, temperature and metal ions. Enzyme assay, units of enzyme activity and specific activity. Michaelis - Menten equation, significance of  $K_m$ ,  $V_{max}$ .

### UNIT-II

Cofactors, coenzymes, metalloenzymes. Enzyme inhibition: Irreversible inhibition and Reversible inhibition - competitive, non- competitive and uncompetitive. Enzyme regulation : allosteric enzymes, zymogen activation, covalent modification and isoenzymes. Overview of Abzyme, ribozyme and enzyme immobilization.

### UNIT-III

Glycolysis and its regulation. TCA cycle and its regulation. Electron transport chain and oxidative phosphorylation. Significance of - gluconeogenesis, HMP shunt and glyoxylate cycle. Glycogen synthesis and degradation, Glycogen storage diseases.

### UNIT-IV

Synthesis and degradation of Saturated and Unsaturated Fatty acids, Ketone bodies, Synthesis of Triacyl glycerides, Phospholipids and Cholesterol.

### UNIT-V

Transamination and oxidative deamination and Urea cycle. Biosynthesis and degradation of phenylalanine and valine. Inborn errors of amino acid metabolism. Synthesis and degradation of purine and pyrimidine nucleotides. Formation of deoxyribonucleotides.

## **COURSE OUTCOMES:**

- The student can understand the molecular basis of enzyme kinetics.
- The student be familiar with various types of enzyme immobilization.
- The student understand the abzymes and ribozymes with respect to their mechanism and functions.
- The student can understand about the enzymatic mechanism of glucose synthesis from non-carbon sources and the pathway of glycogen synthesis and storage
- The student can understand the synthesis of saturated,unsaturated fattyacids and triacylglycerides
- The student know about inborn errors associated with amino acid metabolism

## **Recommended Books:**

1. Enzymes: Biochemistry, Biotechnology, Clinical Chemistry by Palmer, 2<sup>nd</sup> edition, East West publishers
2. Lehninger Principles of Biochemistry by Nelson, D and Cox, D. –7<sup>th</sup> Edition. Mcmillan Pub.
3. Biochemistry by L.Stryer– 8<sup>th</sup> Edition. (Freeman-Tappan).
4. Biochemistry by D.Voet and J.G.Voet– 4<sup>th</sup> Edition. (John weily).
5. Biochemistry by Garrett and Grisham 6<sup>th</sup> Edition. (Cengage Learning)
6. Biochemistry Concepts and Connections by Mathews et. al.,Global Edition.
7. Principles of Biochemistry by David Rawn etal., 5<sup>th</sup> Edition (Pearson)
8. Essentials of Glycobiology. 3<sup>rd</sup> Edition. (CSHL press)
9. Harper's Biochemistry by Robert K. Murray et al., – 30<sup>th</sup> Edition. (Langeman).
10. Biochemistry by U.Satyanarayana—4<sup>th</sup> Edition.

## BTSC2011: BIOANALYTICAL TECHNIQUES

**Preamble:** The biochemical techniques predominately embrace a broad cross-section of modern analytical techniques and latest sophisticated instruments like HPLC, XRD, NMR, GC-MS, ORD...etc. The course will help to build the knowledge about the bioanalytical techniques used to analyze various biomolecules and also the use of radio tracer techniques in biology.

### Course objectives:

The bioanalytical methods predominately embrace a broad area of basic and advanced analytical techniques used in biology.

1. To learn the fundamentals of many techniques used regularly for the analysis of the biological molecules. Throughout the course different broad classes of techniques for the separation of DNA, RNA, and protein are discussed.
2. To make the students understand of the principle of various techniques used to analyse biomolecules.
3. To make the students aware of the different components of the equipment that are used and methodology to analyse biomolecules.

### UNIT-I (Chromatography Techniques)

Principles and applications of chromatographic techniques- Paper chromatography, thin layer chromatography, gel filtration, ion-exchange chromatography, affinity chromatography, GC, HPLC and GC-MS.

### UNIT-II (Electrophoresis Techniques)

Principles and concepts of electrophoretic techniques- native PAGE, SDS-PAGE, Agarose gelelectrophoresis, capillary electrophoresis, isoelectric focusing (IEF), two dimensional, pulse field and diagonal electrophoresis.

### UNIT-III (Spectroscopic Techniques)

Principles and applications of Optical Rotatory Dispersion (ORD), Circular Dichroism (CD), Nuclear Magnetic Resonance spectroscopy (NMR), Electron Spin Resonance spectroscopy (ESR), Fluorescence spectroscopy. X-ray diffraction.

### UNIT-IV (Centrifugation Techniques)

Principles and applications of preparative centrifugation: Differential centrifugation, density gradient centrifugation, rate zonal centrifugation and isopycnic centrifugation. Types of rotors. Analytical centrifugation: sedimentation coefficient, boundary sedimentation, band sedimentation.

### UNIT-V (Tracer and Biosensor Techniques)

Radioactive and non-radioactive tracer techniques and their applications in biological sciences. Detection and measurement of radioactivity. Principles of electrochemical techniques-operation and applications of pH, oxygen, ion-selective and gas sensing electrodes. Biosensors- principle, design and applications.

### COURSE OUTCOMES:

1. The students will be able to comprehend the applications of different techniques used to analyse biomolecules.
2. The students will be informed of the limitations of various techniques so that they will know which technique to apply for different kinds of analyses of the biomolecules.

3. The course will also guide them to develop new techniques or in the direction of improving the existing techniques.

**Recommended Books:**

1. Practical Biochemistry by Keith Wilson & Walker, 5th edition, Cambridge University Press.
2. A Biologists guide to Principles and techniques of practical Biochemistry by BD Williams (Edward Arnold).
3. Principles and Techniques of Biochemistry and Molecular Biology by K Wilson & J Walker, 7<sup>th</sup> Edition, Cambridge University Press.
4. Biophysical chemistry principles and techniques by Upadyay & Nath, Himalaya publishing House.
5. Instrumental methods of chemical analysis by Chatwal & Anand, 5<sup>th</sup> edition, Himalaya Publishers.
6. Modern Experimental Biochemistry by Rodney F Boyer, 3rd Edition.
7. Fundamentals of Biostatistics by Khan & Khanum, Ukaaz publications.
8. Biostatistics by Daniel, 10th edition, Wiley Publishers.
9. Physical Chemistry: Science of Biology by Atkins, Freeman & Company

## **BTSC2041: MOLECULAR BIOLOGY AND rDNA TECHNOLOGY**

### **Course Objectives:**

The objectives of this course are

- to make students understand how molecular machines are constructed and regulated so that they can accurately copy, repair and interpret genomic information in prokaryotes and eukaryotic cells.
- to appreciate the subject of molecular biology as a dynamic and ever-changing experimental science.
- To help students understand manipulation of DNA by various genetic engineering tools

### **UNIT-I**

Features of DNA Replication, mechanism of DNA replication in prokaryotes and eukaryotes, enzymes and proteins involved in DNA replication, DNA damage and repair

### **UNIT-II**

Transcription mechanism in prokaryotes and eukaryotes, Types of RNA polymerases and promoter-polymerase interactions, DNA-dependent RNA polymerase, RNA transport and editing, inhibitors of transcription and applications of antibiotics.

### **UNIT-III**

Mechanism of translation in prokaryotes and eukaryotes, Co- and post translational modifications, protein targeting, regulation of gene expression-operon concept, cis-trans elements, DNA methylation, RNAi and gene silencing

### **UNIT-IV**

Genetic engineering molecular tools: Restriction enzymes, DNA ligases, Polymerases, Alkaline phosphatase, Poly nucleotide kinase, Terminal deoxy nucleotide transferase. Cloning vectors: Plasmids, Bacteriophage-derived vectors and artificial chromosomes. Gene Recombination and Gene transfer: Transformation and screening of recombinants.

### **UNIT-V**

Hybridization techniques: Southern and Northern hybridization. Principle and applications of Polymerase Chain Reaction (PCR) and Reverse transcription (RT) PCR. Preparation of Genomic and cDNA libraries, DNA sequencing by chemical, enzymatic and Next Generation Sequencing (NGS) methods, DNA fingerprinting.

### **Course outcomes:**

By the end of this course, students will be able to:

- Acquire basic knowledge on mechanism of DNA replication.
- comprehend the basic mechanism and methods to measure rate of gene expression.
- Understand molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes.
- Explain about different enzymes and vectors used in genetic engineering
- Describe different nucleic acid hybridization and sequencing techniques

## **Recommended Books:**

1. Recombinant DNA: Genes and Genomes - a Short Course by James D. Watson, (2006) WH Freeman & Co; 3rd edition
2. Lewin's Genes-XII by Jocelyn E. Krebs et al., (2017) Jones and Bartlett Publishers, Inc; 12th edition
3. Principles of Gene Manipulation and Genomics by Primrose & Twyman (2006) 7thed (Oxford).
4. Molecular Biotechnology: Principles and Applications of Recombinant DNA by Glick et al., (2017) 5th ed ASM Press.
5. Gene Cloning and DNA Analysis: An Introduction by T.A. Brown (2016) 7thed (Wiley-Blackwell).
6. Molecular Biology of the Cell by Bruce Alberts (2014), 6th edition, Garland Science
7. Genomes by T.A. Brown (2017) 4th ed Garland Science Publishers.
8. Molecular Biology of the Gene by Watson et al., (2013) Person Publishers
9. Molecular Cell Biology by Lodish et al., (2016) 8th Edition, WH Freeman publishers
10. Karp's Cell and Molecular Biology: Concepts and Experiments by Janet Iwasa (2016), John Wiley & Sons Inc; 8 edition

## BTSC 2021: ENZYMOLOGY AND METABOLISM LAB

### Course objectives:

- To train students in the practical aspects of enzymology so that they can perform qualitative and quantitative assay procedures.
- To conduct the experiments on enzymes to study their kinetic behavior at various temperatures, pH etc with respect to the kinetic parameters such as  $K_m$  and  $V_{max}$

1. Assay of salivary amylase
2. Assay of potato acid-phosphatase
3. Effect of pH on enzyme activity
4. Effect of temperature on enzyme activity
5. Effect of incubation time on enzyme activity
6. Effect of substrate concentration on enzyme activity

### Course Outcomes:

By the end of this practical course, the student will be able to

- Gain hands-on experience in conducting various enzyme assays and analysis
- Perform experiments related to various factors influence the enzyme and the enzyme activity

### Recommended Books:

1. Modern experimental Biochemistry by Rodney Boyer – 3<sup>rd</sup> Edition (Benjamin Cummings).
2. Biochemical methods by Sadasivam and Manikam – 3<sup>rd</sup> Edition (New Age International Pvt. Ltd. Publishers).
3. An introduction to practical biochemistry by D.T.Plummer – 2<sup>nd</sup> Edition (McGraw Hill).
4. Laboratory manual in Biochemistry by J. Jayaraman (Wiley Eastern limited).
5. Biochemistry - a laboratory courses by J. M.Beckar – 2<sup>nd</sup> Edition (Academic Press).
6. Introductory practical Biochemistry by S. K.Sawhney and Randhir Singh – 2<sup>nd</sup> Edition (Narosa).



## BTSC 2031: BIOANALYTICAL TECHNIQUES LAB

### Course objectives:

- To train students in the qualitative analysis of amino acids, carbohydrates.
- To train the students in quantitative estimation of amino acids, carbohydrates, cholesterol and antioxidants.

### Experiments:

1. Qualitative analysis of amino acids
2. Qualitative analysis of carbohydrates
3. Determination of isoelectric point of glycine.
4. Estimation of protein by Lowry's method.
5. Estimation of glycine by Sorenson's formal titration
6. Estimation of cholesterol by Zak's method.
7. Estimation of carbohydrate by Anthrone method
8. Estimation of ascorbic acid by 2, 6-dichlorophenol indophenol method

### Course Outcomes:

By the end of this practical course, the student will be able to

- Learn the techniques of qualitative and quantitative estimation of amino acids, proteins, cholesterol and ascorbic acid.
- Learn the usage of lab equipment like colorimeter and spectrophotometer.

### Recommended Books:

1. Modern experimental Biochemistry by Rodney Boyer, 3rd Edition, Benjamin Cummings.
2. Biochemical methods by Sadasivam and Manikam, 2nd Edition, Wiley Eastern limited.
3. An introduction to practical biochemistry by DT Plummer, 2nd Edition, Mc Graw Hill.
4. Laboratory manual in Biochemistry by J Jayaraman, 2nd Edition, Wiley Eastern limited.
5. Biochemistry - A laboratory courses by JM Beckar, 2nd Edition, Academic Press.
6. Introductory practical Biochemistry by SK Sawhney & Randhir Singh, 2nd Edition, Narosa

## **BTSC2031: MOLECULAR BIOLOGY AND rDNA TECHNOLOGY LAB**

### **Course objectives:**

The experiments are designed to make students gain hands on experience to isolate DNA and RNA from prokaryote and eukaryotes; to quantify and amplify nucleic acids.

### **Experiments:**

1. Isolation of DNA from Eukaryotic cells.
2. Isolation of Plasmid DNA by alkaline Lysis method
3. Separation of DNA by Agarose gel electrophoresis
4. Purity of isolated DNA by A260/A280 Ratio
5. Isolation of RNA by Trizol method
6. DNA denaturation and Hyperchromic effect
7. Estimation of DNA by DPA method
8. Estimation of RNA by Orcinol method
9. Restriction digestion of DNA
10. Ligation of DNA
11. Polymerase Chain Reaction (PCR)

### **Course outcomes:**

The Students will be able to:

1. isolate DNA and RNA from prokaryote and eukaryotes
2. know the extraordinary power of restriction and other enzymes in molecular cloning and genetic manipulations.
3. gain hands-on training in various molecular techniques for gene manipulation

### **Recommended Books:**

1. Biotechnology: A laboratory course by Becker J.M.
2. Molecular Cloning: A laboratory manual Vals. 1-3, Sambrook, J.
3. Biochemistry - a lab course by J.M.Becker (Academic Press).
4. Molecular Cloning: A laboratory manual Vals. 1-3, Sambrook, J.

## **BTSC3001: PLANT AND ANIMAL BIOTECHNOLOGY**

### **Preamble:**

This course deals with basic methodology associated with animal and plant cell culture methods and the role played by the culture media and kinetics of cell growth. This paper deals with phytohormones and plant cell hybridization techniques. This paper also explains the properties of animal stem cells and induced pluripotency. This course gives a detailed view on human reproductive systems and transgenic techniques.

### **Course objectives:**

The objectives of this course are to introduce the techniques of cell, tissue and organ culture, stem cells and induced pluripotency. Student will learn about basics and advanced developments in reproductive biology. This course also helps to make students aware of different practices employed in the production of transgenic animals and gene therapy.

### **UNIT-I**

Phytohormones, types of culture: Seed, Embryo, Callus, Organs, Cell and Protoplast culture. Micropropagation: advantages and disadvantages. Organogenesis and somatic embryogenesis. In vitro haploid production: Androgenic and Gynogenic methods. Transgenic plants:

Production methods and its applications.

### **UNIT-II**

Protoplast Isolation and fusion methods somatic hybridization, identification and selection of hybrid cells and its limitations. Cybrids, Somaclonal variations. Plant growth promoting bacteria, Nitrogen fixation.

### **UNIT-III**

Basic techniques of animal cell and tissue culture. Different types of animal cell culture media Natural, synthetic media, cryopreservation of cells, applications of cell culture. Stem cells: Properties, types and applications.

### **UNIT-IV**

Causes of infertility in male and females. super ovulation, embryo transfer. In vitro Fertilization methodology, Artificial insemination, Immuno contraception.

### **UNIT-V**

Production of transgenic animals -by microinjection, retroviral, vector method and embryonic stem cell method. Animal cloning – methodologies and its applications. Gene Therapy-Ex vivo and In vivo gene therapy.

### **Course outcomes:**

By the end of this unit, the student should be able to understand

- The process of production of transgenic animals

- The mechanism of animal cloning
- Gene knockdown and knockout methods

### **Recommended Books:**

1. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications by R. Ian Freshney
2. Molecular Biotechnology by Glick.
3. Gene cloning and DNA analysis an introduction by T.A. Brown (Blackwell).
4. Biotechnology by U.Satyanarayana.
5. Biotechnology by B.D.Singh (Kalyani).
6. Plant Tissue Culture and Practice.by Bhojwani, S.S. and Razdan
7. Plant Biotechnology: The Genetic Manipulation of Plants, by Slater, A., Scott, N.W. & Fowler, M.R.
8. In Vitro Fertilization: The A.R.T. of Making Babies (Assisted Reproductive Technology) (2013) by Geoffrey Sher, Virginia Marriage Davis, Jean Stoess
9. In-Vitro Fertilization 3rd Edition (2011), by Kay Elder, Yves Ménézo, Joyce Harper, John Huntriss

## BTSC3011: IMMUNOBIOLOGY

**Preamble:** Immunology is a fascinating and challenging field that has both theoretical and practical applications. Immunology can be intimidating for many students, but it does not have to be. It grows steadily from simple beginnings, as do many areas of biology. You will be able to apply these ideas to new problems if you learn not only the facts, vocabulary, and concepts of immunology, but also the problem-solving process. This is the true excitement of immunology.

### Course Objectives:

1. An understanding of basic immunological concepts
2. An appreciation of how the experiments are designed and interpreted to test scientific hypothesis
3. Intellectual skills to read critically the current immunologic literature

### UNIT- I

Innate immunity and Adaptive immunity. Immunological barriers. Pattern recognition receptors. Toll like receptors. Cells of the immune system - lymphocytes, macrophages, neutrophils, NK, NKT cells and Innate lymphoid cells. Structure and functions of lymphoid organs. Antigens, Immunogens, Adjuvants, Haptens. Factors contributing to antigenicity. Superantigens. Epitopes.

### UNIT- II

B cell development, maturation, activation, and memory. BCR. Types of B cells Classification, Structure, and functions of antibodies. Antigenic determinants-isotypes, allotypes and idiotypes. The generation of antibody diversity. Recognition of antigen by B-Cell receptors Effector cell mechanisms of humoral response

### UNIT- III

T cells-development, maturation, activation, and memory. TCR and Types of T cells. MHC restriction. Recognition of antigen by T-Cell receptor. MHC & HLA-Types, structure, and properties. Organization of MHC genes. Antigen processing and presentation. Cell mediated immune responses. Regulation of immune response.

### UNIT- IV

Complement system -Classical, alternate and MBL pathways, biological functions and regulation. Cytokines and receptors-Properties, biological functions and signalling pathways. Inflammasomes. Inflammation.

### UNIT- V

Tolerance and factors involved in maintaining tolerance. Autoimmune diseases - Organ specific and Systemic. Hypersensitivity - Mechanism and pathophysiology of different types of hypersensitivity.

**Course outcomes:** After completion of this unit, the student will be able to

- Distinguish between innate immunity and acquired immunity
- Describe the basic structural and functional components of the immune system
- Understand the development processes of T cells and B cells
- Factors that contribute to the development of autoimmunity
- Distinguish between different types of Delayed type hypersensitivity

### **Recommended Books:**

1. Immunology: A Short Course (2021). by Richard Coico. Wiley-Blackwell
2. Cellular and Molecular Immunology (2021). Abul K. Abbas, Andrew H. Lichtman, Shiv Pillai. Elsevier - Health Sciences
3. Kuby Immunology (2019). J Punt., S Stranford., P Jones., & J. A. Owen. New York: W.H. Freeman.
4. Roitt's Essential Immunology (2017). Peter J. Delves, Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt. Wiley- Blackwell
5. Janeway's Immunobiology (2016). Murphy, K., Weaver, C. New York: W. W. Norton & Company.

## **BTSC3041: INDUSTRIAL BIOTECHNOLOGY**

### **Preamble:**

The significance of this course is to provide students with effective theoretical knowledge and principles relevant to Industrial Biotechnology. As per the course content, one can understand the diversity of microorganisms and search for strains from the natural environment, which are able to produce novel or unusual products of high commercial value. The main task of the industrial biotechnologist is to develop procedures for obtaining new microbial metabolites by rapid and reliable isolation and screening procedures and metabolic engineering. Understanding various principles of reactor designs, scale-up and downstream processing is primary and essential in large-scale production of various biologically active principles or products. This course also provides the knowledge about the importance of immobilization of enzymes/ cells and their applications.

### **Course Objectives:**

1. To educate students about the fundamental concepts of industrial biotechnology and its related applications, thus preparing them to meet the challenges of the new and emerging areas of biotechnology industry.
2. To develop skills about the screening and maintenance of industrially useful microorganisms, the sterilization kinetics, fermentation processes, reactor design, product development and recovery.
3. To improve the base knowledge and to bring awareness on various industrial processes.

### **UNIT- I**

Screening, isolation and maintenance of microbes, preservation of isolated pure cultures. Sterilization of media: Batch and Continuous sterilization. Strain selection, Strain improvement: physical and chemical methods

### **UNIT – II**

Bioreactor: design and parts of bioreactor, types of bioreactor, Batch reactor, Continuous reactor, fixed bed reactor, fluidized bed reactor, trickle fermenter. single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient ( $K_a$ ) determination, factors depending on scale up principle and different methods of scaling up.

### **UNIT – III**

Downstream processing: solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Isolation and Purification of proteins.

### **UNIT- IV**

Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Ethanol, hydrogen, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; anti-cancer agents.

### **UNIT – V**

Microbial products of pharmacological interest, steroid fermentations and transformations. Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing. Application of immobilized enzymes in medicine and industry.

**Course outcomes:**

By the end of the course, the student will be able to:

- isolate and screen the microorganisms from the soil, air or water and preserve the selected strains.
- understand mass transfer and scale up processes.
- gain knowledge about the design parameters and operations of the bioreactors.
- be acquainted with the protein purification process.
- understand the important microbial / industrial processes in industrial chemicals, solvents, insecticides etc
- understand the transformations and metabolic engineering of biologically active molecules.
- know the immobilization techniques.

**Recommended Books:**

1. Modern Industrial Microbiology and Biotechnology, Second Edition 2nd Edition (2017) by Nduka Okafor,  
Benedict C. Okeke
2. Casida LE. (2016). Industrial Microbiology.2nd edition. New Age International Private Limited.
3. Crueger W and Crueger A. (2017). Cruegers Biotechnology: A Textbook of Industrial Microbiology.  
2<sup>nd</sup> edition. Panima Publishing Co. New Delhi.
4. Patel AH. (2015). Industrial Microbiology.2nd edition, Laxmi Publications-New Delhi.
5. Stanbury PF, Whitaker A and Hall SJ.(2016). Principles of Fermentation Technology.3<sup>rd</sup>ed,  
Butterworth-Heinemann Ltd.



## **BTSC3021: PLANT AND ANIMAL BIOTECHNOLOGY LAB**

**Course objectives:** Learn good laboratory practices in Plant and Animal tissue culture laboratories. Acquire skills and hands on experience in basic plant tissue culture using various explants. Perform basic experiments in cell viability and growth. Gain knowledge in preparation of glycerol stocks.

### **Experiments:**

1. Preparation of simple growth nutrient (Knop's medium), full strength, half strength, solid and liquid.
2. Preparation of complex nutrient medium (Murashige & Skoog's medium)
3. Sterilization and preparation of various explants for plant tissue culture.
4. To demonstrate various steps of Micropropagation.
5. Isolation of protoplasts from Leaf.
6. Preparation of animal cell culture media
7. Preparation of single cell suspension cultures from spleen
8. Enumeration of cells in culture by haemocytometer
9. Preparation of glycerol stocks

### **Course outcomes:**

On completion of this course, students will be able to perform basic experiments on plant and animal biotechnology and help them to take up plant and animal biological research as well as placement in relevant biotech industry.

### **Recommended Books:**

1. Plant cell culture - A practical approach by Dixon RA.
2. Plant tissue culture - Theory and practice by Bhojwani, S.S.
3. Biotechnology: A laboratory course by Becker, J.M.
4. Animal cell culture - A practical approach Ed. By John R.W. Masters (IRL Press).
5. Animal cell culture techniques, Ed. Martin Clyenes (Springer).
6. Culture of Animal cells; A manual of Basic techniques by R. Ian Freshney

## **BTSC3031: IMMUNOBIOLOGY LAB**

### **Course objective**

- To learn how to prepare blood smears
- To learn and peripheral blood mononuclear cells using a density-interface centrifugation technique, from defibrinated or anticoagulated human blood.
- To identify human blood group
- To learn and familiarize with the techniques in the quantitation of antibodies present in the serum by precipitation methods
- To learn quantitative estimation the antibody using enzyme conjugates

### **Experiments:**

1. Preparation and examination of peripheral blood smears
2. Isolation of peripheral blood mononuclear cells by density gradient centrifugation
3. Cell Lysis and Protein Extraction
4. Blood grouping
5. Double Immuno diffusion
6. Radial Immunodiffusion
7. ELISA

### **Course outcomes:**

On completion of this course, students will be able to perform experiments of separation of mononuclear cells, human blood group identification, Quantitative and qualitative estimation of antibodies.

## INDUSTRIAL BIOTECHNOLOGY LAB

### Course objectives:

- To train the students in isolation and screening of useful microorganisms from their native habitats.
- To make students gain expertise in industrial methods such as batch fermentation, production and estimation of enzymes and alcoholic beverages.
- To improve the base knowledge and to bring awareness on various industrial processes.

### Experiments:

1. Selective isolation of actinomycetes and fungi from soil samples.
2. Microbiological assay of an antibiotic including the construction of standard curve.
3. Solvent extraction & analysis of a metabolite from a bacterial culture.
4. Fermentative production of protease by shake flask method.
5. Fermentative production of amylase by shake flask method.
6. Immobilization of an enzyme by gel entrapment.
7. Immobilization of whole cells for enzyme production by gel entrapment.
8. Production of alcohol by *Saccharomyces cerevisiae* and its estimation.
9. Production of citric acid by *Aspergillus niger*.
10. Production of red wine from grapes.
11. Production of Glutamic acid by *Corynebacterium glutamicum*.

### Course outcomes:

By the end of this practical course, the student will be able to :-

- Gain knowledge to investigate, design and conduct experiments, analyse and interpret data, and apply the laboratory skills to isolate a potent production strain.
- Be acquainted with immobilization skills to produce enzymes and able to demonstrate their usability of enzymes under *in vitro* conditions.
- Gain knowledge on the downstream processing of metabolites.
- Gain hands on experience in fermentation of industrially important enzymes, organic acids, alcohol and wine.

### Recommended Books:

1. A Manual of Industrial Microbiology and Biotechnology by AL Demain et al., 3rd Edition, ASM Press.
2. Immobilization of Enzymes and Cells: Methods in Biotechnology by GF Bickerstaff, Volume I, Springer Publishers.
3. Principle of fermentation technology by Stanbury by PF Stanbury, A Whitakar, and SJ Hall, 2nd Edition, Elsevier.
4. Biotechnology: A Laboratory Course by JM Becker, Academic Press.
5. Lab Manual in Biochemistry by JJayaraman, Wiley Eastern Limited.

## **BTSC: 2071 GENERAL MICROBIOLOGY**

### **Preamble:**

This course has been designed to introduce the field of microbiology by studying different kinds of microorganisms with special emphasis on microbial diversity. By studying this course, the student develops knowledge to isolate and identify the microorganisms. Moreover, this course imparts knowledge about the morphological, and physiological features among diverse microbial species and also different kinds of methods to control microbes.

### **Course objectives:**

1. To familiarize with the historical foundations in the field of microbiology and to understand the classification system of bacteria and archaea.
2. To impart knowledge on microscopy techniques and to gain knowledge on the sterilizing agents and concepts of culture dependent and independent techniques
4. To familiarize with the polyphasic approaches employed to characterize the microorganisms and bacterial growth kinetics
5. To impart knowledge about vegetative thalli structures and reproductive structures of algae and fungi.
6. To understand the clinical manifestations of protozoans and to know about the viral structures

### **UNIT- I**

Introduction to microbiology - Historical Foundations of Microbiology; Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Beijerinck, Winogradsky, Edward Jenner, Ivanowski; Golden era of microbiology. Whittaker's and Carl Woese's three kingdom classification systems, Bergey's classification of bacteria & Achaea

### **UNIT-II**

Microscopy - Principles and applications of light, phase, fluorescent and electron microscopy, confocal microscopy; Ultra structure of microorganisms (bacteria, algae, fungi and protozoa) and acellular microorganisms (Viruses, Viroids, Prions); Preparation and staining of specimens; Fixation, Dyes, simple and differential staining; Sterilization - physical, chemical and radiation methods.

### **UNIT-III**

Isolation of pure cultures- Culture dependent techniques (spread plate, streak plate and pour plate methods) Characterization and Identification of bacteria based on morphology, biochemical characteristics, Phage typing and ribotyping; culture independent technique; Types of nutrient media for bacterial growth, microbial growth – principles & kinetics.

### **UNIT-IV**

General characteristics of algae and blue green algae, thallus organization, pigments, flagella, eyespot food reserves; General characteristics of fungi, fungal cells and vegetative growth, multihyphal systems, Types of culture media for cultivation of algae and fungi, Economic importance of algae & fungi.

## UNIT-V

General characteristics with special reference to Plasmodium, Entamoeba, Leishmania; Virus taxonomy, ICTV regulations, Baltimore system of virus classification, virus structure, and cultivation of virus-Embryonated egg, animal cell culture methods; TMV, lytic and lysogenic cycle (T4 and  $\lambda$  phages).

### Learning Outcomes:

After completion of this unit, the student will be able to

- Learn about the features, clinical manifestations of Plasmodium, Entamoeba, Leishmania
- Learn the regulations issued and nomenclature system followed by ICTV.
- Learn the characteristics used to classify the viruses and virus structures
- Learn about the multiplicity of infection in phage particles.

### Recommended Books:

1. Textbook of Microbiology by Ananthanarayan and Paniker's, 10<sup>th</sup> Edition.
2. Microbiology - Principles and Explorations by Black, 9<sup>th</sup> Edition, John Wiley & Sons.
3. Prescott's Microbiology, 11<sup>th</sup> Edition, McGraw-Hill Publishers.
4. Microbiology: An Introduction (2016) by Tortora *et al.*, 12<sup>th</sup> Edition Pearson publishers
5. Sherris Medical Microbiology, (2018) by Kenneth J. Ryan *et al.*, 7<sup>th</sup> Edition McGraw-Hill Education
6. Brock Biology of Microorganisms (2015) by Michael T. Madigan (15<sup>th</sup> Edition), Pearson publishers
7. Algae (2008) by James E. Graham (2<sup>nd</sup> Edition), Benjamin Cummings
8. The Fungi by Sarah C. Watkinson, Academic Press; 3<sup>rd</sup> Edition (2016)
9. Fungi: Experimental Methods in Biology (2019) by Ramesh Maheshwari, 2<sup>nd</sup> Edition, CRC Press
10. Human Virology by Flint, 4<sup>th</sup> Edition, ASM Press.

## BTSC:2081 CLASSICAL GENETICS

**Preamble:** This course is designed for students to learn the basics of inheritance of genetic material. It covers the fundamental discoveries made to understand the inheritance. It talks in detail about how the genomes of organisms changed during evolution. The experiments that proved both quantitative and qualitative changes in DNA is discussed.

### Course Objectives

1. To introduce the concepts of Mendelian genetics and Chromosome. Theory of Heredity.
2. To familiarize students with deviation from Mendelian Genetics.
3. To impart knowledge concerning linkage and crossing over and utilize the information to perform gene mapping.
4. To describe different types of chromosomal aberrations and explain their role in evolution.
5. To introduce the concepts of pedigree analysis and statistical tool for testing genetic hypothesis.

### UNIT - I

Mendelism & Chromosome Theory – Mendel's principles, applications of Mendel's principles, Chromosome Theory of Heredity (Sutton-Boveri), Inheritance patterns, phenomenon of Dominance, Inheritance patterns in Human.

### UNIT - II

Extension of Mendelism – Sex-linked, Autosomal and cytoplasmic inheritance, extranuclear inheritance Mitochondrial and chloroplast inheritance. Deviation from Mendel's Dihybrid phenotype, allelic Variation & Gene function – Multiple allele, Genetic interaction, Epistatic interactions, Non-Epistatic inter-allelic genetic interactions, Atavism/Reversion, Penetrance (complete & incomplete), Expressivity, Pleiotropism, Modifier/Modifying genes.

### UNIT - III

Linkage & Crossing over - Linkage, Sutton's view on linkage, Morgan's view on linkage, Bateson & Punnett's Coupling & Repulsion hypothesis Chromosome theory of Linkage, kinds of linkage, linkage groups. Determination of linkage groups, determination of map distance, determination of gene order, cytological mapping. Types of Crossing over, mechanism of Meiotic Crossing over, theories about the mechanism of Crossing over, cytological detection of Crossing over, significance of Crossing over.

### UNIT - IV

Chromosomal variation in Number & Structure – Euploidy, Non-disjunction & Aneuploidy, Aneuploid segregation in plants, Aneuploidy in Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy, Chromosomal Mosaics, Polytene chromosome in Diptera, Deletion, Duplication, Inversion, Translocation, Position Effect, Centromeric & Non-centromeric breaks in chromosomes, chromosomal rearrangements in Human being, Chromosomal aberrations & evolution.

### UNIT - V

Pedigree analysis – Pedigrees of Sex-linked & Autosomal (dominant & recessive), Mitochondrial, Incomplete dominance & Penetrance. Formulating & Testing Genetic Hypothesis – problems of Sex-linkage, problems of genes with Multiple alleles, problems of gene interactions, Chi-square, t-test.

**Course outcomes:**

After completion of this unit, the student will be able to

- Understand the Mendel's laws Chromosome and theory of heredity
- Understand different types of deviation from Mendelian Genetics
- Understand the concept of Penetrance and expressivity
- Understand the principle crossing over and linkages.
- Understand different types of chromosomal aberrations and their role in evolution
- Perform statistical analysis such as t test and Chi-square test

**Recommended Books:**

1. Medical Biotechnology by Bernard Glick, Terry L delovitch, Cheryl L Patten
2. Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
4. An introduction to Human Molecular Genetics by Pasternak et al., Wiley Pubs
5. Human Chromosomes by Miller & Tharman, Springer Publishing Company
6. Genes XII, by Lewin B, Pearson India Elements of medical Genetics by Turnpenny and Ellard, Churchill L

## **BTSC 2091: GENERAL MICROBIOLOGY LAB**

### **Course objectives:**

- To familiarize with good laboratory practices and biosafety levels.
- To demonstrate the methods for isolation of bacteria from soil by various isolation procedures.
- 3. To identify the morphology of bacteria by microscopic observation and enumeration of bacterial growth.
- To determine the sensitivity of the microorganisms towards chemicals and metals.
- To familiarize with the morphological features of microorganisms by microscopic observations

### **Experiments:**

1. Culture media preparation methods
2. Techniques for isolation of pure cultures
3. Staining methods: - Simple, Gram, & spore
4. Enumeration of bacterial growth curve
5. Detection of motility by hanging drop method
6. Antibiotic sensitivity test by disc / well diffusion methods
7. Observation of permanent slides of protozoa, fungi and algae

**Course outcomes:** After completion of this unit, the student will be able to

- Learn basic microbiology laboratory safety methods and aseptic techniques.
- Perform the streak-plate and/or the spread plate inoculation procedure to separate the cells of a mixed culture so that discrete colonies can be isolated.
- Perform biological staining by smear preparation for simple, gram and spore staining
- Conduct an experiment for generating a bacterial growth curve.
- Perform the disc–agar diffusion technique for determination of antimicrobial activity of chemotherapeutic agents
- Identify morphological features of fungi, protozoa and algae

### **Recommended Books:**

1. Microbiology: A Laboratory Manual (2020) by James G. Cappuccino 12th Edition Pearson Publishers
2. Laboratory Exercises in Microbiology (2016) by John Harley 8th Edition, McGraw-Hill Education
3. Microbiology: Laboratory Theory and Application (2015) 4th Edition by Michael J. Leboffe, Morton Publishing Company
4. Benson's Microbiological Applications Laboratory Manual in General Microbiology (2012) by Alfred Brown & Heidi Smith 13th edition, McGraw-Hill Publishers.



## **BTSC 2101: CLASSICAL GENETICS LAB**

### **Course Objectives:**

To make the students learn how cells divide, types of cell division and different stages in each type of cell division.

1. To make the students aware of the dihybrid cross, and the variations of it.
2. To make the students understand the arrangement of chromosomes, the distinctive features of human chromosomes, and how the silencing of chromosomes occurs in buccal smears.
3. To make students learn to grow cells, arrest them during cell division and check the ploidy level of chromosomes.

### **Experiments:**

1. Permanent and temporary mount of mitosis.
2. Permanent and temporary mount of meiosis.
3. Mendelian deviations in dihybrid crosses
4. Demonstration of - Barr Body - Rhoeo translocation.
5. Karyotyping with the help of photographs
6. Pedigree charts of some common characters like blood group, color blindness and PTC tasting.
7. Study of polyploidy in onion root tip by colchicine treatment.

Course outcomes:

After completion of this unit, the student will be able to

- Get acquainted in laboratory techniques of genetics
- Learn and identify different cell cycle stages
- Prepare Pedigree charts
- Understand the concept of polyploidy

### **Recommended Books:**

1. Gardner, E.J., Simmons, M.J., Snustad, D.P. (2006). Principles of Genetics. 8th edition John Wiley & Sons.
2. Snustad, D.P., Simmons, M.J. (2009). Principles of Genetics. 5th edition. John Wiley and Sons Inc.
3. Klug, W.S., Cummings, M.R., Spencer, C.A. (2009). Concepts of Genetics. 9th edition, Benjamin Cummings.
4. Russell, P. J. (2009). Genetics- A Molecular Approach. 3rd edition, Benjamin Cummings.
5. Griffiths, A.J.F., Wessler, S.R., Lewontin, R.C. and Carroll, S.B. 9th edition.

## BTSC 2061: PLANT AND ANIMAL PHYSIOLOGY

**Preamble:** This course aims at understanding how the living world is classified, along with gaining knowledge about flow of energy in and out of the biological systems. Main purpose of this course is to enlighten the student about red-ox reactions occur in eukaryotic and vertebrate systems in fixing as well as dissipating the free energy. Animal physiology, on the other hand, discusses machinery evolved in animals, including digestive, circulatory and nervous systems, in utilizing the food produced by plants.

### Course objectives:

- An understanding of basic concepts about the classification of living world
- General understanding about how life originates and understanding diversity of living world
- Intellectual skills and vocabulary to read related scientific literature

### UNIT-I

Water relations: Cell water potential, soil plant atmosphere continuum. Photosynthesis: Light absorption, emission, energy transfer, Z-scheme of photosynthesis, electron transfer, photophosphorylation, CO<sub>2</sub> fixation in C<sub>3</sub>, C<sub>4</sub>, CAM plants, environment and its impact on photosynthesis.

### UNIT-II

Photorespiration: Respiration complexes, structure, function and regulation; cyanide resistant respiration. Plant hormones: Biosynthesis, transport, regulation and applications.

### UNIT-III

Composition of blood, coagulation of blood and fibrinolysis. Circulatory systems: general plan, electrical and mechanical properties of myogenic and neurogenic hearts. Heart - cycle including electrocardiogram, Hemodynamics. Cardiovascular response to extreme conditions like exercise, diving and hemorrhage. Neural control of cardiovascular system. Respiratory system: respiratory pigments, transport of gases in blood, regulation of body pH, respiratory response to extreme conditions like hypoxia, diving and exercise. Physiology of respiration and neural control of breathing.

### UNIT-IV

Structure of nerve cell, Origin of membrane potential, Mechanism of propagation of nerve impulse in unmyelinated and myelinated nerve fibres. Neuro transmitters. Structure and organization of muscle cells. Biochemical changes associated with muscle contraction and relaxation.

### UNIT-V

Gastrointestinal system: Functional structure of digestive glands - salivary glands, pancreas, liver, gastric and intestinal wall glands- neural and hormonal regulation of secretion of digestive juices. Digestion of food nutrients in different parts of the alimentary canal in animals. Absorption of food- the molecular structure of the absorptive surface. Assimilation of food, egestion. The peristaltic movements, their regulation and significance.

Excretory system: Functional anatomy of kidney - the nephron and its functions, the mechanism of urine formation and its concentration - the countercurrent theory, electrolyte balance, acid-base balance. The feedback and hormonal control of renal functions. Micturition

**Course outcomes:**

After completion of this course, the student will be able to

1. Importance of pigments in harvesting sun's energy; cyclic and non-cyclic photo-phosphorylations in generating useful form of energy
2. Explain how ion channels work and differentiate voltage gated and ligand gated channels
3. Mechanisms of producing action potential in nerve cells and its progression from CNS to the organ
4. How actin and myosin fibres organized in muscle cells and bring about muscle contraction and relaxation
5. Understand about the importance of different glands and their secretions in food digestion

**Recommended Books:**

1. Introductory Plant Physiology by GR Noggle & GJ Fritz, 2<sup>nd</sup> Edition, PHI learning Pvt.Ltd., New Delhi.
2. Text book of Medical Physiology by AG Guyton & JE Hall, 11<sup>th</sup> Edition, Harcourt, Asia.
3. Medical Physiology by Sembulingam.
4. Human Physiology by Ross & Wilson.
5. Text book of Medical Biochemistry by Chaterjee, Jaypee.
6. Harper's Biochemistry by RK Murray *et al.*, 30<sup>th</sup> Edition, McGraw Hill-Lange Publishers.

## **MARINE BIOTECHNOLOGY**

### **Preamble:**

This course aims at understanding how the living world can meet the food requirements. This course provides knowledge about ocean profile and rotation of required nutrients between ocean and its surrounding atmosphere. Management of aqua ponds, preservation of the crop after harvesting, gaining quality assurance during preservation for exports and to know about the measures being implemented by different Govt. agencies for the upliftment of fisher folk becomes possible with the present study.

### **Course objectives:**

1. An understanding of basic concepts about aquaculture practices.
2. General understanding about the maintenance of economically important aquatic animals to meet the food requirements of the living world
3. To gain intellectual skills to manage aqua ponds.

### **UNIT –I**

Chemical Composition of sea water. Biological features of the marine environment, Estuaries, Tropical shores and brackish water. Biogeochemical cycles in marine ecosystem.

### **UNIT –II**

General aquaculture practices - fish, shrimp and crab culture practices, induced breeding techniques - Hypophysation and Eyestalk ablation. Management of aquaculture farms – Feeding schedules, feed formulations, wet feeds and dry feeds. Fish byproducts. Economically important aquatic resources.

### **UNIT-III**

Mariculture: Culture of Lobsters, Mussel, Pearls, Oysters and Sea-weeds. Biology of estuaries – Estuarine adaptations, Coral reef communities and conservation methods.

### **UNIT-IV**

Post harvesting and preservation technologies – on board handling, drying and dehydration, salt curing, smoking, marinades, freezing, freeze drying, modified atmosphere packaging. Quality assurance.

### **UNIT-V**

Marine pollution- Causes and preventive measures, Role of government agencies – Role of NABARD and other central government agencies in the upliftment of fisher folk. The Marine Products Exports Development Authority (MPEDA), Integrated coastal zone management, ocean policy and Coastal regulatory zone (CRZ)

### **Course outcomes:**

1. Gain knowledge about physicochemical and biological features of different aquatic habitats.
2. Know about the cyclic movements of nutrients between oceanic water and its surrounding atmosphere.
3. Know about the maintenance of economically important aquaculture ponds.
4. Understand to produce aqua products to meet the food requirements.
5. Know the culture of different economically important sea products.
6. Understand how sea creatures are adapted for estuarine habitats.

### **Recommended Books:**

1. Elements of Marine Ecology Fourth Edition R.V. Tait F. A. Dipper 1998
2. Marine fisheries ecology by Simon Jennings, Michel J. Kaiser, 2001 by Blackwell Science Ltd, a Blackwell Publishing company
3. Aquaculture: Farming Aquatic Animals and Plants edited by John S. Lucas, Paul C. Southgate (2012), second edition; (Wiley Blackwell)
4. Post-harvest Technology of Fish and Fish Products by K. K. Balachandran, Daya publishinghouse.
5. Marine Fish Culture (1998) By John W. Tucker Jr. Springer publishers
6. Fish and Fisheries (2006) by By B. N. Yadav, DAYA publishing house
7. Induced Fish Breeding: A Practical Guide for Hatcheries (2017) By Nihar Ranjan Chattopadhyay, Academic Press.

## BTSC 2121: MEDICAL BIOTECHNOLOGY

**Preamble:** This course deals about different methodologies involved in the production of various health care products and helps us to understand about the process of tissue engineering. This course enlightens on hybridoma technology and basic and new generation strategies to design vaccines and specific attempts to prepare vaccines against some of the diseases challenging mankind and discusses the application of various molecular probes.

### Course objectives:

- This course helps us to understand about the production and applications of health care products and Hybridomas.
- Gives a view on the design of vaccines and problems associated with the development of vaccines against some of the diseases.
- This course critically examines the production of health care products and the mechanism of gene therapy
- Gives an overview of physiology of reproductive systems and various methodologies developed for *in vitro* fertilization

### UNIT – I

Vaccines: Active and Passive Immunization, Designing Vaccines for Active Immunization, Whole-Organism Vaccines, Purified Macromolecule Vaccines, Recombinant-Vector Vaccines, DNA Vaccines, Multivalent Subunit Vaccines. Edible vaccine, RNA vaccine, Strategies for development of vaccines against HIV and Malaria.

### UNIT – II

Hybridoma technology - Production and applications of monoclonal antibodies. Antibody engineering, chimeric antibodies. DNA in the diagnosis of diseases, Disease diagnosis using Enzyme probes. DNA fingerprinting and DNA profiling and application in forensic medicine.

### UNIT –III

Production of recombinant health care products- Insulin, growth hormone, factor VIII, tissue plasminogen activator, Urokinase, interferons, lymphokines and Hepatitis-B vaccine. Nanomedicine - Preparation of Nano particles for target based drug delivery.

### UNIT –IV

Gene Therapy: Ex vivo gene therapy- vectors in gene therapy, Therapy for Adenosine deaminase deficiency , Lesch-nyhan syndrome, hemophilia. In vivo gene therapy, gene delivery by viral and non viral vectors, Gene therapy for Cancer, AIDS. Antigene and antisense therapy.

### UNIT –V

In vitro fertilization in humans and Cattle- Types and causes of male and female infertility. Sperm collection and Cryopreservation. Artificial insemination, superovulation and Oocyte recovery. In vitro oocyte maturation. Embryo culture and transfer. Amniocentesis, Immunocontraception.

### Course outcomes:

On completion of this course, students should be able to:

1. Understand basics of Research and Development in the fields of medical biotechnology
2. Apply knowledge gained on various gene therapies in respective fields of pharmaceutical industry
3. Describe basic science behind the physiology of reproductive systems with special emphasis on IVF process

**Recommended Books:**

1. Molecular Biotechnology by Glick.
2. Gene cloning and DNA analysis an introduction by T.A. Brown (Blackwell).
3. Biotechnology by U. Satyanarayana.
4. Biotechnology and genomics by P.K. Gupta.
5. Biotechnology by B.D. Singh (Kalyani).

## **BTSC 3051: STEM CELL BIOLOGY**

### **Preamble:**

This course offers an opportunity to the students to understand the basics of stem cells, genetic manipulation of stem cells and their applications to various diseases affecting mankind.

### **Course objectives:**

- To provide students with basic understanding of Stem Cell biology and their applications
- To introduce students to regenerative medicine and tissue engineering.

### **UNIT-I**

Introduction to stem cells. Types-Embryonic, adult stem cells. Properties, potency, Differences and similarities in adult and embryonic stem cells. Stem cell niches. Stem cells localized in different tissues- Hematopoietic and Umbilical cord blood stem cells.

### **UNIT-II**

Isolation and characterization of stem cells. Stem cell markers. Mechanisms of self-renewal. Epigenetics in stem cells development. Transcriptional control of gene expression in ESC: role of miRNAs, Linc RNAs and RNA binding proteins. Cell cycle regulation in stem cells.

### **UNIT-III**

Tissue derivation from different germ layers. Induced pluripotency of stem cells, Markers and factors involved in induced pluripotency. Production of induced pluripotent stem cells-earlier attempts and recent advancements. Applications of iPSCs

### **UNIT-IV**

Tissue engineering. Autologous and Allogenic Stem Cell Transplantation, Stem cells in genetherapy. Applications of stem cells in regenerative medicine-neurodegenerative diseases, stroke, cardiac disorders, cancer, and diabetes.

### **UNIT-V**

Cryopreservation of stem cells. Stem cell banking. Clinical trials in stem cell research. Challenges and promises of stem cell applications in medicine and research. Ethical and regulatory issues involving stem cell research.

### **Course outcomes:**

By the end of this course, students will be able to:

- comprehend the concept of stem cells, different types of stem cells
- describe the concept of stem cell renewal, markers, and cell cycle regulation
- Explain how somatic cells can be made pluripotent and their uses
- recognize treatment of human diseases connected to stem cell therapy
- Understand the ethical, political and religious issues related to stem cell research

### **Recommended Books:**

1. Essentials of Stem Cell Biology by R Lanza & A Atala, 3rd Edition, Academic Press.
2. Stem Cells: Basics and Applications by KK Deb & SM Totey, Reprint 2009, Tata McGraw-Hill Education,.
3. Stem Cells: From Mechanisms to Technologies by MK Stachowiak & E Tzanakaki, World Scientific publishers



4. Principles of Tissue Engineering by R Lanza *et al.*, 4th Edition, Academic Press.
5. Stem Cell Anthology: From Stem Cell Biology, Tissue Engineering, Cloning, Regenerative
6. Medicine and biology by BM Carlson, Academic press.
7. Stem Cells: From Basic Research to Therapy, Volume I by F Calegari & C Waskow, 1st Edition, CRC Press.

## **BTSC 3061: BIOINFORMATICS**

### **Preamble:**

Bioinformatics is an information technology applied to the management and analysis of biological data with the aid of computers. It is the science of using information to understand biology. It is a field in which biological information collected, compared, studied and analyses to find the interrelation between them for solving structural, functional and evolutionary problems using computational technologies.

### **Course objectives:**

- The objective of this course is to provide theoretical and practical knowledge of the usage of computational tools and databases
- This course enables investigation of molecular biology and evolution-related ideas by using various tools and databases.

### **UNIT -I**

Scope of computers in biological research. Anatomy of computers and its accessories, types of computers. Introduction to networks (internet) and its applications. Introduction to Bioinformatics, history of Bioinformatics, branches of Bioinformatics, scope and research areas of Bioinformatics

### **UNIT -II**

Introduction to Biological Databases, Classification of Biological Databases, National Center for Biotechnology Information (NCBI), EMBL Nucleotide Sequence Database (EMBL-Bank), DNA Data Bank of Japan (DDBJ). Protein Information Resource (PIR), UniProt, TREMBL, Protein Data Bank (PDB), Human genome data base.

### **UNIT -III**

Concept of Alignment, Pairwise Alignment, Multiple Sequence Alignment (MSA), MSA by CLUSTALW, Scoring Matrices, Point Accepted Mutation (PAM), Blocks of Amino Acid Substitution Matrix (BLOSUM).

### **UNIT -IV**

Methods of Phylogeny- Distance based and character-based methods. Software for Phylogenetic Analyses, Consistency of Molecular Phylogenetic Prediction.

### **UNIT -V**

Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Introduction to genomics, Genome Annotation: Pattern and repeat finding, Gene identification tools. Introduction to proteomics.

### **Course outcomes:**

By the end of this course, the student will be able to

1. Acquire basic knowledge about the bioinformatics and its scope in biology and allied fields that are useful in biological research
2. Gain knowledge of various biological databases and their uses in research.
3. Be acquainted with the sequence alignment and its variants and its role in constructing phylogenetic trees.
4. Be acquainted with the genome annotation and gene identification using dry-lab techniques
5. Comprehend various methods in phylogenetic tree construction and their importance

### **Recommended Books:**

1. Essential Bioinformatics by Jin Xiong, Reprint 2011(Cambridge University Press).
2. Biological Sequence Analysis by Richard Durbin, Sean R. Eddy, Anders Krogh, Graeme Mitchison, Indian Reprint (Cambridge University Press).
3. An Introduction to Bioinformatics by T. K. Attwood and D. J. Parry-Smith Addison, Reprint 2011 (Wesley Longman, Harlow).
4. Introduction to Bioinformatics by Arthur M. Lesk, 3rd Edition (Oxford University Press).
5. Bioinformatics: Sequence and Genome Analysis by David W. Mount, 2nd Edition (Cold Spring Harbor Laboratory Press).

## **BTSC 3071: VIRAL PATHOLOGY**

**Preamble:** This course has been designed to introduce the field of Virology and help students to acquire sufficient level of knowledge, skills and aptitude in all aspects of the epidemiology, prevention, diagnosis and management of infections and communicable diseases related to Viruses. Moreover, this course imparts knowledge about the morphological, and physiological features among diverse plant and animal viruses and also different kinds of control methods. Furthermore, the course inculcates the student's about various techniques to purify, inactivate and diagnostic methods, and cultivation of viruses in laboratory.

### **Course objectives:**

- The objectives of this course is to introduce field of Virology with special emphasis on history, structure and classification of viruses.
- To impart knowledge on interaction of virus and host, pathogenesis of various viral infections
- To familiarize with the methods to culture viruses, purify and inactivation of viruses
- To impart knowledge on epidemiology and emerging and reemerging of viruses and diagnostic methods for their early detection.
- To understand the life cycle of clinically important viruses and prions.

### **UNIT- I**

History and development of viruses; Nature, origin of viruses; ICTV; Nomenclature, and Baltimore classification of viruses; Virus structure; capsid symmetry types; quasi equivalence; characteristics of viruses.

### **UNIT- II**

Isolation, cultivation and quantification of viruses; Purification and inactivation of viruses - physical and chemical methods. Animal viruses and their interactions with hosts; Host resistance and viral evasion mechanisms.

### **UNIT- III**

Molecular mechanisms of viral pathogenesis with respect to poliovirus, influenza, rotavirus, herpes virus, Hepatitis B Virus and HIV; laboratory diagnosis of viral diseases; new and emerging viruses (Ebola, Zika, Corona), Anti viral agents

### **UNIT- IV**

Virus replication and genome expression, assembly of TMV; replication of  $\Phi$ X174, coliphage fd, coliphage  $\lambda$ , and T4 bacteriophage. Molecular mechanisms of phage interaction with bacterial cells.

### **UNIT- V**

Transmission of viruses (Direct and Indirect) persistence of viruses and their mechanism; Virus ecology evolution and epidemiology; Structure, life cycle and patho physiology of infectious molecules – Prions & viroids.

**Course outcomes:**

By the end of this course, the student will be able to

1. Acquire knowledge regarding history, origin and evolution of viruses
2. Learn different methods of isolation and cultivation of viruses
3. Understand better the process of viral infections with host
4. Understand the viral evasion mechanisms
5. Understand the molecular mechanism of leading viral pathology and diagnosis and epidemiology of viral infections
5. Understanding the structure and life cycle of Prions and viroids

**Recommended Books:**

1. Microbiology – An Introduction (2020) by Tortora, Funk & Case, 13th Edition, Pearson education.
2. Introduction to Modern Virology, Basic Microbiology by N Dimmock, A Easton & Keith Leepard, 6th Edition, John Wiley and Sons
3. Principles of Virology by SJ Flint, 3rd Edition, ASM Press
4. Brock Biology of Microorganisms (2018) by Michael T Madigan & Kelly S Bender, 15th Edition, Pearson education
5. Virology: Principles and Applications by John Carter & Venetia A Saunders, John Wiley & sons.
6. Fundamentals of molecular virology, 2nd ed.: Hoboken, NJ: John Wiley & Sons, c2011

## **BTSC 3081: MOLECULAR DIAGNOSTICS**

**Preamble:** Molecular Diagnostics are the tools which are based on the principles of Molecular Diagnosis. It is the process of identifying a disease by understanding the molecules, such as proteins, DNA, and RNA, in a tissue or fluid, which forms the markers of the diseases directly or indirectly. Molecular diagnostics is a new discipline that captures genomic and proteomic expression patterns and uses the information to distinguish between two or more conditions at the molecular level. The course focuses on learning and understanding how the various molecular techniques can be developed and utilized in diagnosis.

### **Course objectives:**

- To introduce biochemistry and diagnostic tools for different disease models.
- To familiarize students with genomic instability and gene mapping
- To impart knowledge concerning molecular tools used for the diagnosis.
- To describe the properties of a biomarker.
- To introduce the concepts of immunotherapy and immunodiagnostics.

### **UNIT-I**

History of diagnostics, Age of molecular diagnostics, Significance, Scope, Rise of diagnostic industry in Indian and global scenario. Biochemical tests for detection and quantification of sugar, albumin, urea, protein, globulin, vitamin. Biochemistry and diagnostic tests of following diseases - Duchenne Muscular Dystrophy (DMD), Creatine phosphokinase-(CPK), Phenylketonuria-PKU (phenylketone), G6PD deficiency syndrome (G6PD), Mucopolysaccharidosis, Endocrine disorders related to thyroid and reproduction (TSH, T3, T4, Estradiol, Testosterone, LH, FSH).

### **UNIT-II**

Mechanism and factors involved. Common fragile sites and methods of induction. Heritable fragile sites. Trinucleotide Repeats. Mechanism of expansion and triplet repeats and related disorders. Genetic linkage maps. Diseases resulting from Chromosomal Aberrations.

### **UNIT-III**

DNA Extraction Methodologies, DNA Quantitation, Capillary Electrophoresis. DNA based Techniques in the diagnosis of diseases-Hybridization, PCR and RT PCR. RNA signature-based methods in detection of different diseases. Protein and DNA microarrays in diagnosis.

### **UNIT-IV**

FDA definition of disease markers, Role of markers in Disease diagnosis. Approaches and methods in the identification of disease markers, predictive value, diagnostic value, emerging blood markers for sepsis, tumour & cancer markers, markers in inflammation and diagnosis of cytoskeletal disorders.

### **UNIT-V**

HLA typing, Immunotherapy and immunodiagnostics, antigen-antibody binding interactions and assays; antibodies polyclonal and monoclonal antibodies, Immunoassays – types RIA, ELISA, western blotting and specific applications. Immunodiagnostic methods for detection of microbial infections-WIDAL and VDRL.

**Course outcomes:**

After completion of this unit, the student will be able to

1. Understand different mechanism of genomic instability
2. Understand the molecular mechanism behind the onset of fragile sites
3. To perform genetic mapping in *Drosophila*
4. Understand the role of biomarkers in Disease diagnosis.
5. Understand the principle of different molecular methods used for the disease diagnosis.
6. Analyse different types of PCR.
7. Understand the principle of hybridoma technology.

**Recommended Books:**

1. Medical Biotechnology by Bernard Glick, Terry L delovitch, Cheryl L Patten
2. Molecular biology of the cell. Bruce Alberts, 6th Edition
3. Molecular Cell Biology: Darnell J, Lodish H and Baltimore D
4. An introduction to Human Molecular Genetics by Pasternak et al., Wiley Pubs
5. Human Chromosomes by Miller & Tharman, Springer Publishing Company
6. Genes XII, by Lewin B, Pearson India

## **BTSC 3091: FOOD BIOTECHNOLOGY**

### **Course objectives:**

- To demonstrate a level of comprehension of concepts of food science. Critically evaluate and solve issues or problems pertaining to food science.
- To familiarize students with the concept of energy and energy content of foods.
- To impart knowledge concern in the microorganisms in foods and various factors affecting their growth and microbial food borne diseases.
- To introduce nutritive value of food concept and food additives.
- To familiarize students about applications of enzymes in food industry.
- To familiarize students regarding regulatory aspects of food biotechnology, food safety, food quality and quality assurance.

### **UNIT-I**

Energy: Energy content of foods - physiological fuel value - review. Measurement of energy expenditure:

BMR, RMR, thermic effect of feeding and physical activity, methods of measurement. Estimating energy requirements of individuals and groups.

### **UNIT-II**

Microorganisms in foods. Factors affecting the microbial growth. Microbial food borne diseases. Food poisoning, control measures for food poisoning out breaks. Analysis of microorganisms and their products in foods, Fermented foods, role of microbes in fermented foods and genetically modified foods.

### **UNIT-III**

Food groups, functions of foods. Nutritive value, composition, storage and preservation of cereals, pulses, nuts & oil seeds, milk & milk products, egg, fish, meat, vegetables, fruits, sugars, fats and oils. Food additives: Synthetic & natural colorants, natural & artificial sweeteners, stabilizers and emulsifiers.

### **UNIT-IV**

Applications of enzymes in food industry: Amylases, Proteases, Lipases, Glucose isomerase, lactase, pectinase and renin in food industry. Production of bread, cheese, idly, beverages and appetizers. Food packaging methods and materials.

### **UNIT-V**

Functional foods: Advances in Biotechnology for the production of functional foods; Regulatory aspects of food biotechnology; Future strategies for development of biotechnology-enhanced functional foods for human nutrition. Food safety, evaluation of food quality and quality assurance (PFA, FSSAI, HACCP, ISO and FSO systems).

### **Course outcomes:**

After completion of this unit, the student will be able to

1. Understand the fundamentals of food biotechnology
2. Identify the concept of Estimating energy requirements



3. Learn Factors affecting the microbial growth and Microorganisms in foods
4. Understand the concept of Fermented foods and genetically modified foods
5. Understand the role of stabilizers and emulsifiers
6. Comprehend various food packaging methods and materials used
7. Understand the regulatory aspects of food biotechnology.

**Recommended Books:**

1. Text book of Human Nutrition by Mehtab S Bamji, 3<sup>rd</sup> Edition, Oxford and IBH publishing Pvt. Ltd.
2. Food Processing Principles & Applications by Ramaswamy & Marcotte , Taylor and Francis-CRC Publications.
3. Food Packaging: Principles and practice by GL Robertson, 3<sup>rd</sup> Edition, Taylor and Francis group.
4. Food Chemistry by Meyer LH, Affiliated East and west Press Ltd., Bombay, 1987.
5. FSSAI Training manual.
6. Nutrition Science by B Srilakshmi, 2<sup>nd</sup> Edition, New Age International Publishers Pvt. Ltd.
7. Food Science by B Srilakshmi, 2<sup>nd</sup> Edition, New Age International Publishers Pvt. Ltd.
8. Food facts and Principles by N Shakuntala Manay & M Shadakshara Swamy, New Age International Publishers Pvt. Ltd., 1987.
9. Food Microbiology by Frazier, 4<sup>th</sup> Edition, WC McGraw-Hill Incorporation.