

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

Accredited by NAAC with A⁺ Grade



CURRICULUM AND SYLLABUS

of

B.Sc. Biochemistry

(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>

Program Educational Objectives (PEOs)

B.Sc., Biochemistry science graduates, within three years of graduation should

1. Exhibit an ability to apply fundamental knowledge related to biochemical sciences in an interdisciplinary manner for providing solutions to need based problems.
2. Engross an ability to decisively analyze scientific data, draw objective inferences and apply this knowledge for human welfare.
3. Be able to demonstrate proficiency and ethical perception on areas relevant to Biochemistry.
4. Acquire communication skills and exhibit commitment towards teamwork which is necessary for functioning productively and professionally on multidisciplinary fields of Biochemistry.

Program Objectives (PO)

At the end of this program, the student will be able to

- PO 1:** Understand various aspects of biomolecules and an overview of their metabolic events
- PO 2:** Understand various aspects of cell, cellular events, and genetic basis of life.
- PO 3:** Gain knowledge in conventional techniques, modern analytical techniques, omics, bioinformatic approaches and nanotechnologies.
- PO 4:** Acquaint the principles of enzymology, kinetics and their applications in industry and medicine
- PO 5:** Gain an overview of the organization of vital physiological systems, their function and abnormalities in both animal and plant systems
- PO 6:** Gain theoretical and practical knowledge of genome, expression of genes and, their regulation, repair and application of rDNA technology for superior traits.
- PO 7:** Understand various clinically important microorganisms; and the elicitation and regulation of immune response.
- PO 8:** Gain knowledge of microorganisms and bioprocess technologies with reference to production of enzymes, vitamins, antibiotics and organic acids.
- PO 9:** Acquire knowledge regarding ethical conduct of research, clinical trials, economic, political, ELSI of the HGP
- PO 10:** Acquaint and apply intellectual property rights (IPR) principles to real problems and analyse the social impact
- PO 11:** Gain knowledge in diagnosis, prognosis and management of various diseases and addressing clinical problems
- PO12:** Understand and apply techniques in biological research and in discovery of new products.

Program Specific Outcomes (PSOs)

- PSO 1:** Gain knowledge and insights on various aspects of Biochemistry
- PSO 2:** Apply knowledge, tools and techniques for solving biochemical problems
- PSO 3:** Acquaint Central Dogma of life and understands the various facets of Molecular Biology

CURRICULUM STRUCTURE OF B.Sc. BIOCHEMISTRY

(2021-22 ADMITTED BATCH)

University Core (UC)

Course code	Level	Course title	L	T	P	S	J	C
CSEN1001	1	IT Productivity Tools^	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^	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

^ 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
BCBI1001	1	Biomolecules	3	0	0	0	0	3
BCBI1011	1	Biochemistry Lab	0	0	0	0	2	1
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
BCBI2011	2	Metabolism and Bioenergetics Lab	0	0	2	0	0	1
BCBI2021	2	Biochemical Techniques	3	0	0	0	0	3
BCBI2031	2	Biochemical Techniques Lab	0	0	2	0	0	1
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
BCBI3011	3	Genetic Engineering Lab	0	0	2	0	0	1
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
BCBI3051	3	Immunology Lab	0	0	2	0	0	1

Programme Elective (PE)*

Course code	Level	Course title	L	T	P	S	J	C
BCBI2061	2	Industrial Biochemistry	3	0	0	0	0	3
BCBI2091	2	Industrial Biochemistry Lab	0	0	2	0	0	1
BCBI2071	2	Molecular Cell Biology	3	0	0	0	0	3
BCBI2101	2	Molecular Cell Biology Lab	0	0	2	0	0	1
BCBI2081	2	Bioinformatics	3	0	0	0	0	3
BCBI2111	2	Bioinformatics Lab	0	0	2	0	0	1
BCBI2121	2	Human Physiology and Nutrition	3	0	0	0	0	3
BCBI2131	2	Plant Biochemistry	3	0	0	0	0	3
BCBI2141	2	Genomics and Proteomics	3	0	0	0	0	3
BCBI2151	2	Genetics	3	0	0	0	0	3
BCBI2161	2	Functional Foods and Nutraceuticals	3	0	0	0	0	3
BCBI2171	2	Introduction to Nanobiology	3	0	0	0	0	3
BCBI3061	3	Applied Biochemistry	3	0	0	0	0	3
BCBI3151	3	Molecular Modeling and Structural Bioinformatics	3	0	0	0	0	3
BCBI3081	3	Basics of Cancer Biology	3	0	0	0	0	3
BCBI3091	3	Stem cell Biology	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 BCBI2061 then he/she has to study BCBI2091 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 Biochemistry Program

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

Minor courses in Biotechnology

Course code	Level	Course title	L	T	P	S	J	C
BTSC1021	1	Cell Biology	3	0	0	0	0	3
BTSC1031	1	Cell Biology Lab	0	0	2	0	0	1
BTSC2011	2	Bioanalytical Techniques	3	0	0	0	0	3
BTSC2001	2	Enzymology & Metabolism	3	0	0	0	0	3
BTSC3011	3	General Immunology	3	0	0	0	0	3
BTSC2041	3	Molecular Biology & rDNA technology	3	0	0	0	0	3
BTSC2031	3	Molecular Biology & rDNA technology Lab	0	0	2	0	0	1
BTSC3001	3	Plant & Animal Biotechnology	3	0	0	0	0	3
BTSC3021	3	Plant & Animal Biotechnology Lab	0	0	2	0	0	1
BTSC3041	3	Industrial Biotechnology	3	0	0	0	0	3
* Eligibility: This minor course is offered to the students of B.Sc Biochemistry/ Microbiology/ Food Science & Tech/ Environmental Science/Chemistry.								

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

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

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 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 .
- 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
- learnenglishteens.britishcouncil.org
- <https://eslflow.com/>
- <https://www.englishclub.com/>
- <https://www.oxfordlearnersdictionaries.com/>
- <https://dictionary.cambridge.org/>
- 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
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

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

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

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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
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

Unit	Topics	Hours
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 & 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
	Total Hours	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
	Total Hours	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, Specify 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)

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

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

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

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.

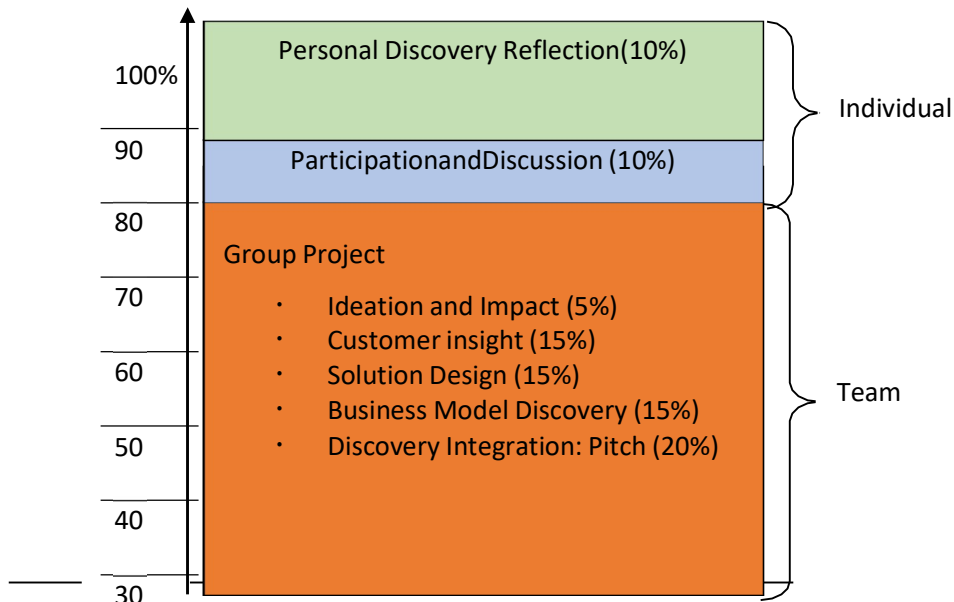
“Design” is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

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 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%
(1st 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

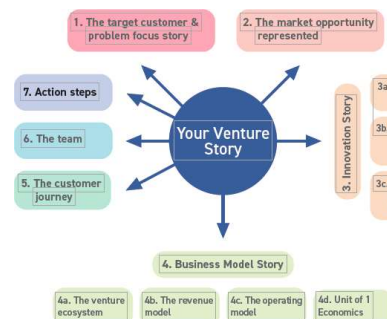
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
1	1	Course Overview	<ol style="list-style-type: none"> 1. Why is entrepreneurship important? 2. What is Personal Discovery through Entrepreneurship? 3. Four Stages; Personal Discovery, Solution Discovery, Business Model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

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

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

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

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

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

Course Outcomes

- Identify one's values, passions, skills and their will to contribute to society
- Formulate an idea and validate it with customers
- Demonstrate prototyping and analyze the competition for the product
- Create business models for revenue generation and sustainability of their business
- 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

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 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

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 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

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

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

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

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

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

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

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

L	T	P	S	J	C
3	0	0	0	0	3*

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, 2nd Edition. Cengage Learning India. 2012.

Additional Reading

1. Benny Joseph. Textbook of Environmental Studies 3rd 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. 6th Edition. 2017.
2. Botkin D.B. Environmental Science: Earth as a Living Planet. John Wiley and Sons. 5th 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)

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

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)

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

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)

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

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)

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

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.

FACULTY CORE:

CHEM1011: CHEMISTRY – I

L	T	P	S	J	C
3	0	0	0	0	3

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.

Course outcomes

UNIT - I	Inorganic Chemistry-1	No of Hours : 9L
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 ψ and ψ^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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	learn about the fundamental assumptions of atomic theory	L3
•	Explain the composition of atoms including electronic configuration	L3
•	Learn quantization of energy and determine electronic configuration of atoms and ions	L2
•	Learn Schrodinger equation and its significances	L5
•	Represent different atomic orbitals	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT - II	Inorganic Chemistry-1	No of Hours : 9L

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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	The students will learn about ionic, covalent bonding in molecules.	L3
•	Compare/contrast the properties of molecular and ionic compounds.	L3
•	Draw homonuclear & heteronuclear diatomic molecules	L2
•	Learn shapes of covalent on the basis of VSEPR and hybridization	L5
•	Calculate lattice energy using Born-Haber cycle Born-Landé equation	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT - III	Organic Chemistry-1	No of Hours : 9L
Fundamentals of Organic Chemistry Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. 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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	The students learn about the fundamental concepts of reaction mechanism.	L3
•	To learn reactive species in organic chemistry	L3
•	To learn concept of aromaticity	L2
•	To learn various organic intermediates	L5
•	Compare the Strength of organic acids and bases	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT - IV	Organic Chemistry-1	No of Hours : 9L
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).		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	The student shall learn the essential concepts of chirality, configuration and isomerism	L3
•	The student shall learn nomenclature of isomers in organic chemistry	L3
•	Students learn different representations	L2
•	Students will familiarize with the elementary concept of saturated aliphatic hydrocarbons	L5
•	Students will learn various chemical properties	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT - V	Organic Chemistry-1	No of Hours : 9L

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 dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction).		
Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition).		
Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes;		
Reactions: formation of metal acetylides, addition of bromine.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	The students will learn synthetic reactions	L3
•	To learn various reaction mechanisms	L3
•	To learn properties of aromatic alcohol, aromatic and aliphatic ether, aldehydes and ketones.	L2
•	To learn acidity of alkenes and alkynes	L5
•	To learn synthesis and reactions of alkenes and alkynes.	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
Textbook(s):		
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. In organic 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		

CHEM1031: CHEMISTRY – II

L	T	P	S	J	C
3	0	0	0	0	3

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

1. To introduce the concept of solution and phase chemistry in physical chemistry
2. To introduce functional group chemistry in organic chemistry
3. To impart knowledge on the essential functional groups in organic chemistry.
4. To impart knowledge on the essential functional groups reactions
5. To impart knowledge on the essential functional groups properties

Course outcomes:

UNIT – I	Section A: Physical Chemistry-1	No of Hours: 9
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. Lever rule. 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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	Comprehend the thermodynamics of ideal solutions	L2
•	Draw the vapour pressure-composition and temperature composition curves of ideal and non-ideal solutions.	
•	Learn the principle behind distillation of solutions	L1
•	learn about the essential concepts important principle and terms of phase rule.	L3
•	apply phase rule to one component and two component systems	L3
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT - II	Title Conductance	No of Hours: 9
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).		

Learning Outcomes:		
After completion of this unit, the student will be able to		
•	Learn Transference number and its experimental determination	L5
•	Apply 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.	L1
•	learn the elementary concepts of conductance and electrochemistry.	L3
•	learn the applications of Kohlrausch law.	L3
•	Calculate thermodynamic properties: G, H and S from EMF data.	L2
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT – III	Section B: Organic Chemistry-3	No of Hours: 9
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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	learn the concept of synthesis and reactions carboxyl Functional group	L3
•	learn the concept of synthesis and reactions carboxyl Functional group derivatives.	L3
•	learn the concept of synthesis and reactions amine Functional group and derivatives	L2
•	learn the concept of synthesis and reactions diazonium Functional group and derivatives.	L5
•	learn the special named reactions of carboxyl, amine functional groups.	L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT – IV	Amino Acids, Peptides and Proteins	No of Hours: 9
Preparation of Amino Acids: Strecker synthesis using Gabriel's phthalimide synthesis. Zwitter ion, Isoelectric point and Electrophoresis.		
Reactions of Amino acids: ester of –COOH group, acetylation of –NH ₂ 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) & C activating groups and Merrifield solid-phase synthesis.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
•	learn the elementary reactions and properties	
•	mechanism of amines and diazonium salts	L3
•	learn the concept of applications of diazonium salts in synthetic organic chemistry.	L2
•	familiarize with synthetic approaches to simple amino acids and concept of proteins.	L5
•	familiarize with concept of proteins, their structures.	
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
UNIT – V	Carbohydrates	No of Hours: 9
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.	
Learning Outcomes:	
After completion of this unit, the student will be able to	
•	learn about the classification of carbohydrates. L3
•	learn general properties of carbohydrates. L3
•	familiarize with the structure of mono, di and polysaccharides L2
•	learn about the ascending and descending in monosaccharides L5
•	familiarize the reactions and properties of mono, di and polysaccharides L1
Pedagogy tools: Blended learning, Case let, video lectures, self-reading	
Textbook(s):	
1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).	
2. Morrison, R. T. & Boyd, R. N. Organic Chemistry,	
3. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
4. 3. Finar, I. L. Organic Chemistry (Volume 1),	
5. Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).	
6. 4. Finar, I. L. Organic Chemistry (Volume 2),	

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

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

CSCI1001: BASICS OF INFORMATION TECHNOLOGY

L T P S J C
3 0 0 0 0 3

Introduction

Course objective

Course outcome

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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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, Audio Output.		
Learning Outcomes:		

After completion of this unit, the student will be able to		
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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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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Textbook(s):		
1. 1.Introduction to Information Technology by V. Rajaraman, PHI Learning Pvt.Ltd. 2013.		
Reference Books:		
1. Computing Fundamentals by Peter Norton, Tata Mc. Graw Hill, 6 th edition, 2006.		
2. Fundamentals of Computers by E.Balagurusamy, Tata McGraw Hill, 2009		

CHEM1021: CHEMISTRY - I LAB

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

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.

Course outcome

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 KMnO_4 .
3.	Estimation of water of crystallization in Mohr's salt by titrating with 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 $\text{Na}_2\text{S}_2\text{O}_3$.
Learning Outcomes:	
After completion of this unit, the student will be able to	
•	The student will learn about the quantitative analysis concepts of redox chemistry
•	Separate mixtures of Sodium carbonate and Sodium hydrogen carbonate
•	Determine strengths of solutions of oxalic acid and water of crystallization in Mohr's salt with KMnO_4 .
•	Determine strengths of Fe(II) solutions with $\text{K}_2\text{Cr}_2\text{O}_7$
•	Determine strengths of Cu(II) solutions iodometrically with $\text{Na}_2\text{S}_2\text{O}_3$
Pedagogy tools: Blended learning, Case let, video lectures, self-reading	
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.
Learning Outcomes:	
After completion of this unit, the student will be able to	
•	Detect heteroatoms (N, S, Cl, Br, I) in organic compounds
•	Separate amino acids with paper chromatography
•	Separate sugars with paper chromatography

Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
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.	

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

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

CHEM1051: CHEMISTRY – III

L	T	P	S	J	C
3	0	0	0	0	3

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)

UNIT – I		
Evaluation of analytical data: 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.		
Learning Outcomes:		
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.	
UNIT - II		
UV-Visible spectrophotometry: 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 (Fe^{2+} , Ni^{2+}) and anions (PO_4^{3-} , NO_3^-).		
Learning Outcomes:		
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)
UNIT – III	
Flame Emission and Flame Absorption Spectrometry: 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.	
Learning Outcomes:	
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.
UNIT – IV	
Electroanalytical methods: Basic principle, Instrumentation and applications of pH metric, potentiometric and conductometric titrations.	
Learning Outcomes:	
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)
UNIT – V	
Separation techniques	
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.	
Chromatography: Principle and classification of the technique. Mechanism of separation: adsorption and partition. Development of chromatograms	
Learning Outcomes:	
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)
Textbook(s):	
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.	

PHYS1091: BIOPHYSICS

L T P S J C
3 0 0 0 0 3

Introduction

Course objective

Course outcome

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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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.		
Learning Outcomes:		
After completion of this unit, the student will be able to		
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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	
Learning Outcomes:	
After completion of this unit, the student will be able to	
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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.	
Learning Outcomes:	
After completion of this unit, the student will be able to	
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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 th 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 st Edition, CRC press.	

CHEM1041: CHEMISTRY - II LAB

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

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. 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.

Course outcomes

Section A: Physical Chemistry	
Distribution Study of the equilibrium of one of the following reactions by the distribution method: $I_2(aq) + I^-(aq) \rightleftharpoons I_3^-(aq)$ $Cu^{2+}(aq) + xNH_3(aq) \rightleftharpoons [Cu(NH_3)_x]^{2+}$	
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	
Learning Outcomes:	
After completion of this unit, the student will be able to	
•	learn determination of conductance, cell constant. L3
•	apply the concepts of electrochemistry for redox titrations by instrumental methods of analysis L3
•	construct phase diagrams L1 Perform the following conductometric titrations
•	Perform the following conductometric titrations L5

•	learn determination of conductance, cell constant.	L3
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
Section B: Organic Chemistry I		
Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.		
Organic Chemistry 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.	
Learning Outcomes:		
After completion of this section, the student will be able to		
•	analyse an unknown organic compound having monofunctional group in a systematic	L3
•	Prepare derivatives of -COOH, phenolic, aldehydic, ketonic, amide, nitro, amines	L3
•	learn separation of amino acids by paper chromatography	L1
•	plot the Titration curve of glycine	L2
Pedagogy tools: Blended learning, Case let, video lectures, self-reading		
Textbook(s):		
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.		
Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.		
Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).		
Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press		

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

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

PHYS1101: BIOPHYSICS LAB

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

Introduction

Course objective

Course outcomes

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
Learning Outcomes:	
After completion of this unit, the student will be able to	
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Reference book(s):	
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.
4.	Drenth, J. (2010) Principles of Protein X-ray Crystallography, Spri

PROGRAMME CORE:

BCBI1001 BIOMOLECULES

L	T	P	S	J	C
3	0	0	0	0	3

Course Description:

Biochemistry is a discipline, which aims at understanding the chemical properties of the biomolecules, their structural architecture, principles of stereochemistry and molecular forces responsible for the activities of biomolecules. The course includes their importance in understanding various bio molecular reactions and how they fold to their native, functional forms.

Course Objectives

- To understand the role of water, pH, buffers & osmotic pressure in biological system
- To understand the structural and biological roles of carbohydrates (Mono, oligo, polysaccharides).
- To gain the concept of lipids, their biological and chemical roles.
- To acquire and understand the structures of DNA and RNA, sequence determination and synthesis.
- To study the structure & biological role of porphyrins and to remember chemistry and physiological role of vitamins.

UNIT – I

Biophysical Concepts: Basic classification of biomolecules, Role of water in biological processes. Biological importance of pH, pKa of functional groups in proteins and nucleic acids. Importance of buffers in biological systems. Significance of osmotic pressure in biological systems

Learning outcomes:

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

- Understand the classification of biomolecules
- Describe the role of water in biological processes
- Describe the biological role of pH, pKa of functional groups
- Understand the importance of buffers in biological buffers
- Understand the significance of osmotic pressure in biological systems

UNIT – II

Carbohydrates: Classification, monosaccharides, D and L designation, open chain and cyclic structures, epimers and anomers, mutarotation, reactions of carbohydrates. Structure and

biological importance of disaccharides (sucrose, lactose, maltose). Biological importance of structural polysaccharides (cellulose) and storage polysaccharides (starch, glycogen).

Learning outcomes:

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

- Understand the classification and chemical properties of carbohydrates
- Describe the chemistry and biological roles of mono and disaccharides
- Describe the structure and role of homo, heteropolysaccharides
- Understand the structure and biological role of peptidoglycans, glycosaminoglycans and glycoproteins
- Elucidate the structure of starch

UNIT – III

Lipids: Classification, saturated and unsaturated fatty acids, structure and properties of fats and oils. General properties and structures of phospholipids, sphingolipids and cholesterol. Biomembranes - Behavior of amphipathic lipids in water. Formation of micelles, bilayers, vesicles, liposomes.

Learning outcomes:

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

- Know the classification and properties of fatty acids, fats and oils
- Describe the chemistry and biological roles of phospholipids in membranes
- Describe the biological roles of phospholipids and sphingolipids
- Understand the biological role of prostaglandins
- Explain the structure and properties of cholesterol

UNIT-IV

Nucleic Acids: Structure of purines and pyrimidines, nucleosides, nucleotides. Importance of phosphodiester bond. Watson-Crick DNA double helix structure, Types of RNA and DNA. Effect of acids, alkali and nucleases on DNA and RNA. Denaturation of nucleic acids. Structure and properties of porphyrins

Learning outcomes:

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

- Know the structure and properties of bases, nucleosides, nucleotides
- Understand the importance of phosphodiester bond
- Understand the structure of DNA, RNA and its forms

- Learn the effects of acids, alkali and nucleases on DNA and RNA
- Know the structure and biological role of porphyrins – Heme

UNIT-V

Basic structure of Bacteria, plant and animal cell. Membrane composition and organization, Fluid mosaic model. Structure and functions of cell organelles – Mitochondria, Chloroplast, Endoplasmic reticulum, Nucleus, Golgi body.

References:

1. Textbook of Biochemistry by West and Todd, Oxford and IBH, 4th Ed.
2. Principles of Biochemistry by Nelson and Cox, Freeman, 4th Ed.
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Outlines of Biochemistry by Conn and Stumpf, John Wiley and Sons, 5th Ed

BCBI 1011-BIOCHEMISTRY LAB

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

Course description: Biochemistry is a discipline, which aims at understanding the chemical properties of the biomolecules, their structural architecture, principles of stereochemistry and molecular forces responsible for the activities of biomolecules. This course includes preparation of buffers and identification of various biomolecules like carbohydrates, lipids etc using biochemical tests.

Course objectives:

- To prepare various buffers and determine their pH.
- To perform qualitative identification of various carbohydrates like glucose, fructose etc.
- To prepare osazones.
- To qualitatively identify lipids based on their biochemical properties.
- To find out the absorption maxima of colored substances.

List of experiments:

1. Preparation of buffers (acidic, neutral and alkaline) and determination of pH.
2. Qualitative identification of carbohydrates- glucose, fructose, ribose/xylose, maltose, sucrose, lactose, starch/glycogen.
3. Preparation of osazones and their identification.
4. Qualitative identification of lipids- solubility, saponification, acrolein test, Salkowski test, Lieberman-Burchard test.
5. Absorption maxima of colored substances- *p*-Nitrophenol, Methyl orange.

Course Outcomes:

- Learn prepare various buffers and determine their pH.
- Perform qualitative identification of various carbohydrates like glucose, fructose etc.
- Prepare osazones of various carbohydrates and learn their identification.
- Qualitatively identify lipids based on their biochemical properties.
- Analyse the absorption maxima of colored substances.

References:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

BCBI1021: PROTEIN CHEMISTRY AND ENZYMOLOGY

L	T	P	S	J	C
3	0	0	0	0	3

The course deals with basic chemistry of amino acids and protein with their specific reaction mechanisms. The courses more emphasize on the role of protein as enzymes with their classification, kinetics of enzyme action and mechanism of enzyme catalysis

Course Objectives:

- To explain the amino acid reactions and formations of peptide bonds
- To impart knowledge on proteins properties and structural organization of protein structure
- To provide the details about the enzyme classification and enzyme characteristics
- To describe enzyme action using the kinetics
- To deliver molecular mechanism of enzyme catalysis

Unit-I

Amino Acids and Peptides: Classification, structure, chemical reactions of amino acids due to carbonyl and amino groups. Essential and non-essential amino acids, Peptide bond - nature and conformation.

Learning outcomes:

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

- Illustrate the classification, structure of amino acids (L2) .
- Explain the specific reactions of amino acids (L2).
- Understand the importance of essential and non-essential amino acids(L2).
- Draw the peptide bond structure and conformation (L2).
- Outline the amino acid role in biological functions (L2).

Unit-II

Proteins: Classification based on solubility, shape, and function. General properties of proteins, denaturation and renaturation of proteins. Structural organization of proteins- primary, secondary, tertiary and quaternary structures (Eg. Hemoglobin).

Learning outcomes:

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

- Illustrate the classification of proteins (L2).
- Outline the properties and functions of proteins(L2).
- Understand the higher order protein organization and the structure stabilizing factors(L2).
- Identify the different protein structures with examples(L3).
- Corelate the protein structural organization to its biological functions (L2).

Unit-III

Enzymes – Classification. Enzyme specificity. Active site. Activation energy, transition state. Lock and key and induced fit models. Definition of holo-enzyme, apo-enzyme, coenzyme, cofactor. Fundamentals of enzyme assay, enzyme units.

Learning outcomes:

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

- Illustrate the enzyme classification (L2).
- Explain the different functional attributes of enzyme components (L2).
- Outline the enzyme characteristics and enzyme assay procedures (L2).
- Describe the fundamental models of enzyme-substrate interaction (L2).
- Identify the enzyme by the reaction catalysed by the enzyme (L2).

Unit-IV

Enzyme Kinetics - Factors affecting the catalysis- substrate concentration, pH, temperature. Michaelis - Menten equation for uni-substrate reaction (derivation not necessary), significance of K_m and V_{max} . Enzyme inhibition- irreversible and reversible inhibitions.

Learning outcomes:

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

- Understand the enzyme kinetic parameters (L2).
- Explain the different factors affecting the enzyme kinetics (L2).
- Determine the enzyme rate to the given substrate concentration using Michaelis - Menten equation (L2).
- Illustrate the significance of K_m and V_{max} (L2).
- Outline the enzyme inhibition process and its significance (L2).

Unit-V

Outline of mechanism of enzyme action- acid-base and covalent catalysis. ATCase as an allosteric enzyme. Covalent modification- phosphorylation and zymogen activation (trypsinogen and chymotrypsinogen).

Learning outcomes:

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

- Explain the enzyme acid-base catalysis mechanism (L2).
- Explain the enzyme covalent catalysis mechanism (L2).
- Understand the mechanism of allosteric regulation of aspartate transcarbamoylase (ATCase) enzyme (L2).
- Outline the effects of covalent modifications on enzyme activity (L2).
- Distinguish between the different mechanism of enzyme catalysis (L2).

Course Outcomes :

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

- Explain the amino acid reactions and formations of peptide bonds
- Impart knowledge on proteins properties and structural organization of protein structure
- Outline the details about the enzyme classification and enzyme characteristics
- Describe enzyme action using the kinetics
- Illustrate the molecular mechanism of enzyme catalysis

Recommended Books:

1. Fundamentals of Enzymology by Nicoles C. Price and Lewis Stevens, Oxford Uni. Press.
2. Understanding Enzymes by Trevor Palmer, Harvard publishing
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Biochemistry by Stryer, WH Freeman and CO. 4th Ed.
5. Biochemistry by Lehninger, Kalyani Publishers.

BCBI1031: PROTEIN CHEMISTRY AND ENZYMOLOGY LAB

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

Amino acids are the building blocks proteins, which have wide biological activities. One of the function of proteins is catalyzing the biochemical reactions in living organisms and favor the reaction under physiological conditions. The enzymology lab covers identification of amino acids using qualitative tests, the assay of amylase, protease, catalase. The lab course also covers the analysis of factors pH, temperature affecting the enzyme catalysis taking acid phosphatase as reference enzyme.

Course Objectives:

- To qualitative identification of amino acids -histidine, tyrosine, tryptophan, cysteine and arginine.
- To assay of amylase activity in crude potato extract
- To assay the protease activity
- To assay the catalase activity
- To determine the effect of pH, temperature on phosphatase activity

Experiments:

1. Qualitative identification of amino acids – histidine, tyrosine, tryptophan, cysteine, arginine
2. Assay of amylase
3. Assay of protease
4. Assay of catalase
5. Assay of phosphatase
6. Determination of optimum temperature for phosphatase.
7. Determination of optimum pH for phosphatase.

Learning Outcomes:

At the end, the student will be able to:

- Identify the amino acids histidine, tyrosine, tryptophan, cysteine and arginine by performing specific qualitative tests (L5)
- Estimate the amylase activity by performing the enzyme assay (L5)
- Estimate the protease activity by performing the enzyme assay (L5)
- Estimate the catalase activity by performing the enzyme assay (L5)
- Estimate the phosphatase activity by performing the enzyme assay (L5)
- Determine the optimum temperature for phosphatase activity by performing the phosphatase activity at different temperatures (L5)
- Determine the optimum pH for phosphatase activity by performing the phosphatase activity in different pH buffers (L5)

Course Outcomes

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

- Identify the histidine, tyrosine, tryptophan, cysteine and arginine (CO1)
- Determine the amylase, protease, catalase activity in various biological samples (CO2)
- Analyse the effect of pH and temperature on enzyme activity (CO3)
- Design an enzyme assay for determination enzyme activity (CO4)
- Apply the knowledge of enzyme activity for the industrial applications (CO5)

Recommended Books:

1. Experimental Biochemistry: A student companion by Beedu Sashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.
2. Laboratory Manual in Biochemistry by Jayaraman, New Age International Publishers, New Delhi.
3. Introductory practical biochemistry by SK Sawhney & Randhir singh. Narosa publications.
4. Biochemical methods by S Sadasivan & A Manickam. New Age international publishers

BCBI2001: METABOLISM AND BIOENERGETICS

L	T	P	S	J	C
3	0	0	0	0	3

The student will be able to review and consolidate concepts in the areas of Metabolism and Bioenergetics, focusing on the main metabolic pathways in a living cell, their regulation and disturbances in disease, and how energy is obtained and transduced to meet the cell's requirements.

Course Objectives:

- To understand the overview and interplay of metabolic pathways.
- To describe the individual reactions, cofactors, inhibition, energetics and regulation of pathways.
- To correlate the pathways with diseases associated directly or indirectly with them.
- To understand the clinical applications of synthetic purine and pyrimidine analogs.
- To comprehend the thermodynamics involved in energetics of biochemical pathways.

UNIT -I

Carbohydrate metabolism: Concept of anabolism and catabolism. Glycolytic pathway. Citric acid cycle. Amphipathic role. Anaplerotic reactions. Glycogenolysis and glycogenesis. Pentose phosphate pathway. Gluconeogenesis.

Learning Outcomes:

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

- Understand the function of specific anabolic and catabolic pathways and how these pathways are controlled and interrelated(L1).
- Predict the products from pyruvate under different physiological conditions(L2).
- Describe what happens during carbohydrate metabolism - glycolysis and glycogenolysis(L2).
- Able to understand the glycogenesis and gluconeogenesis and their significance (L2).
- Explain compensatory pathways that maintain homeostasis in the body (L2).

UNIT- II

Lipid Metabolism - Catabolism of fatty acids (β - oxidation) with even number of carbon atoms, Ketogenesis, *de novo* synthesis of fatty acids. Biosynthesis and degradation of triacylglycerol. Biosynthesis of cholesterol

Learning Outcomes:

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

- Describe what happens in fatty acid oxidation and synthesis as well as in ketogenesis(L1).
- Learn about the oxidation of fatty acids into acetyl CoA and energy production from fattyacids (L2).
- Learn about fatty acid biosynthesis and regulation (L1).
- Learn about cholesterol biosynthesis and regulatory mechanisms (L1).

- Explain the metabolism of triacylglycerol and lecithin (L2).

UNIT- III

Thermodynamic principles – Chemical equilibria; free energy, enthalpy (H), entropy (S). Oxidation-reduction reactions. Organization of electron carriers and enzymes in mitochondria. Oxidative phosphorylation. Uncouplers and inhibitors of oxidative phosphorylation.

Learning Outcomes:

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

- Define the thermodynamic principles and discuss their bioenergetics (L1).
- Explain and give examples of High energy compounds (L1).
- Describe the energy changes that bring about biological transformations (L2).
- Explain the role of ATP coupled reactions and coenzymes that exist in oxidized and reduced form (L2).
- Understand the role and applications of inhibitors and uncouplers (L2).

UNIT- IV

Amino acid Metabolism: General reactions of amino acids - transamination, decarboxylation and deamination, Glycogenic and ketogenic amino acids. Urea cycle and regulation. Biosynthesis of serine and phenylalanine.

Learning Outcomes:

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

- Understands the general reactions of amino acids in metabolism (L1).
- Explain what happens during digestion of proteins, catabolism of amino acids and the Ureacycle(L2).
- List the ketogenic and glycogenic amino acids and describe the general strategies for amino acid synthesis(L1).
- Analyze complex chemical problems and draw logical conclusions(L2).
- Analyze the congenital disorders of protein metabolism(L2).

UNIT- V

Metabolism of Nucleic acid: Biosynthesis and regulation of purine and pyrimidine nucleotides. Catabolism of purines and pyrimidines.

Learning Outcomes:

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

- Describe importance of nucleic acid metabolism (L1).
- Explain the recycling and synthesis of nucleotides (L2).
- Describe the mechanism of nucleotide degradation and effects of degradation products (L2).
- Understand the regulatory mechanism of nucleotide synthesis and degradation (L2).

- Explain the diseases associated with the nucleic acid metabolism (L2).

Course outcomes:

- Acquires knowledge related to the role of TCA cycle in central carbon metabolism, importance of anaplerotic reactions and redox balance (CO1).
- Gains an overview and interplay of metabolic pathways of lipids (CO2).
- Understands the thermodynamics involved in energetics of biochemical pathways (CO3).
- Gains insights into metabolic process of amino acids (CO4).
- Understand the nucleic acid metabolic pathways and diseases associated with it (CO5)

Recommended Books:

1. Textbook of Biochemistry by West and Todd, Oxford and IBH, 4th Ed.
2. Principles of Biochemistry by Nelson and Cox, Freeman, 4th Ed.
3. Biochemistry by Voet and Voet, John Wiley and Sons, 3rd Ed.
4. Outlines of Biochemistry by Conn and Stumpf, John Wiley and sons, 5th Ed.
5. Biochemistry by Matthews, PSN, 3rd Ed.
6. Biochemistry by Lehninger, Kalyani Publishers, 2nd Ed.
7. Biochemistry by Stryer, WH Freeman and CO, 4th Ed.

BCBI2011: METABOLISM AND BIOENERGETICS LAB

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

Quantitative analysis of various biomolecules finds application in identification, estimation, and analysis of homogenates of biological importance. The practical knowledge of Quantitative analysis in Biochemistry lab course equips the students with better learning outcomes in analysis and research.

Course Objectives:

- To learn about practical implications and their use in analysis and identification of molecules.
- To acquire working knowledge of analytical methods commonly used in the laboratory.

1. Estimation of amino acid by Ninhydrin method.
2. Estimation of protein by Biuret method.
3. Estimation of protein by Lowry method.
4. Estimation of glucose by DNS method.
5. Estimation of glucose by Benedict's titrimetric method.
6. Estimation of total carbohydrates by Anthrone method.
7. Absorption spectra of protein-BSA, Nucleic acids- Calf thymus DNA.

Learning Outcomes:

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

- Understand about units of measurement and preparation of reagents (L1).
- Learn use of analytical equipment, safety with chemicals(L1).
- Estimate the concentrations of different biological components(L2).
- Identify components and analyze the purity of solutions by examining absorption spectra(L2).
- Know types of errors in estimations of different biomolecules(L1).

Course Outcomes:

- Obtains knowledge about preparation of reagents, chemical usage, spectral analysis.
- Acquires working knowledge of analytical methods commonly used in quantitative analysis laboratory.

Recommended Books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, McGraw Hill.

3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa.

BCBI2021: BIOCHEMICAL TECHNIQUES

L	T	P	S	J	C
3	0	0	0	0	3

Course Overview

Biochemical studies rely on the availability of appropriate analytical techniques and their applications. This undergraduate course deals with the different biochemical techniques such as cell disruption methods, centrifugation, spectrophotometry, chromatography, electrophoresis and radioactivity to gain knowledge on the biomolecules such as proteins, nucleic acids and their functions.

Course Objectives:

The course will help students to acquaint with basic instrumentation, principle and procedure of various biochemical techniques related to Centrifugation, Chromatography, Electrophoresis, Spectrophotometry and Radioactivity. This will enable the students to implement the use of these techniques in biological research and in discovering new products/compounds.

UNIT-I

Homogenization - Methods of disrupting cells and tissues. Centrifugation -Basic principles of sedimentation, Principle, methodology and applications of analytical and preparative ultracentrifugation.

Learning Outcomes:

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

- List the various methods of cell disruption and homogenization.
- Gains the basic principles of centrifugation and factors that determine the rate of sedimentation of a particle.
- Defining differential centrifugation, density centrifugation, and analytical centrifugation.

UNIT-II

Principle and applications of chromatographic techniques- paper, thin layer, gel filtration, ion-exchange and affinity chromatography.

Learning Outcomes:

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

- Understand the fundamentals behind the various separation's methods.

- Describe the operating principles of the various chromatography separation techniques, including paper, thin layer, gel filtration, ion exchange and affinity chromatography.

UNIT-III

Principles and applications of polyacrylamide (native and SDS) and agarose gel electrophoresis, Criteria of purity.

Learning Outcomes:

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

- Describe protein/DNA separation methods and analysis by polyacrylamide and agarose gel electrophoresis
- Use the operating principles of the various separation techniques based on charge and size isomers of proteins.

UNIT IV

Introduction to spectroscopy, light-matter interaction, Beer-Lambert law, chromophores and fluorophores Absorption spectroscopy UV, Visible, Atomic absorption spectroscopy.

Learning Outcomes:

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

- Will be able to describe the principles of different spectroscopy methods.
- Explain working principles, taking spectrum and outline of atomic absorption spectroscopy device.
- Distinguish the specialties and applications of various types of spectroscopic methods

UNIT V

Introduction to radioactivity, Nature and units of radioactivity, detection, and measurement of radioactivity – GM and Scintillation counters. Autoradiography. Applications of radioisotopes in biology.

Learning Outcomes:

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

- Describe the concepts of radioactivity units, detection and measurement of radioactivity.
- Understand the factors that determine the biological effects of radiation and applications of radioisotopes in biology.

Text Books

1. A Biologists guide to Principles and techniques of practical Biochemistry by B.D.Williams, Edward Arnold.
2. Principles and Techniques of Biochemistry and Molecular Biology by Keith Wilson, John Walker, Cambridge University Press, 7th Ed.
3. Biophysical chemistry principles and techniques by Upadhyay, Upadhyay and Nath, Himalaya publishing.

Reference Books

1. Instrumental methods of chemical analysis by Chatwal and Anand, Himalaya Publishers, 5th Ed.
2. Modern Experimental Biochemistry by Rodney F. Boyer.

Course Outcomes:

1. The course will help students to acquaint with basic instrumentation, principle and procedure of various sophisticated instruments like HPLC, Ultra-centrifugation, Mass Spectroscopy, GM counters etc.
2. The units of this paper are crucial for implementation of research ideas at molecular level. It trains the students in adopting various techniques in biological research.

BCBI2031: BIOCHEMICAL TECHNIQUES LAB

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

This skill based course will teach the students the various biochemical separation principles and instrumentations that are used in the analytical laboratories. This course covers both fundamental and applications of the instruments that are routinely used for the characterization of biomolecules.

Course Objectives

1. To describe general principles involved in separation of biomolecules from foods.
2. To understand the steps involved in the separation of amino acids and plant pigments by chromatographic approaches.

List of Experiments

1. Separation of amino acids by paper chromatography.
2. Separation of sugars by paper chromatography
3. Separation of plant pigments by TLC.
4. Separation of serum proteins by PAGE.
5. Isolation of casein from milk.
6. Isolation of starch from potatoes
7. Spectrophotometry: The absorption spectrum and determination of molar absorption coefficient of aromatic amino acids

Course Outcomes

1. The student will obtain hands-on training in basic separation techniques in biochemistry and gain expertise in the isolation of various biomolecules.
2. Will be able explain and execute the steps involved in the separation using chromatographic approaches.
3. Will be able to separate serum proteins by electrophoresis.

Text Books:

1. Biochemical methods by Sadasivam and Manikam, Wiley Eastern Limited.
2. An introduction to practical Biochemistry by D. T. Plummer, Mc Graw Hill.
3. Laboratory manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
4. Introductory Practical Biochemistry by S. K. Sawhney and Randhir Singh, Narosa
5. Experimental Biochemistry by B.S. Rao and V. Deshpande, I.K. International

BCBI2041: MOLECULAR BIOLOGY

L	T	P	S	J	C
3	0	0	0	0	3

Course description

Molecular Biology deals with the basics and understanding of the central dogma. It helps the student in knowing the organization of the genome, replication, transcription, translation and their regulation in both prokaryotes and eukaryotes. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life.

Course Objectives

- To understand the organization of nuclear genome.
- To understand the DNA replication in both prokaryotes and eukaryotes.
- To gain the knowledge of promoters, RNA polymerase, mechanism of transcription in both prokaryotes and eukaryotes, and regulation of gene expression.
- To gain the knowledge of genetic code, knowledge of ribosome, mechanism of translation (protein synthesis) in both prokaryotes and eukaryotes.
- To gain the knowledge of inhibition of protein synthesis), and post translational modifications.

UNIT- I

Genome Organization and Replication: Organization of genome in prokaryotes and eukaryotes. Experimental evidence to prove nucleic acids as genetic material. Nature and structure of the gene.

Learning outcomes:

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

- Understand the organization and the role of nuclear genome in prokaryotes (L2)
- Understand the organization and the role of nuclear genome in eukaryotes (L2)
- Explain the differences between the genetic material in both prokaryotes and eukaryotes (L2).
- Explain experiments with evidence's to prove nucleic acids as genetic material (L2).
- Describe the fine structure of gene in prokaryotes and eukaryotes (L1).

UNIT- II

Models of replication, Meselson-Stahl's experimental proof for semi-conservative model. DNA replication in prokaryotes and eukaryotes.

Learning outcomes:

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

- Explain the mechanism of DNA replication in both prokaryotes and eukaryotes (L2).
- Explain about the enzymes involved and their role in DNA replication (L2).
- Describe the role and types of DNA polymerases in both prokaryotes and eukaryotes (L1).
- List the differences between DNA polymerases in both prokaryotes and eukaryotes (L2).

- Describe the models of replication, and Meselson-Stahl's experimental as a proof for semi-conservative model (L2).

UNIT- III

Transcription: Transcription in prokaryotes and eukaryotes – Initiation-Elongation- Termination. Role of RNA polymerase and promoters in transcription. Regulation of gene expression Lac and Tryptophan operon.

Learning outcomes:

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

- Explain the mechanism of transcription in both prokaryotes and eukaryotes (L2).
- Describe the role and types of RNA polymerases in both prokaryotes and eukaryotes (L2).
- Describe the role and types of promoters in both prokaryotes and eukaryotes (L2).
- Compare and contrast RNA polymerases in both prokaryotes and eukaryotes (L2).
- Compare and contrast promoters in both prokaryotes and eukaryotes (L2).

UNIT- IV

Genetic code and Translation: Genetic code, deciphering of genetic code, Nirenberg's and Khorana's experiments, wobble hypothesis, degeneracy of genetic code.

Learning outcomes:

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

- Understand the general features of genetic code (L1), with special emphasis on deciphering of genetic code, and Nirenberg's and Khorana's experiments (L2).
- Understand wobble hypothesis, and degeneracy of genetic code (L2).
- Learn the structural components of ribosomes in both prokaryotes and eukaryotes (L2).
- Understand the mechanism of protein synthesis in both prokaryotes and eukaryotes (L2)
- Study inhibitors of protein synthesis (L1) and use the knowledge to inhibit protein synthesis of various prokaryotes and eukaryotes (L3).

UNIT- V

Protein Synthesis - Ribosome structure, activation of amino acids (aminoacyl t-RNA synthetases). Initiation, elongation and termination of protein synthesis. Inhibitors of protein synthesis. Post-translational modifications.

Learning outcomes:

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

- Understand the concept of Post- translational modifications (L2).
- Understand the concept of regulation of gene expression
- Understand the concept of regulation of gene expression with reference to operon (L2).
- Understand the concept of regulation of gene expression with reference to Lac operon (L2).
- Understand the concept of regulation of gene expression with reference to Trp operon (L2).

Course Outcomes

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

1. Understand the organization of nuclear genome (prokaryotes and eukaryotes) (CO1).
2. Understand the DNA replication (prokaryotes and eukaryotes) along with enzymes involved in DNA (CO2).
3. Gain the knowledge of promoters, RNA polymerase, mechanism of transcription in both prokaryotes and eukaryotes; and regulation of gene expression (CO3).
4. Gain the knowledge of genetic code and ribosome (CO4).
5. Gain the knowledge of mechanism and inhibition of translation (protein synthesis); and the knowledge of post translational modifications (CO5).

Recommended Books:

1. Molecular Biology of the gene by Watson, Pearson, 5th Ed.
2. Molecular Biology of the cell by Alberts, Garland science, 4th Ed.
3. Biochemistry by Matthews, Pearson, 3rd Ed.
4. Biochemistry by Voet and Voet, John Wiley and sons, 3rd Ed.
5. Molecular cell Biology by Lodish, Freeman, 6th Ed.
6. Principles of Biochemistry by Nelson cox. PALG, 4th Ed.
7. Biochemistry by L.Stryer, Freeman, 5th Ed.
8. Molecular Biology by Robert F.Weaver, McGraw Hill

BCBI2051: MOLECULAR BIOLOGY LAB

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

Course description

Molecular Biology laboratory deals with understanding the principles of isolating DNA & RNA, determining the purity of isolated DNA & RNA, and quantifying the isolated DNA & RNA from different sources. It helps the student to analyse isolated DNA content for better understanding of cellular life.

Course Objectives

- To understand the principles of isolating genomic DNA from various sources such as onion/liver/coconut endosperm.
- To understand the principles of isolating plasmid DNA.
- To understand the principles of determining the purity of isolated DNA.
- To understand the principles of quantifying or estimating DNA
- To understand the principles of quantifying or estimating RNA.

Practical's Laboratory Sessions

1. Isolation of DNA from onion/liver/coconut endosperm.
2. Isolation of plasmids.
3. Determination of purity of nucleic acids by UV-spectrophotometric method.
4. Estimation of DNA by diphenylamine method.
5. Estimation of RNA by orcinol method.

Recommended Books:

1. Lab manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited.
2. Biochemistry – a lab course by J.M. Becker, Academic Press.
3. Experimental Biochemistry: A student companion by Beedu Sashidhar Rao and Vijay Deshpande, I.K. International Pvt. Ltd., New Delhi.

Course Outcomes

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

- Understand the principles of isolating genomic DNA from various sources such as onion/liver/coconut endosperm and will be able to isolate genomic DNA from onion/liver/coconut endosperm (CO1).
- Understand the principles of isolating plasmid DNA and will be able to isolate plasmid DNA (CO2).
- Understand the principles of determining the purity of isolated DNA and will be able to determine the purity of isolated DNA (genomic and plasmid DNA) (CO3).
- Understands the principles of quantifying or estimating DNA and will be able to determine the quantity of DNA (CO4).
- Understands the principles of quantifying or estimating RNA and will be able to determine the quantity of RNA (CO5).

BCBI3001: GENETIC ENGINEERING

L	T	P	S	J	C
3	0	0	0	0	3

Genetic engineering also known as recombinant DNA technology is the field of biology that studies the various techniques used to cut and join together genetic material, especially DNA from different biological species, and to introduce the resulting hybrid DNA into an organism in order to form new combinations of heritable genetic material. It has been used to create powerful research tools and model organisms, and also used to address current problems in agriculture and medical fields. Applications for genetic engineering are increasing to identify the locations and functions of specific genes in the DNA sequence of various organisms so as to develop transgenic varieties with superior qualities and desired traits.

Course Objectives

- To understand the concept of recombinant DNA technology.
- To compare different types of cloning and expression vectors. To learn about construction, screening of gene libraries and blot analysis techniques.
- List several present day applications of genetic engineering and analyse the benefits and drawbacks of manipulating an organism's DNA
- To learn the concept of RNA silencing
- To study various methods of gene therapy, delivery systems for gene therapy and applications of genetic engineering.

UNIT – I

Outlines of recombinant DNA technology. Restriction endonucleases, RFLP, restriction maps. Isolation of gene fragments using restriction endonucleases, Ligation of fragments – Cohesive and blunt ends, Homopolymer tailing

Learning outcomes:

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

- Learn and remember the outlines of recombinant DNA (L1)
- Understand the types, role and function of restriction endonucleases and how to construct restriction map (L2).
- Understand the mechanism of ligation of fragments (L2).
- Explain and understand the isolation of gene fragments using restriction endonucleases (L2).
- Explain the cohesive and blunt ends in rDNA technology (L2).

UNIT – II

Cloning vectors – plasmids, bacteriophages, cosmids, Ti - plasmid. Expression vectors, viral vectors, YAC, BAC. Cloning strategies – shot gun experiments, cDNA cloning in bacteria. PCR

Learning outcomes:

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

- Learn the structure and properties of cloning vectors (L2).
- Compare and contrast cloning and expression vectors (L2).
- Understand viral vectors, YAC and BAC vectors (L1).
- To highlight cloning strategies- short gun experiments and cDNA cloning in bacteria (L2).
- Illustrate the concept of cDNA cloning in bacteria (L2).

UNIT – III

Prokaryotic hosts – *E. coli*, *B. subtilis*, Eukaryotic hosts – Yeast and mammalian cell lines. Gene transfer techniques: Biological delivery systems - *Agrobacterium tumefaciens*, SV40, Retroviral systems, Artificial delivery systems - Gene gun, Microinjection, Lipofection, Electroporation, Ca - DNA coprecipitation.

Learning outcomes:

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

- Learn the structure and role of prokaryotic hosts in rDNA technology (L1)
- Learn the structure and role of eukaryotic hosts in rDNA technology (L1)
- Learn about the different gene transfer techniques (L2).
- Understand the different biological delivery systems (L2).
- Understand the mechanism of artificial delivery systems (L1).

UNIT - IV

Identification of recombinants. Expression of cloned genes in bacteria, plant and animal cells. Blot analysis - Southern, Northern and Western blot.

Learning outcomes:

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

- Describe the methods of identifying the recombinants (L2).
- To understand the mechanism of expression of cloned genes in bacteria (L2).
- To understand the mechanism of expression of cloned genes in plants (L2).
- To understand the mechanism of expression of cloned genes in animals (L2).
- Explore the applications of blot analysis

UNIT – V

Applications of rDNA technology: Applications of rDNA technology in agriculture, industry and medicine. Production of insulin, monoclonal antibodies. Transgenic plants - production of golden rice, transgenic animals - mouse and sheep.

Learning outcomes:

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

- Highlight the applications of genetic engineering in biological and medical fields (L2).
- Applications of rDNA technology in medicine, agriculture and industry (L2).
- Describe the production of insulin and monoclonal antibodies (L2).
- Understand the production of transgenic plants (L2).
- Understand the production of transgenic animals (L2).

Course Outcomes

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

- Understand the concept of rDNA technology, restriction endonucleases, mapping (CO1).
- Learn the different types of vectors, cloning in bacteria (CO2).
- Learn the prokaryotic and eukaryotic hosts and their role in rDNA technology (CO3).
- Understand the methods to identify recombinants, study the expression in bacteria, plants and animals (CO4).
- Expression of cloned genes in bacteria, plant and animal cells Understand the present day applications of genetic engineering with both advantages and disadvantages (CO5).

Recommended Books:

1. Human Molecular Genetics by Tom Strachan and Andrew Read, Taylor & Francis Publisher, 3rd Ed.
2. Principles of gene manipulation & genomics by Primrose & Twyman, Oxford, 7th Ed.
3. Molecular cell biology by Lodish, Freeman, 6th Ed.
4. Molecular Biotechnology - Principles and applications of Recombinant DNA by Glick, 2nd Ed.

BCBI3011: GENETIC ENGINEERING LAB

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

Genetic engineering has wide applications in the field of medical, agriculture, industry and environment. The practical knowledge of the course equips the students with better learning outcomes of rDNA technology in all fields to address current problems.

Course Objectives:

- To provide students with experimental knowledge and hands on experience in understanding how to manipulate specific genes to produce desired traits to address current problems facing humanity.
- To learn how to construct restriction map and also to ligate the DNA from different sources.
- To provide hands on experience with amplification of DNA isolated from different sources.
- To express genes by transformation of cloned genes into bacteria *E.coli* and plant cells.
- To learn the technique of Southern blotting.

Genetic Engineering:

1. Restriction digestion and construction of restriction map using restriction enzymes
2. Ligation of restricted DNA fragments
3. Amplification of DNA using specific primers by PCR
4. Preparation of competent *E.coli* cells, transformation and expression of cloned gene
5. *Agrobacterium* – mediated gene transfer into plants and expression of genes
6. Southern Blotting

Recommended Books:

1. Biotechnology: A laboratory course by Becker J.M.
2. Green, M. R., & Sambrook, J. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
3. Lab manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited
4. Biochemistry – A lab course by J. M. Becker, Academic Press.

Course Outcomes:

- Acquires working knowledge of manipulating genes and techniques involved in the process.
- Gains knowledge in constructing a restriction map and ligation process.
- Gains hands on experience with amplification of DNA isolated from different sources.
- Expression of genes by transformation of cloned genes into bacteria *E.coli* and plant cells.
- Acquires knowledge on the technique of Southern blotting.

BCBI3021 CLINICAL BIOCHEMISTRY

L	T	P	S	J	C
3	0	0	0	0	3

Clinical Biochemistry has contributed immensely to the growth of modern medical and health science. They have applications in clinical diagnosis, understanding pathology of diseases, treatment of diseases, designing of drugs and understanding their metabolism. Keeping in pace with the developmental trends in various subareas of Biochemistry it is expected that the students undertaking Clinical Biochemistry course become conversant with the fundamentals and at the same time at the end of the programme they exhibit certain levels of learning outcomes applicable to healthy living.

Course Objectives:

- To familiarize students with the specific characteristic features of clinical biochemistry.
- To understand the pathophysiology and molecular basis of the most prevalent diseases.
- To understand the role of diagnostic enzymes in disease diagnosis.
- To bring awareness about differential diagnosis and importance of function tests.
- To know how basic biochemistry can be applied to medical diagnosis, treatment, and management of diseases.

UNIT-I

Blood and blood disorders. Plasma proteins in health and disease. Causes, management and types of anemias, haemoglobinopathies and thalassemias.

Learning Outcomes:

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

- Understands the biochemical basis of blood related disorders (L1).
- Students will become aware with the variations in the levels of plasma proteins and their relationship with various diseases (L2).
- Understand the pathology and clinical manifestation associated with haemophilia (L1).
- Distinguish normal and abnormal hematological findings to predict the diagnosis of hematological disorders (L2).
- Understand the causes and management of anemias, hemoglobinopathies and Thalassemias (L2).

UNIT-II

Plasma lipoproteins, cholesterol, triglycerides and phospholipids in health and disease. Clinical features of atherosclerosis. Enzyme patterns in myocardial infarction.

Learning Outcomes:

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

- Describe the types of different lipoproteins and their significance (L1).
- Acquaint with the role of cholesterol and phospholipids in health and disease (L2).
- Understand plaque formation and its clinical significance (L1).
- Relate laboratory results to clinical diagnosis and relationship to heart function (L1).
- Know the biochemical tools needed to accomplish preventive, diagnostic, and therapeutic intervention in diseases.

UNIT-III

Disorders of gastric function, methods of evaluation. Pancreatic exocrine disorders-malabsorption syndromes. Pancreatic endocrine disorders-Diabetes mellitus.

Learning Outcomes:

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

- Assess gastric physiology, the most importantly acid secretion, as well as gastric motility and gastric emptying(L1).
- Measure the presence of functional gland failure of exocrine insufficiencies(L1).
- Measure the presence of functional gland failure of endocrine insufficiencies(L1).
- Provide a framework for differential diagnosis of exocrine pancreatic insufficiency vs other malabsorptive conditions(L2).
- Demonstrate a systematic in-depth understanding of diabetes and its clinical management(L2).

UNIT-IV

Structure and functions of the liver. Liver diseases-jaundice, hepatitis. Tests for conjugated and total bilirubin in serum, albumin: globulin ratio, hippuric acid and bromsulphthalein tests. Serum enzymes in liver diseases- SGPT, GGT and alkaline phosphatase.

Learning Outcomes:

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

- Describe and explain the role of liver function in bilirubin metabolism (L1)
- Identify the tests used for bilirubin analysis (L1).
- Get acquainted with the role of enzymes in diagnosis of various liver diseases (L2).
- Relate laboratory results of SGOT, SGPT, GGT, ALP to clinical diagnosis(L3).
- Understands common disorders of liver (L2).

UNIT-V

Kidney-structure of nephron, urine formation, normal and abnormal constituents of urine. Biological buffers. Tests for creatinine and phenol red test. Renal disorders-Glomerulonephritis, CKD, Renal stones.

Learning Outcomes:

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

- Students will learn about the formation, normal and abnormal constituents of urine and their significance in maintaining good health (L1).
- Describe the contributions of different buffer systems to respiratory and metabolic disorders of metabolism (L2).
- Explain that the renal compensation of altered $[H^+]$ involves alterations in blood biochemistry to restore the blood pH (L3).
- Perform various biochemical tests to determine creatinine, urea clearance and albumin, ketone bodies, glucose in urine (L2).
- Understands common disorders of kidney (L2).

Course outcomes:

- Describe and identify defects in metabolism and correlate them with deficiency of key metabolic enzymes (CO1).
- Report the enzymes assayed in the clinical laboratory and their clinical significance (CO2).
- Arrive at common methods of analysis metabolic function of various organs (CO3).
- Relate laboratory results to clinical diagnosis and relationship to heart, liver, kidney and pancreas function (CO4).
- Know the biochemical and molecular tools needed to accomplish preventive, diagnostic, and therapeutic intervention on hereditary and acquired disorders (CO5).

Recommended Books

1. Biochemical aspects of human disease by RS Elkeles and AS. Tavit, Blackwell Scientific publications.
2. Textbook of Medical Biochemistry by M. N. Chatterjee, Jaypee, 6th Ed.
3. Textbook of Biochemistry with clinical correlations by Devlin, JOHN publishers, 6th Ed.
4. Textbook of Biochemistry by S. Nagini, Scitech publishers.
5. Clinical biochemistry by S. Ramakrishna and Rajiswami.

BCBI3031 CLINICAL BIOCHEMISTRY LAB

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

Clinical Biochemistry has applications in clinical diagnosis, understanding pathology of lifestyle and other diseases. The practical knowledge of diagnostics in Clinical Biochemistrylab course equips the students with better learning outcomes in diagnosis and research.

Course Objectives:

- To learn about practical implications and their use in diagnosis and identification of diagnostic molecules.
- To acquires working knowledge of analytical methods commonly used in the clinical laboratory.

1. Determination of blood group and Rh typing.
2. Estimation of Hb
3. Estimation of blood glucose
4. Estimation of serum bilirubin.
5. Estimation of serum SGPT.
6. Estimation of serum creatinine.
7. Urine analysis for albumin, sugars and ketone bodies.

Learning Outcomes:

- Will be able to clinically assess the laboratory indicators of physiologic conditions and diseases (L1).
- Relate laboratory results to clinical diagnosis of marker molecules in diseases pertaining to heart, liver, kidney, blood and urine (L2).
- Gain ability to apply knowledge of clinical biochemistry in health and diagnostic purposes (L3).

Course Outcomes:

- Obtains knowledge about diagnostic enzymology and biomarkers in health and disease.
- Acquires working knowledge of analytical methods commonly used in the clinical laboratory.

Recommended Books

1. Practical Clinical Biochemistry by Harold Varley.
2. Experimental Biochemistry by BeeduSashidhar Rao and Vijay Deshpande, IKI Pvt. Ltd.

BCBI3041 IMMUNOLOGY

L	T	P	S	J	C
3	0	0	0	0	3

Immunology is the study of how the body defends itself against disease. It also helps us to understand how the immune system is tricked into attacking its own tissue, leading to diseases like rheumatoid arthritis, diabetes, or allergy. The development of both has long been linked with the development of vaccines for smallpox and anthrax. More recently, the application of modern techniques of biology to the immune system has led to a dramatic increase in our understanding of the immune system and its impact on body function, as well as in the control of microbial and other types of disease. The overall aim of this course is to give insights about immunology which is a very active area for both fundamental research and for the development of new biotechnological products to diagnose or prevent disease.

Course Objectives:

- To have an overview of immune system, organs and cells of immune system, and immune responses.
- To learn about antigens and epitopes and their role as immunogen.
- To learn structure, function, and types of antibodies.
- To learn about types of antigen-antibody interactions and hypersensitivity.
- To learn about various immunological techniques, transplantation immunology and immunomodulation.

UNIT-I

Immunology: Anatomical and Physiological barriers. Organization of immune system. Innate and Adaptive immune systems. Organs and cells of immune system. Humoral and Cell mediated Immune System. Immune responses.

Learning Outcomes:

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

- Learn about anatomical barriers of the immune system (L2).
- Learn about physiological barriers of the immune system (L2).
- Learn the various organs and cells of immune system; and their role in immune responses (L2).
- Learn about the organization of immune system (L2).
- Learn about immune responses (L2).

UNIT-II

Concept of Receptors, Immunogen. Antigen and types, Hapten and adjuvants, Epitopes and types, MHC and types, HLA and types, Antigen processing and presentation.

Learning Outcomes:

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

- Know the concept of receptors and immunogen (L2).
- Understand Antigen, Hapten, Adjuvant, and Epitopes (L2).

- Learn about antigen, processing and presentation (L2).
- Understand types of antigen and epitopes (L2).
- Understand types of MHC and HLA (L2).

UNIT-III

Antibody, Immunoglobulin classes, structure, and function. Isotypes, Allotypes and Idiotypes. Theories of antibody formation - clonal selection theory. Antibody diversity. Immune regulation. Cytokines, Interleukins, Interferons, and their role. Inflammation.

Learning Outcomes:

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

- Understand the classes of immunoglobulins, their structure and function (L2).
- Learn about Isotypes, Allotypes and Idiotypes (L1).
- Understand the concept of clonal selection theory and antibody diversity (L2).
- Learn the concept of immune regulation and inflammation (L2).
- Learn about cytokines, interleukins, interferons and their role (L2).

UNIT-IV

Antigen-Antibody interactions and types. Complement components and its role. Hypersensitivity and types. Immunodeficiencies and types. Immunological tolerance and immunosuppression. Autoimmunity and breakdown of self - tolerance.

Learning Outcomes:

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

- Understand about Antigen-Antibody interactions and types (L2).
- Learn about types of hypersensitivity (L4).
- Know about Autoimmunity and breakdown of self – tolerance (L1).
- Learn about immunodeficiencies and types (L2).
- Understand about immunological tolerance and immunosuppression (L2).

UNIT-V

Immunodiagnostics - RIA, ELISA. Vaccines and their types. Monoclonal antibodies and their applications, Hybridoma technology. Transplantation immunology. Immunomodulation.

Learning Outcomes:

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

- Understand the principle and application of RIA and ELISA (L2).
- Understand vaccines and their types (L2).
- Explain hybridoma technology to generate monoclonal antibodies and the applications of monoclonal antibodies (L2).
- Understand the concept of transplantation immunology (L2)
- Explain the concept of immunomodulation (L3).

Course Outcomes:

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

- Understand the overview of immune system, organs and cells of immune system, and immune responses (CO1).
- Explains about antigens and epitopes and their role as immunogen (CO2).
- Learn about structure, function, and types of antibodies; and immune regulation (CO3).
- Understand about types of antigen-antibody interactions, hypersensitivity and immunodeficiencies (CO4).
- Explain about various immunological techniques, vaccines, monoclonal antibodies, transplantation immunology and immunomodulation (CO5).

Recommended Books

1. Textbook of Microbiology by Ananthnarayan, ORIE, 7th Ed.
2. Immunology Kuby.
3. Immunology, Ivan Roitt

BCBI3051: IMMUNOLOGY LAB

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

Course Description: This course aims to identify the blood groups, cell count analysis in blood. Quantitative analysis of various biomolecules finds application in identification, estimation, and analysis of homogenates of biological importance. The practical knowledge of Quantitative analysis in Biochemistry lab course equips the students with better learning outcomes in analysis and research.

Course Objectives:

- To learn about practical implications and their use in analysis and identification of molecules.
- To acquire working knowledge of analytical methods commonly used in the laboratory.

1. Identification of A, B, O blood groups.
2. Total Leukocyte Count of the given blood sample.
3. Differential Leukocyte Count of the given blood sample.
4. Separation of serum and plasma from the blood sample (demonstration).
5. VDRL and WIDAL test
6. Immunodiffusion by Ouchterlony method.
7. ELISA
8. Immunoelectrophoresis

Course Outcomes:

- Obtains knowledge about blood grouping, cell count.
- Acquires working knowledge of analytical methods commonly used in disease conditions

Recommended Books:

1. Immunology methods manual - The comprehensive source book by Lefkovits. I6.
Manual of clinical laboratory immunology by Rose NR.
2. The experimental foundations of modern immunology by Clark W.R.

PROGRAMME ELECTIVES

BCBI2061 INDUSTRIAL BIOCHEMISTRY

L	T	P	S	J	C
3	0	0	0	0	3

This course encompasses areas such as enzyme production, vitamin production, fuel and waste management and imparts basic concepts for the development of useful products taking advantage of natural resources. This course also gives insights into the bioethical problems created by biological and medical progress and its impact along with intellectual property rights and their protection.

Course objectives:

- To study the microbiology, biochemistry and engineering in an integrated fashion with the goal of using microorganisms and cell and tissue cultures to manufacture useful products.
- To acquaint with the upstream and downstream processes of fermentation technology.
- Acquainting with the major products of traditional biotechnology industry of food and flavor ingredients, industrial alcohol, antibiotics and citric acid.
- Impart an overview of relevance use of microbial biofertilisers and biopesticides.
- To gain insights into bioethical issues and IPR.

UNIT – I

Fermentation technology - surface, submerged and continuous culture techniques. Design and operation of fermenters, Agitation and Aeration, selection and growth of microorganisms in controlled environments, medium development.

Learning Outcomes:

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

- Get acquainted with the industrial aspect of the field of Microbiology, and also learn about growth pattern of microbes in different industrial systems.
- Acquire experimental knowhow of microbial production of various industrial products such as alcohol, exopolysaccharides, enzymes, etc.
- Develop an understanding of process control, upstream and downstream process.
- Acquaint with the selection and growth of microorganisms in controlled environment
- Analyze different methods like media optimization for improvement of the production.

UNIT – II

Production of fermented milks, cheese, alcoholic beverages. Fermentative production of penicillin, amylase and glutamic acid.

Learning Outcomes:

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

- Recognize the advantages of bioreactors over conventional chemical methods.
- Identify different strains of microbes used in fermentation of milk products
- Understand the process of production of alcoholic beverages
- Recognize the role of fermentation in producing drugs and different strains used.
- Describe how species are often genetically modified to yield the maximum amounts of antibiotics, amino acids, vitamins and enzymes.

UNIT – III

Microbial transformation - types, techniques and commercial applications, Bioleaching, Biodegradation, Biomass and Bioenergy.

Learning Outcomes:

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

- Understand the approaches and synthetic methods in tandem for generating compounds around core structures, which can be screened for various biological activity studies.
- Learn the principles & mechanisms of microorganisms and its applications in environmental pollution control.
- Understand the role of microorganisms in producing biologically important molecules by transformation
- Gain an overview of key topics on sustainable bioenergy production, including the main biomass systems for bioenergy generation.
- Reflect on the economical and green practices of metal extraction

UNIT – IV

Sewage water treatment - primary, secondary and tertiary treatments. Biofertilizers - Aneabena, Azolla; Biocontrol agents- Insecticidal toxins of *Bacillus thuringiensis*

Learning Outcomes:

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

- Identify methods to extract pollutants, remove toxicants, neutralise coarse particles, kill pathogens so that quality of discharged water is improved.
- Understand the reduction of BOD, COD, eutrophication etc. of receiving water bodies

- Understand the prevention of biomagnification of toxic substances in food chain.
- Familiarize with the microbes used as bio fertilizers for various crop plants and their advantages over chemical fertilizer.
- Identify and apply pesticides in a legal, safe, correct and environmentally conscious manner

UNIT – V

Biosafety guidelines and regulations, animals in research. Ethical, legal and social implications (ELSI) of HGP. Intellectual property rights.

Learning Outcomes:

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

- Understand the biosafety guidelines and regulations to be followed
- Ensure the ethical conduct and recommend educational efforts in research Ethics.
- Introduces the science and the economic, political, ethical, legal and social issues of the HGP.
- Apply intellectual property law principles (including copyright, patents, designs and trademarks) to real problems
- Analyse the social impact of intellectual property law and policy.

Course outcomes

At the end of the course, a student will be able to:

- Comprehend the microbiology, biochemistry and engineering in an integrated fashion with the goal of using microorganisms to manufacture useful products.
- Design medium for microbial growth, solve the mass balance of production process, propose and use the sterilizers for removal of microbial contaminants, state the significance of aeration and agitation for synthesis of bioproducts and modes of operation of Fermenter.
- Analyse the upstream and downstream processes of fermentation technology.
- Collect knowledge of relevant use of microbial biofertilizers and biopesticides.
- Apply the insights gained about bioethical issues and IPR in career and research.

Recommended Books:

1. Industrial Microbiology by Prescott, CBS Publishers, 4th Ed.
2. Biotechnology by Crueger, PANI Publishhersh.
3. Principles of Fermentation Technology by Stanbury
4. Industrial Microbiology by A.H.Patel

UNIT – I

BCBI2091 INDUSTRIAL BIOCHEMISTRY LAB

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

The course offers hands-on training for UG students who aspire to go for higher education in industrial biochemistry. Imparts knowledge in areas such as enzyme, vitamin production and imparts basic concepts for the development of useful products.

Course Objectives

1. To impart knowledge on fermentation.
2. To familiarize learners about production of citric acid, wine and amylase.
3. To introduce learners about improving the fermentative efficiencies.
4. To acquaint learners on production of biofertilizers

Bioprocess Technology:

1. Fermentative production of citric acid by *Aspergillus niger* and quantification of citric acid
2. Fermentative production of amylase by *Bacillus subtilis* and quantification of amylase
3. Fermentative production of fruit wine
4. Quantification of fruit wine and calculation of fermentation efficiency
5. Production of Biofertilizer using *Azolla* / *Nostoc*

Course outcomes

At the end of the course, a student will be able to:

- Analyse the upstream and downstream processes of fermentation technology.
- Design medium for microbial growth, understand the significance of aeration and agitation for synthesis of bioproducts and modes of operation of Fermenter.
- Understand the biochemistry, microbiology and engineering using microorganisms to manufacture useful products.
- Gain knowledge of relevant use of microbial biofertilizers.

Recommended Books:

1. A manual of Industrial Microbiology and Biotechnology by Demain A.L.
2. Immobilization of enzymes and cells: Methods in Biotechnology by Bickerstaff G.F.
3. Biotechnology: A laboratory course by Becker J.M.
4. Molecular Cloning: A laboratory manual Vols. 1-3, Sambrook, J.

5. Lab manual in Biochemistry by J. Jayaraman, Wiley Eastern Limited
6. Biochemistry – A lab course by J. M. Becker, Academic Press

BCBI2071: MOLECULAR CELL BIOLOGY

L	T	P	S	J	C
3	0	0	0	0	3

Cell biology is essentially the study of life, health, and disease, depend upon the intricate relationship between the cellular and nuclear components. This course encompasses cells and their organelles, membrane biology, cell communication, advanced cell biology, and cell signalling. Completion of this course improves the understanding of the cellular basis for life and opens up new approaches for the investigation, diagnosis, and treatment of disease.

Course Objectives:

- To study the structure of prokaryotic and Eukaryotic cells
- To study functions of their organelles, composition of the plasma membrane, and membrane transport mechanisms.
- To study the cellular communications and signal transduction mechanism in eukaryotic and prokaryotic cells.
- To learn the applications of different types of microscopes for studying cell morphology
- To understanding mitosis, meiosis, and cell cycle.

UNIT-I

Cell and organelles: Structure of prokaryotic and Eukaryotic cells. Structure and functions of mitochondria, chloroplast, nucleus, endoplasmic reticulum, Golgi, lysosomes, ribosomes.

Learning outcomes

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

- Distinguish the structure of the prokaryotic and eukaryotic cells (L2).
- Gain knowledge of structure and functions of mitochondria (L1).
- Gain knowledge of structure and functions of chloroplast, nucleus (L1).
- Gain knowledge of structure and functions of nucleus, endoplasmic reticulum, Golgi (L1).
- Gain knowledge of structure and functions of lysosomes, ribosomes (L1).

UNIT-II

Membrane Biology: Structure and composition of the plasma membrane. Membrane transport - Membrane channels and pumps, exocytosis, and endocytosis. Intracellular trafficking.

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

- Understand the organization of plasma membrane (L2)
- Comprehend the membrane transport by channels (L3)
- Understand the membrane transport by pumps (L3)
- Know about the exocytosis and endocytosis (L1)
- Recognize the process of intracellular trafficking (L2)

UNIT-III

Cell communication: Cytoskeletal elements. Extracellular matrix, cell-cell interactions. Cell-matrix interactions. Cellular communication – exosomes, bacterial chemotaxis, and quorum sensing.

Learning outcomes

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

- Know the types of extracellular matrix components and their functions (L1)
- Understand cell-cell interactions (L2).
- Understand cell-matrix interactions (L2).
- Explain mechanisms of cellular communications by exosomes (L2).
- Explain mechanisms of cellular communications by bacterial chemotaxis, and quorum sensing (L2).

UNIT-IV

Advanced Cell Biology: Cell morphology - Phase contrast, fluorescent, confocal, and electron microscopy. Mitosis and Meiosis. Cell cycle and its regulation.

Learning outcomes

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

- Learn the principles and applications of phase contrast and fluorescent microscopy (L1)
- Learn the principles and applications of confocal, and electron microscopy (L1)
- Compare and contrast the events of the cell cycle and its regulation (L3)
- Understand the mitotic division and its phases (L2).
- Understand the meiotic division and its phases (L2).

UNIT-V

Cell signaling: Signal transduction, General features, types of signal transducers. G - proteins, secondary messengers - cAMP, cGMP, calcium, DAG, IP3, nitric oxide.

Learning outcomes

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

- Learn the general features of signal transduction and types of signal transducers (L1)
- Understand the signal transduction mechanisms and their significance normal and diseases cells (L2)
- Compare and analyze the functions of G – proteins and secondary messengers (L3)

Course Outcomes

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

- Draw the structure of the cell, distinguish bacterial, plant, and animal cells, locate cell organelles along with their functions (CO1)
- Know the structure and composition of the plasma membrane and understand membrane transport mechanisms (CO2).
- Understand cell-cell interactions and explain different types of cellular communications (CO3).
- Observe cells and their internal structures using different types of microscopes, compare and contrast mitosis and meiosis and understand cell cycle and its regulation. (CO4).
- Understand mechanisms signal transduction, second messenger concept of signalling pathways (CO5).

Recommended Books:

1. Molecular Biology of the Cell by B. Alberts *et al.* Garland publications incorporation, 4th Ed.
2. Molecular Cell Biology by Harvey Lodish *et. al.* W. H. Freeman, 4th Ed.
3. Cell and Molecular Biology by E. D. P. De Roberties, International edition.
4. The Cell: A molecular approach by Geoffery M Cooper, 2nd Ed.

BCBI2101: MOLECULAR CELL BIOLOGY LAB

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

Cell biology is essentially the study of life, health, and disease, depend upon the intricate relationship between the cellular and nuclear components. This course encompasses cells and their organelles, membrane biology, cell communication, advanced cell biology, and cell signalling. Completion of this course improves the understanding of the cellular basis for life and opens up new approaches for the investigation, diagnosis, and treatment of disease.

Course Objectives:

- To study the structure of prokaryotic and Eukaryotic cells and their organelles
- To carry out cytological studies for identification of stages of mitosis
- To perform cytological studies for identification of stages of meiosis in onion flower bud
- To learn karyotyping of human chromosomes
- To isolate and estimate chlorophyll from leaf tissue

Experiments

1. Microscopic observation of prokaryotic and eukaryotic cells and their organelles using permanent slides
2. Preparation of cytological studies for identification of stages of mitosis
3. Preparation of cytological studies for identification of stages of meiosis in onion flower bud
4. Karyotypic study of human chromosomes
5. Extraction and identification of carbohydrates from wild potatoes and sweet potatoes
6. Isolation and estimation of chlorophyll from leaf tissue

Learning outcomes

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

- Distinguish the structure of the prokaryotic and eukaryotic cells (L2).
- Distinguish different phases of mitosis and meiosis (L1).
- Extract and identify carbohydrates from wild potatoes and sweet potatoes (L2).
- learn technique of karyotyping of human chromosomes (L3).
- Learn the technique of isolation and estimation of chlorophyll from leaf tissue (L3).

Course Outcomes

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

- Differentiate prokaryotic cells and eukaryotic cells (CO1)
- Identify changes in different phases of mitosis and meiosis(CO2).
- Extract and identify carbohydrates from wild potatoes and sweet potatoes (CO3).

- Carryout karyotyping of human chromosomes (CO4).
- Isolate and estimate chlorophyll from plant tissue (CO5).

Recommended Books:

5. Cell Biology : Practical Manual by Dr. Renu Gupta et al. Prestige Publishers
6. Cell Biology Laboratory Manual by Dr. William H. Heidcamp, (Free online copy).
7. Cell Biology: A Laboratory Handbook, Volumes 1, 2, 3; Edited by Julio E. Celis, Academic Press.

BCBI2081 BIOINFORMATICS

L	T	P	S	J	C
3	0	0	0	0	3

Course Description:

Bioinformatics / Computational Biology is the science of storing, retrieving and analyzing large amounts of biological information. The course depicts the types of biological information being generated and stored into the repositories. The important public data banks provide details of biological systems and components will be discussed. It reviews a wide range of applications using biological databases including computational sequence analysis, sequence homology searching, protein sequence analysis and phylogenetic analysis.

Course Objectives:

At the end of the course a student is expected to:

- To understand explosion, nature and types of biological data and its role in biological research to solve real world biological problems.
- To understand the concept and types of literature databases, nucleic acid databases, protein databases, protein structure databases, metabolic databases, and their uses
- To understand the concept and principles of sequence alignments - types, methods, tools and applications
- To understand the concept and principles of multiple sequence alignments methods, tools and applications.
- To understand the concept and principles of phylogenetic trees, methods, tools and applications.

UNIT-I

Biological Data: Nature and Types of Biological Data; Bioinformatics: Definition, Scope and Applications; Biological Databases: NAR Databases Categories, Nucleic Acid Sequence Databases-NCBI, EMBL and DDBJ; Literature databases- PubMed and PubMed Central.

Learning Outcomes:

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

- Understand the nature of biological data and its classification (L1).
- Define bioinformatics and explain in detail about scope and applications of bioinformatics (L2)
- Explain in detail about biological databases and their appropriate uses (L2)
- Explain about major bioinformatics resources (L2). Describe the formats of data available from resources and its appropriate usage (L2).
- Explain in detail about nucleic acid sequence databases, and literature databases.

UNIT-II

Protein Sequence Databases- UniProt, NCBI-Protein and TrEMBL; Protein Structure Databases- PDB, SCOP, CATH; Metabolic Pathway Databases- KEGG, BioCyc.

Learning Outcomes:

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

- Understand various kinds of protein data and availability of resources (L1).
- Explain about protein sequence data, and the availability of protein sequence data resources
- Describe structural data formats of databases (L2)
- Describe the protein structural databases and the availability of protein structural data resources (L2)
- Describe the metabolic pathway databases and the availability of metabolic pathway data resources (L2)

UNIT-III

Concepts of Sequence-Homology, Similarity and Identity; Types of Homology- Orthologs and Paralogs; Sequence Alignment Strategies-Global and Local; Sequence Alignment Methods-Dot Matrix Method, Measures of sequence similarity. Scoring Matrices: PAM and BLOSUM, Comparison between PAM and BLOSUM

Learning Outcomes:

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

- Differentiate between types of sequence similarities (L2).
- Describe the various types of scoring matrices used for alignments (L2).
- Compare scoring matrices PAM and BLOSUM (L2)
- Describe the various types of sequence alignment strategies (L2).
- Describe various measures of sequence similarity (L2).

UNIT-IV

Sequence Alignment Methods- Dynamic Programming: Use of Needleman and Wunsch Algorithm for Global Alignment, Use of Smith and Waterman Algorithm for Local Alignment. Database Similarity Searching: Outline of BLAST Search Steps, Parameters, Variants and Applications

Learning Outcomes:

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

- Understand the concept of sequence alignment (L1) and explain the methods for aligning sequences (L2).
- Explain the use of Needleman and Wunsch algorithm for global sequence alignment (L2).
- Explain the use of Smith and Waterman algorithm for local sequence alignment (L2).

- Describe the methodology, parameters and the applications of BLAST (L2).
- Describe BLAST and its variants for sequence bases searches (L2).

UNIT-V

Multiple sequence alignment - Definition, Properties, Features, Tools and its Applications; Phylogenetics Basics – Terminology, Forms of Tree Representation and Overview of Tree Construction Methods.

Learning Outcomes:

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

- Explain multiple sequence alignment (MSA), tools for MSA and its applications (L2).
- Understand the difference between pairwise and multiple sequence alignments (L2).
- Describe phylogenetic trees, types and their applications (L2).
- Describe the phylogenetic trees and their construction methods (L2).
- Describe various tree evaluation methods to evaluate a phylogenetic tree (L2).

Recommended Books:

- 1) Introduction to Bioinformatics, Lesk, A.M; Oxford University Press, Fourth ed.
- 2) Bioinformatics and Functional Genomics, Jonathan Pevsner; Wiley, 2nd Ed.
- 3) Introduction to Bioinformatics, Teresa K. Attwood, David J. Parry-Smith; Pearson Education
- 4) Essential Bioinformatics, JinXiong; Cambridge University Press, First ed.

Course Outcomes:

Upon completion of the course, the students will be able to:

- Classify different types of Biological Databases (CO1).
- Understand basics of sequence alignment and implementation of matrices (CO2).
- Explain about the concept of pairwise sequence alignment, algorithms and tools for pairwise alignment (CO3).
- Describe about Multiple Sequence Alignment, its significance, algorithms and tools used for MSA (CO4).
- Describe about the various techniques, algorithms and tools used for Phylogenetic Analysis (CO5).

BCBI2111 BIOINFORMATICS LAB

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

Course Description:

Bioinformatics / Computational biology is defined as the application of tools of computation and analysis to the capture and interpretation of biological data. This course describes the main tools/databases of the bioinformatics for analysis and provides hands-on demonstrations like how they are being used to interpret biological data and to further understanding of disease.

Course Objectives

- To explore data available in major bioinformatics resources.
- To perform biological literature search.
- To retrieve nucleotide, protein sequences, structural and metabolic data in different formats.
- To identify homologous sequences and phylogenetic analysis.

Practical's Laboratory Sessions:

1. NAR Database Category List
2. Biological Literature Databases– PubMed, PubMed Central
3. Nucleic Acid Sequence Databases– NCBI Nucleotide
4. Nucleic Acid Sequence Databases –EMBL ENA
5. Nucleic Acid Sequence Databases – DDBJ
6. Protein Sequence Databases – UniProt
7. Protein Structural Databases – PDB
8. Protein Structural Databases – SCOP
9. Protein 3D Structural Databases – CATH
10. Metabolic Pathway Databases – KEGG
11. Metabolic Pathway Databases – BioCyc
12. Pairwise Sequence Alignment – UsingBLAST
13. Multiple Sequence Alignment – UsingClustal Omega Tool
14. Phylogenetic Tree Construction – Using Phylogeny.fr Tool

Course outcomes:

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

- Differentiate between three major bioinformatics resources.
- Search and retrieve right kind of biological literature
- Retrieve and analyze sequence and structural data in their respective formats and their importance.
- Identify the homologous sequences and understand the concept of sequence searches.
- Construct MSAs and phylogenetic trees to infer sequence relationships.

BCBI2121: HUMAN PHYSIOLOGY AND NUTRITION

L	T	P	S	J	C
3	0	0	0	0	3

Preamble:

Human Physiology and Nutrition deals with the basic physiological function in human systems and explains the role of nutrition, vitamins, and minerals in diet. In human systems, the vital physiological systems involved to maintain life like digestion, respiration, circulation, muscular system, and endocrine system are explained along with abnormal functions. Further, the balanced diet, basal metabolic rate, protein energy malnutrition, nutraceuticals, functional foods, and nutritional aspects of vitamins and minerals are explained.

Course Objectives

- To acquire knowledge on digestion and absorption of biomolecules, respiration, and transportation of gases in blood.
- To understand heart structure, cardiac cycle, muscle structure, and mechanism of muscle contraction.
- To study endocrine system with function and abnormalities of various hormonal changes.
- To learn about the role of nutrition in human health with aspects of marasmus, and kwashiorkor.
- To understand the structure, functional and nutritional aspects of vitamins, minerals, nutraceuticals, and functional foods.

UNIT- I

Digestive and Respiratory System: Digestion and absorption of carbohydrates, lipids and proteins. Respiration and transportation of gases in blood (oxygen and CO₂), Bohr's effect.

Learning Outcomes:

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

- Identify blood components with their functions (L1).
- Explain blood clotting mechanism (L2).
- Describe the transport and exchange of gases in the body (L2).
- Highlight the role of Haemoglobin with structural importance in respiration (L2).
- Understand regulatory mechanism of respiration and respiratory changes observed in different conditions (L2).

UNIT-II

Circulatory and muscle physiology: Heart- structure of the heart, cardiac cycle, cardiac factors controlling blood pressure. Kinds of muscles, structure of myofibril, organization of contractile proteins and mechanism of muscle contraction.

Learning Outcomes:

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

- Identify blood components with their functions (L1).
- Explain blood clotting mechanism (L2).

- Describe the transport and exchange of gases in the body (L2).
- Highlight the role of Haemoglobin with structural importance in respiration (L2).
- Understand regulatory mechanism of respiration and respiratory changes observed in different conditions (L2).

UNIT-III

Endocrinology- organization of endocrine system. Outlines of chemistry, physiological role and disorders of hormones of pancreas, thyroid, parathyroid, gonads, adrenals, pituitary and hypothalamus. Mechanism of hormonal action- signal transduction pathways for adrenaline, glucocorticoids, and insulin.

Learning Outcomes:

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

- Identify the organs involved in the endocrine system and their locations in the human body (L1).
- Explain the functions of pituitary hormones and disorders related to pituitary hormones (L2)
- Describe about the functions and abnormalities of thyroid, parathyroid, adrenal, and gonadal hormones (L2)
- Illuminate about the functions of gastrointestinal, pancreatic, and renal hormones (L2)
- Lay down the general mechanism of hormone action (L2)

UNIT- IV

Nutrition: Balanced diet. BMR and factors affecting it. Specific dynamic action of foods. Recommended dietary allowance (RDA) for children, adults, pregnant and lactating women. Biological value of proteins. Sources of complete proteins. Malnutrition- Kwashiorkor, Marasmus and PEM. Role of essential fatty acids in human nutrition. Obesity and starvation.

Learning Outcomes:

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

- Nutritional analysis of diet and their functions (L1).
- Importance of SDA, RDA, BMI in human life (L2).
- Nutritional aspects of dietary proteins (L2).
- Role of essential fatty acids in human nutrition (L2).
- Understand the importance of nutrition on malnutrition (L2).

UNIT – V

Nutritional aspects of Vitamins and Minerals: Vitamins- sources, structure, biochemical roles, deficiency disorders of water- and fat-soluble vitamins. Bulk and trace elements-Ca, Mg, Fe, I, Cu, Mo, Zn, Se and F. Introduction to nutraceutical and functional foods.

Learning Outcomes:

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

- Identify the vitamins and minerals involved in the development and maintenance of the human body.
- Vitamins and Minerals with their functions (L1).
- Biological activities of Vitamins and minerals (L2).
- Structural analysis of nutraceuticals (L2).
- Functional and biological activities of functional foods (L2).

Course outcomes:

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

- To acquire knowledge on digestion and absorption of biomolecules, respiration, and transportation of gases in blood.
- To understand heart structure, cardiac cycle, muscle structure, and mechanism of muscle contraction.
- To study endocrine system with function and abnormalities of various hormonal changes.
- To learn about the role of nutrition in human health with aspects of marasmus, and kwashiorkor.
- To understand the structure, functional and nutritional aspects of vitamins, minerals, nutraceuticals, and functional foods.

Recommended Books:

1. Textbook of human Physiology by Guyton, Elsevier, 11th Ed.
2. Essentials of Medical Physiology by K. Sembulingam, PremaSembulingam, Jaypee, 2nd Ed.
3. Textbook of Biochemistry & Human Biology by G.P.Talwar PHI, 3rd Ed.
4. Textbook of Medical Biochemistry by M.N.Chatterjee, Jaypee 6th Ed.
5. Molecular Endocrinology by Bolander, Elsevier 3rd Ed.

BCBI2131: PLANT BIOCHEMISTRY

L	T	P	S	J	C
3	0	0	0	0	3

Course Description:

Plants are vital resources for the survival of animals and their metabolites have various applications. The course offers the basic knowledge on the biochemical processes of production of organic compounds by fixing atmospheric simpler molecules like carbon dioxide and Nitrogen. It also covers the important hormones actions occurring in the plant growth, secondary metabolites produced in plants with their uses and plant defence mechanisms.

Course Objectives :

1. To explain the mechanism of photosynthetic mechanism
2. To impart knowledge on nitrogen fixation mechanism
3. To present the actions of important phytohormones in plant development
4. To deliver the mechanism of mutations and their role in genetic analysis
5. To describe the concept of population genetics

Unit-I

Photosynthesis: Plastids, Photo phosphorylation- cyclic and non-cyclic. ATP synthase. Rubisco, CO₂ fixation in C₃, C₄ and CAM plants. Photo respiration-significance, mechanism.

Learning Outcomes:

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

- Describe the photosynthetic organelles of plants (L2)
- Explain the conversion of light energy to chemical energy (L2)
- Lay out the mechanism of CO₂ fixation in plants (L2)
- Distinguish between the mechanism of CO₂ fixation in C₃, C₄ and CAM type plants with their adaptation (L4)
- Outline the role of photo respiration in CO₂ fixation (L2)

Unit-II

Nitrogen Fixation: Nitrogen cycle, Non-biological and biological nitrogen fixation. Symbiotic nitrogen fixation, Nitrogenase system. nif genes. Ammonia incorporation into organic compounds.

Learning Outcomes:

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

- Outline the nitrogen transfer in the environment using nitrogen cycle (L2)
- Explain the process of non-biological and biological nitrogen fixation (L2)
- Illustrate the mechanism of symbiotic nitrogen fixation and functioning of nitrogenase system (L2)
- Identify the nif gene expression proteins and their role in the nitrogen fixation (L3)
- Describe the process of ammonia incorporation into organic compounds (L2)

Unit-III

Plant Hormones: Structure, function and mode of action of plant hormones- Auxins, Gibberellins, Cytokinins, Absciscic acid, Ethylene and Strigolactones. Phytochromes.

Learning Outcomes:

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

- Draw the chemical structure of different plant hormones (L2)
- Identify the function of different specific hormones (L3)
- Outline the mechanism of action of different plant hormones (L2)
- Apply the knowledge of different plant hormones to improve the crop yields (L3)
- Describe the role of phytochromes in plant development (L2)

Unit-IV

Plant secondary metabolites: Structure and function of Secondary metabolites-terpenes, saponins, phenolic compounds-lignin, flavonoids, tannins and nitrogen containing secondary compounds-alkaloids.

Learning Outcomes:

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

- Explain the importance of plant secondary metabolites (L2)
- Enlist the different types of secondary metabolites produced by plants (L2)
- Illustrate the functions of different secondary metabolites of plants (L2)
- Identify the specific plant parts to extract the specific secondary metabolites (L3)
- Suggest the specific plants to grow for the required secondary metabolites (L2)

Unit-V

Plant defense mechanisms: Role of Cutin, Waxes, suberin in defense. Anti-Oxidant enzyme systems in plant defense. Mechanism of biotic and abiotic stress factors –pathogens, insects, heat shock, drought and salinity. Thigmonastic and mimicry in plant defense.

Learning Outcomes:

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

- Explain the survival adaptations of plants to the external forces (L2)
- Enlist the different defence mechanisms of plants (L2)
- Illustrate the antioxidant enzyme system in plant defence mechanism (L2)
- Outline the plant defence mechanism against biotic and abiotic stress (L2)
- Describe thigmonastic behaviour of some plants in defence mechanism (L2)

Course Outcomes :

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

- Explain the mechanism of photosynthetic mechanism
- Impart knowledge on nitrogen fixation mechanism
- Present the actions of important phytohormones in plant development
- Deliver the mechanism of mutations and their role in genetic analysis
- Describe the concept of population genetics

Recommended Books:

1. Principles of Biochemistry by Nelson cox, Freeman, 4th Ed.
2. Plant Physiology by Taiz and Zeiger, 3rd Ed.
3. Plant Biochemistry by Hans-Walter Heldt, 3rd Ed
4. Biochemistry and Molecular Biology of Plants by Bob B. Buchanan, 2nd Edition

BCBI2141: GENOMICS AND PROTEOMICS

L	T	P	S	J	C
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Course Overview

Genomics and proteomics are fast-growing fields that develop extensive data for a particular organism to one specific condition and help to deal with complex situations in many cases. The knowledge of genomics and proteomics helps narrow down the experimental procedures to achieve reliable results faster and validate them.

Course Objectives:

1. To acquire knowledge on genome sequencing strategies and methods of assembly.
2. To acquire knowledge on concepts, tools, and databases of comparative genomics.
3. To identify different regions of the genome with their functions using numerous methods.
4. To understand different strategies and methods employed in protein separation and quantification for whole samples of proteins at a time.
5. To understand different principles of protein-protein and protein-DNA interactions.
- 6.

UNIT-I

Large scale genome sequencing strategies - shotgun, hierarchal, high throughput sequencing; Genome assembly, and annotation; Tools for genome assembly.

Learning Outcomes:

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

- Explain the genome sequencing strategies employed with their advantages and disadvantages.
- Describe the concept, methods & tools employed in genome assembly and annotating the genome sequencing.

UNIT-II

Basic concepts and applications of comparative genomics; Whole-genome alignment; Tools and Databases for comparative genomics.

Learning Outcomes:

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

- Describe the basic concepts of comparative genomics & its applications.

- Discuss the concept of whole-genome alignment.
- Discuss the tools & databases for comparative genomics.

UNIT-III

Identification of genes, promoters, splice sites, repetitive elements, CpG islands.

Learning Outcomes:

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

- Describe the methods to employ to identify gene segments in prokaryotes and eukaryotes (like exons and introns) in genome sequence.
- Explain the process of identification regulatory parts in genome sequence like promoters, repetitive elements and CpG islands.

UNIT IV

Protein sequence-structure-function relationship; Motifs, and Domains; Protein expression analysis–2D-gel electrophoresis and protein chip technology; Post-translational modifications.

Learning Outcomes:

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

- Understands the relationship between protein sequence-structure-function.
- Discuss the principle, methodology & applications of 2D gel electrophoresis and protein chip technology.
- Explain the concept of post-translational modifications.

UNIT V

Protein-Protein Interactions, Yeast Two-Hybrid system, STRING, Protein-DNA interactions.

Learning Outcomes:

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

- Enlighten the methods to find the protein-protein interactions using yeast-hybrid method and STRING tool.
- Understand the protein-DNA interactions to solve biological problems.

Text Books

1. Bioinformatics and Functional Genomics, Pevsner, J., John Wiley and Sons.
2. Essential Bioinformatics, Jinxiong, Cambridge University Press

3. Principles of Proteomics – R.M. Twyman, Spl. Indian Ed.

Reference Books

1. Principles of genome analysis and. Genomics, Primrose, S.B. and Twyman, R.M., Third Edition, Blackwell Publishing Company.
2. Bioinformatics: Genes, Proteins and Computers – Orengo, Jones and Thornton
3. Introduction to protein science – A.M. Lesk, 2nd Ed.

Course Outcomes:

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

- Understand the concept of genomics and proteomics and its necessity to solve biological problems.
- Employ good strategies for sequencing the genome of a particular sample. And use different methods and tools to assembly the gene fragments obtained in genome sequencing.
- Identify, predict and annotate the different sequences in the genome assembled by employing suitable tools. And understand the concept, tools, and databases of comparative genomics.
- Understand the basic principles of the protein sequence-structure-function relationship. And the role of motifs and domains in the structure-function of protein.
- Understand the basic principles of protein expression analysis, post-translational modifications, protein-protein interactions, and protein-DNA interactions to solve biological problems.

BCBI2151: GENETICS

L	T	P	S	J	C
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One of the most important processes of living organisms is to reproduce the offspring with same characteristics and little variation. The inheritance patterns are analysed and predicted using the knowledge of genetics. The course covers the basic principles of inheritance, mechanism of inheritance of characters, mutations, variation, and principles of population genetics.

Course Objectives:

1. To explain the principles of heredity and Mendel's experiments
2. To impart knowledge on deviations of Mendel's laws and their causes
3. To provide the details about the mechanism of similarity and variations while genetic information passage to next generations
4. To deliver the mechanism of mutations and their role in genetic analysis
5. To describe the concept of population genetics

Unit-I

History of Genetics, Concepts of Phenotype, Genotype, Heredity, Variation. Heredity and Environment. Mendel experiments on pea plants, Mendelian principles of inheritance.

Learning Outcomes:

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

- Define the different terminologies of genetics (L1)
- Explain the role of environment on heredity (L2)
- Analyse the Mendel's experiments on pea plants (L4)
- Describe the basic laws of inheritance (L2)
- Solve and express the outcome of different genetic crosses (L3)

UNIT-II

Limitations to Mendel's laws. Incomplete dominance and Co-dominance, Complementary gene interaction, Supplementary gene interaction, Epistasis-Dominant epistasis, and recessive epistasis. Multiple alleles. Extra chromosomal inheritance.

Learning Outcomes:

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

- Explain deviations from basic laws of inheritance (L2)
- Describe the dominance principles during inheritance of characters (L2)
- Identify the genetic interaction mechanism based on the genetic ratios (L3)
- Distinguish the inheritance mechanisms with the affecting factors (L4)
- Evaluate the various genetic crosses observed in different experiments (L5)

UNIT-III

Linkage and crossing over. Recombination. Sex-Linked, Sex-influenced, Sex- limited inheritance. Epigenetic mechanism of inheritance. Concept of Forward genetics and reverse genetic approach.

Learning Outcomes:

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

- Describe the process of linkage and crossing over (L2)
- Define the recombination and explain its significance (L2)
- Infer the influence of sex of organism in inheritance (L2)
- Outline the epigenetic mechanism of inheritance (L2)
- Explain the basic strategies of studying genetics (L2)

UNIT-IV

Mutation types, mechanism, and their significance. Basic concept of genetic diseases. Mutagenic methods in genetic analysis-mutagenic agents, methods of isolation of mutants and analysis of mutant progeny.

Learning Outcomes:

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

- Define mutation and outline the types of mutations (L2)
- Describe the mechanism of mutation (L2)
- Explain the importance of mutation in inheritance (L2)
- Illustrate the basis of the genetic diseases (L2)
- Outline the use of mutation mechanism in study of genetic analysis (L2)

UNIT-V

Concepts of a population, gene pool, allele frequencies and genotype frequencies. Genetic Polymorphism. Genetic equilibrium- Hardy-Weinberg Law, factors affecting Hardy-Weinberg Law. Concept of gene evolution, genetic biodiversity.

Learning Outcomes:

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

- Define population, gene pool, allele, and gene frequencies (L2)
- Explain the genetic polymorphism with examples (L2)
- Demonstrate the theory proof of hardy-Weinberg law (L2)
- Illustrate the factors affecting the genetic equilibrium (L2)
- Describe the gene evolution and gene biodiversity(L2)

Course Outcomes:

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

- Explain the principles of heredity and Mendel's experiments
- Impart knowledge on deviations of Mendel's laws and their causes
- Outline the details about the mechanism of similarity and variations while genetic information passage to next generations
- Describe the mechanism of mutations and their role in genetic analysis
- Illustrate the concept of population genetics

Recommended Books:

1. Principles of Heredity by Robert Tymarin.A, Tata McGraw Hill, 7th Ed.
2. Genetics by M. W. Strickberger, Mac Millan, 3rd Ed..
3. Principles of Genetics by Sinnet, McGraw Hill, 5th Ed..
4. Principles of genetics by Gardner, M. J. Simmons, D. P. Snustad, 8th ed

BCBI2161: FUNCTIONAL FOODS AND NUTRACEUTICALS

L	T	P	S	J	C
3	0	0	0	0	3

Functional foods and nutraceuticals deal with the basic structures, sources, and biological function of functional foods including prebiotics, probiotics, and dietary fiber. Further it explains about the sources, structure, functional, and biological activities of Nutraceuticals.

Course Objectives

- To acquire knowledge on sources, structures of phytochemical compounds.
- To understand the functional importance of prebiotics.
- To understand the structures and functions of probiotics.
- To understand the functional importance of nutraceuticals
- Digestion and absorption of functional food products.

UNIT- I

Introduction to Functional Foods-definition, history, and types. Components of functional foods. Stages involved in development of functional foods. Perceived effect of diet on disease prevention. Understanding benefits of functional foods.

Learning Outcomes:

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

- Acquires knowledge about functional foods (L1).
- Structural components of functional foods (L2).
- Develop and formulate novel functional foods (L2).
- Importance of functional foods in disease prevention (L2).
- Understand the benefits of functional foods in human health (L2).

UNIT-II

Probiotics: Taxonomy and important features of probiotic micro-organisms. Health effects of probiotics. Probiotics in various foods: fermented milk products, non-milk products etc. Quality Assurance of probiotics and safety.

Learning Outcomes:

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

- Acquires knowledge about probiotics (L1).
- Nutritional composition and microbial analysis of probiotics (L2).
- Health importance of probiotics (L2).
- Importance of probiotics in disease prevention (L2).

- Importance of fermented milk products in human health (L2).

UNIT-III

Prebiotics: Definition, chemistry, sources, and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases. Perspective for food applications for the non-digestible carbohydrates, Dietary fiber, Resistant starch, Gums.

Learning Outcomes:

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

- Acquires knowledge about prebiotics (L1).
- Nutritional composition and microbial analysis of prebiotics (L2).
- Health importance of prebiotics (L2).
- Importance of prebiotics in disease prevention (L2).
- Importance of dietary fiber and resistant starch in human health (L2).

UNIT- IV

Nutraceuticals: Definition, chemistry, sources, Classification of nutraceuticals - based on food source, mechanism of action and chemical nature. Role of flavonoids, isoprenoids, isoflavones, carotenoids, tocotrienols, terpenoids, polyunsaturated fatty acids, sphingolipids, lecithin, choline.

Learning Outcomes:

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

- Acquires knowledge about nutraceuticals (L1).
- Nutritional composition and structural analysis of phytochemical compounds (L2).
- Health importance of phytochemical compounds (L2).
- Importance of nutraceuticals in disease prevention (L2).
- Mechanism and action of nutraceuticals in human health (L2).

UNIT – V

Concepts of dietary supplements: phytochemicals, dietary fiber, omega 3 and 6 fatty acids. Non-essential nutrients as dietary supplements. Fortified foods: skim milk, hemp milk, yogurt, whole grain bread, eggs. Role of nutraceuticals in health and disease management.

Learning Outcomes:

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

- Acquires knowledge about dietary supplements (L1).
- Nutritional composition and structural analysis of phytochemical compounds (L2).
- Health importance of dietary supplements (L2).
- Importance of dietary supplements in disease prevention (L2).

- Mechanism and action of dietary supplements in human health (L2).

Course Outcomes:

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

- To acquire knowledge on sources, structures of phytochemical compounds.
- To understand the functional importance of prebiotics.
- To understand the structures and functions of probiotics.
- To understand the functional importance of nutraceuticals
- Digestion and absorption of functional food products.

Recommended Books:

- Aluko, Rotimi, Functional Foods and Nutraceuticals, Springer-Verlag New York Inc.,2012.
- Satinder Kaur Brar, Surinder Kaur and Gurpreet Singh Dhillon, Nutraceuticals Functional Foods,2014.

BCBI2171 INTRODUCTION TO NANOBIOLOGY

L	T	P	S	J	C
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Course Description: Nanobiology is the understanding and control of matter at the nanometer scale, where unique phenomena enable novel applications. Encompassing nanoscale science, engineering, and technology, nanotechnology involves imaging, measuring, modeling, and manipulating matter at this length scale. Knowledge in Nanobiology will help considerably to improve, even revolutionize, many technology and industry sectors: information technology, homeland security, medicine, transportation, energy, food safety, and environmental science, among many others.

Course Objectives:

1. To understand the concept of nanomaterials and nanomaterial synthesis.
2. To understand the role of nano technology in tissue regeneration.
3. To study the concepts of bioimaging.
4. To learn the various applications of carbon tubes, dendrimers, liposomes, metallic nanoparticles and Quantum dots.
5. To understand the role of nano-particles in cancer drug delivery.

UNIT – I

Fundamentals of Nanotechnology: Definition of nanomaterial. Mechanical, optical, electronic, magnetic nanomaterials. Chemical properties of Nanomaterials. Metal nanoparticles, magnetic nanoparticles.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand the concept of nanomaterials.
- Learn the various types of nanomaterials.
- Study the applications of mechanical, optical, electronic, magnetic nanomaterials.
- Learn chemical properties of nanomaterials.
- Understand the concept of magnetic nanoparticles

UNIT – II

One-dimensional, two-dimensional and three dimensional nanoparticles. Synthesis of Nanomaterials: Concepts of Bottom Up and Top down Approach and biological synthesis using sol -gel process.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand the concept of types of nanomaterials.
- Learn the various types of synthesis of nanomaterials.
- Learn concepts of bottom-up approach of nanomaterial synthesis.
- Understand the concept of Top down approach of nanomaterial synthesis
- Study the concepts of biological synthesis of nanomaterial using sol -gel process

UNIT – III

Nanostructures, Biological products of nanoparticles using fungi, bacterial, yeast and actinomycetes. DNA- protein nanostructures: oligonucleotide- enzyme conjugates; Concept of Magnetosomes.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand the properties of nanomaterials.
- Learn the various types of nanostructures products of nanoparticles using various organisms.
- Learn concepts of DNA- protein nanostructures.
- Understand the concept of oligonucleotide- enzyme conjugates.
- Study the concepts of magnetosomes.

UNIT – IV

Advantages of nano-sizing. Lab-on chip nanotechnology for better and easy diagnosis; Role of nano technology in tissue regeneration; nano probes for bioimaging, cancer detection.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand the advantages of nano-sizing.
- Learn the various applications of nanotechnology in diagnostics.
- Understand the role of nano technology in tissue regeneration.
- Understand the concept of nanoprobe.
- Study the concepts of bioimaging.

UNIT – V

Carbon tubes, Dendrimers, liposomes, metallic nanoparticles, Quantum dots. Introduction to nanocarriers; Role of nano-particles in cancer drug delivery. Nano toxicity.

Learning Outcomes: By the end of this Unit, the student will be able to

- Understand the applications of nanosystems.
- Learn the various applications of carbon tubes, dendrimers, liposomes, metallic nanoparticles and Quantum dots.

- Learn concepts of nanocarriers.
- Understand the role of nano-particles in cancer drug delivery.
- Study the concepts of nanotoxicity.

REFERENCES:

1. Nanotechnology, Richard Booker, Earl Boysen, Wiley Publications, 2005.
2. Nano: The Essentials. T.Pradeep, McGraw Hill Education, 2010.
3. Nanochemistry: A chemical approach to nanomaterials by G.A.Ozin, A.C.Arsenault, and L.D.Cademartiri, RSe Publishing, 2007.

BCBI3061: APPLIED BIOCHEMISTRY

L	T	P	S	J	C
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Applied Biochemistry deals with the basics and understanding of the central dogma where the genes are located. This knowledge can be employed in determining the function of various genes and proteins for better understanding of cellular life and development of transgenic organisms.

Course objectives:

- To understand the concept of measuring nucleic acid and protein interactions.
- To understand mapping of genes and finger printing techniques.
- To learn different techniques in gene amplification and synthesis.
- To gain knowledge on stem cells, markers and stem cell applications.
- To acquaint the methods of gene therapy and their applications

UNIT-I

Methods for measuring nucleic acid and protein interactions – foot printing, CAT assay, gel shift analysis. DNA markers in genetic analysis – RFLP, RAPD, minisatellites, microsatellites.

Learning outcomes:

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

- Learn and remember the nucleic acid and protein interactions (L1)
- Understand the importance of DNA foot printing and CAT assay (L2).
- Understand the role of genetic markers (L2).
- Explain and understand the RFLP and RAPD in genetic analysis (L2).
- Explain the use of minisatellites and microsatellites in identifying the genes (L2).

UNIT-II

Mapping genes – Chromosomal walking, chromosomal jumping, DNA fingerprinting, single nucleotide polymorphism, FISH, Transposon tagging, site-directed mutagenesis

Learning outcomes:

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

- Gain knowledge on mapping of different genes located on the chromosomes (L1)
- Understand the importance of chromosomal walking and jumping techniques while mapping genes (L2).
- Understand the role of DNA fingerprinting in forensic science (L2).
- Explain and understand the role of single nucleotide polymorphism in mapping genes (L2).
- Explain the use of FISH, transposon tagging and site directed mutagenesis (L2).

UNIT-III

Amplification of DNA: Polymerase Chain Reaction, cDNA synthesis, Rapid amplification of cDNA ends (RACE-PCR), Chemical synthesis of genes

Learning outcomes:

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

- Gain knowledge and acquaint the principle of PCR (L1)
- Understand the importance of PCR and cDNA synthesis (L2).
- Understand the role of RACE – PCR in protecting the cDNA ends (L2).
- Explain and understand the RFLP and RAPD in genetic analysis (L2).
- Explain the use of minisatellites and microsatellites in identifying the genes (L2).

UNIT-IV

Stem cells – embryonic and adult stem cells. Stem cell markers. Stem cell plasticity and differentiation. Application of stem cells in medicine

Learning outcomes:

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

- Understand the concept of stem cells (L1)
- Learn the types and localization of stem cells (L2).
- Understand the role of stem cell markers (L2).
- Differentiate embryonic and adult stem cells (L2).
- Acquaint with the applications of stem cells in medicine (L2).

UNIT-V

Gene therapy: Methods of gene therapy- Ex vivo, In situ, In vivo, somatic and germline. Types and use of rDNA constructs for Gene therapy, Delivery systems for gene therapy.

Learning outcomes:

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

- Illustrate the different methods of gene therapy (L1).
- List the types and application of rDNA constructs for gene therapy (L2).
- Describe the different delivery systems for gene therapy (L2).
- Highlight the applications of gene therapy in biological and medical fields (L2).
- Remember the role of gene therapy with the use of rDNA constructs (L2).

Course Outcomes

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

- Understand the concept of measuring nucleic acid and protein interactions (CO1).

- Learn and understand the concept of mapping of genes and finger printing techniques (CO2).
- Acquaint the different techniques in gene amplification and synthesis (CO3).
- Gain knowledge on stem cells, markers and stem cell applications (CO4).
- Understand the methods of gene therapy and their applications (CO5).

Recommended Books:

5. Human Molecular Genetics by Tom Strachan and Andrew Read, Taylor & Francis Publisher, 3rd Ed.
6. Principles of gene manipulation & genomics by Primrose & Twyman, Oxford, 7th Ed.
7. Molecular cell biology by Lodish, Freeman, 6th Ed.
8. Molecular Biotechnology - Principles and applications of Recombinant DNA by Glick, 2nd Ed.
9. Stem Cells: Basics and Applications by Koushik k Deb, Satish M Totey Tata McGraw-Hill Education, 2009.
10. Stem Cells: From Mechanisms to Technologies edited by Michal K. Stachowiak, Emmanuel Tzanakaki, Publishers: World Scientific.
11. Stem Cells: From Basic Research to Therapy, Volume 1 by Federico Calegari, Claudia Waskow, CRC Press.

BCBI3151: MOLECULAR MODELING AND STRUCTURAL BIOINFORMATICS

L	T	P	S	J	C
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Course Overview

This course introduces fundamental concepts and methods of molecular modeling and structural bioinformatics. Topics covered include representation of chemical molecules, molecular graphics, force fields, structure prediction and structure alignment methods. The main goal of structural bioinformatics is to provide computational approaches for predicting and analyzing 3D structures. Understanding the 3D structures of biological macromolecules is crucial for understanding their function. Applications of structural bioinformatics are oriented towards medical fields and pharmacological research, especially, drug design.

Course Objectives:

1. Describe the basic theoretical aspects of molecular modeling techniques
2. Evaluate the successes and limitations of molecular modeling
3. Describe the protein structure prediction methods
4. Evaluate and discuss protein modeling methods
5. Describe the structural alignment methods

UNIT-I

Representation of Chemical Compounds - Line Notations, Standard Structure Exchange Formats; Molecular Surfaces, Molecular Graphics; Molecular Modeling Methods – Outline, Advantages, Disadvantages and Applications.

Learning Outcomes:

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

- describe and comprehend the fundamental concepts of molecular modeling and computational-driven drug discovery
- well-verse in theoretical and practical aspects of molecular modeling.

UNIT-II

Molecular Mechanics: Force Fields – Definition and Features, Functional Forms –Bond Stretching, Angle Bending, Torsional Terms, Out-of-plane Bending, Crossterms, Electrostatic, Vander Waals and Hydrogen Bonding interactions; Force fields for Biomolecules.

Learning Outcomes:

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

- Understand the theory, concepts and terminology of molecular mechanics.
- Describe the definition & features of force fields.
- Describe the various force fields for biomolecules.

UNIT-III

Protein Primary and Secondary Structure Analysis: Primary Sequence Analysis, Secondary Structure Prediction – Chou-Fasman, GOR, Neural Network.

Learning Outcomes:

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

- Understand the theory, concepts and terminology of molecular mechanics.
- Describe the definition & features of force fields.
- Describe the various force fields for biomolecules.

UNIT IV

Protein Modeling & Evaluation: Homology modelling, Fold Recognition and Abinitio. Error Estimation and Precision, Stereo Chemical Parameters.

Learning Outcomes:

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

- Understand the theory, concepts and various approaches of protein modeling.
- Describe the methods to estimate and calculate the errors in protein models
- Describe the role of stereo chemical parameters in protein models.

UNIT V

Structure Alignment and Comparison: Concept of Protein Structure Comparison and Alignment, Structural Alignment Methods - CE, VAST, DALI, SSAP, TM-align.

Learning Outcomes:

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

- Understand the theory, concepts and various approaches to perform structure alignment & comparison of protein structures.
- Describe the methods of structure alignment methods.

Text Books

- 1) Molecular Modelling: Principles and Applications, A.R. Leach; Pearson Seconded.
- 2) Structural Bioinformatics, Jenny Gu, Philip E. Bourne, Wiley, Seconded.
- 3) Chemoinformatics: A Textbook, Johann Gasteiger, Thomas Engel, Wiley.

Reference Books

1. Essential Bioinformatics, JinXiong; Cambridge University Press, First ed.
2. Introduction to Bioinformatics, Lesk, A.M; Oxford University Press, Fourth ed.

Course Outcomes:

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

1. Access and browse a range of structural data repositories
2. Determine whether appropriate structural information exists about a given small molecule, macromolecule or complex, applying available structure-quality information
3. Build a structural model for a protein which has a structurally characterised relative and evaluate its quality
4. Predict the function of a protein-based on sequence and structure data.

BCBI3081: BASICS OF CANCER BIOLOGY

L	T	P	S	J	C
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This course is designed with fundamentals of cancer cells. It introduces etiology of cancer, molecular basis of cancer, cancer diagnosis. It also introduces principles of cancer therapy.

Course Objectives

- To study the characteristics of human cancer cells, causes of cancer. Prevalence of cancer.
- To identify different types of tumors and cancers.
- To study the molecular basis of cancer
- To study the principles and applications of cancer prediction and diagnostic methods
- To study the principle of different types of therapies

UNIT - I

Fundamentals of cancer cells - characteristics of human cancer cells, causes of cancer. Prevalence of cancer.

Learning outcomes:

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

- Know about characteristics of cancers (L1) .
- Know about sign and symptoms of cancers (L2).
- Recognize causes of cancers (L2).
- Understand the prevalence of cancer (L3).
- Identify risk factors of cancers (L2).

UNIT - II

Etiology - Types of tumors - Benign and malignant tumors. Types of cancer - Carcinoma, Sarcoma, Lymphoma.

Learning outcomes:

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

- Able to different types of cancers (L2).
- Differentiate benign tumors from malignant tumors (L4).
- Understand features of carcinoma (L2).
- Understand the features of sarcoma (L3).
- Learn about the lymphoma (L4).

UNIT - III

Molecular basis of cancer - Carcinogenesis. Tumor suppressor and oncogenes. Basics of cell cycle, metastasis, apoptosis and angiogenesis.

Learning outcomes:

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

- Understand mechanism of carcinogenesis. (L4).
- Learn the about the role of oncogene and tumor suppressor genes in cancer (L3).
- Learn about cell cycle and apoptosis (L2).
- Know about fundamentals of cancer metastasis (L2).
- Describe biology angiogenesis (L3).

UNIT – IV

Principle of diagnostic methods – Blood Tests, Biopsy, Diagnostic Imaging – X-rays, CAT scan and MRI, Mammography.

Learning outcomes:

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

- Learn about clinical examination of cancer by blood tests (L1).
- Understand the application of Biopsy in cancer diagnosis (L1).
- Learn about diagnosis of cancer by X-rays, CT scan (L2).
- Learn about diagnosis of cancer by MRI (L2).
- Learn about diagnosis of cancer by Mammography (L2).

UNIT - V

Treatment - Principles of chemotherapy, radiation therapy, immune therapy gene therapy, nanotherapy.

Learning outcomes:

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

- Understand general principles of cancer therapy (L2).
- Gain knowledge about chemotherapy (L1).
- Understand the concept of radiation therapy (L3).
- Understand the concept of immune therapy (L3).
- Understand the concept of nanotherapy (L2).

Course Outcomes:

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

- Understand fundamentals of cancer cells
- Know the etiology and types of cancers
- Understand the molecular basis of cancer
- Know the principles of diagnostic methods

- Know the treatment and prevention of cancer

Recommended Books:

1. The Biology of Cancer, Janice Gabriel, John Wiley & Sons Ltd., 2nd Ed.
2. Molecular Pathology and Diagnostics of Cancer (Cancer Growth and Progression), Domenico Coppola, Springer.
3. An Introduction to Cellular and Molecular Biology of Cancer, Oxford Medical publications.
4. Cancer Biology, Raymond W. Ruddon, Oxford University Press, Inc., 4th Ed.

BCBI3091 STEM CELL BIOLOGY

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Course Description: Stem cell Biology has emerged as a new and most exciting field of life science in view of its potential clinical applications. Our understanding of stem cells has grown rapidly over the last decade, but the apparently tremendous therapeutic potential of stem cells has not yet been realized. The routine use of stem cells in therapeutics and tissue regeneration is greatly anticipated.

Course Objectives:

- To understand the concept of stem cells.
- To learn the concepts of iPS and stem cell niche.
- To study the applications of stem cells in the treatment of cancer, neurodegenerative diseases etc.,
- To learn the concepts of stem cell transplantation and tissue remodeling
- To study the role of animal models in stem cell research.

UNIT – I

Types of stem cells-Embryonic, adult and Umbilical cord blood stem cells. Characteristic features of stem cells Differences and similarities in adult and embryonic stem cells. Localization of stem cells in different tissues.

Learning Outcomes:

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

- Understand the concept of stem cells.
- Learn the various types of stem cells and their localization
- Study the characteristic features of stem cells.
- Understand the concept of adult and embryonic stem cells.
- Learn differences and similarities in adult and embryonic stem cells.

UNIT - II

Stem cell markers. Tissue specific stem cells. Hematopoietic stem cells. Neural stem cells. Cardiac stem cells. Induced pluripotency. The concept of stem cell niche.

Learning Outcomes:

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

- Understand the concept of stem cell markers.
- Learn the various types of tissue specific stem cells.
- Study the characteristic hematopoietic and neural stem cells
- Understand the concept of cardiac stem cells.
- Learn the concepts of iPS and stem cell niche.

UNIT – III

Stem cells in gene therapy, Applications of stem cells in regenerative medicine- myocardial infraction, cancer, diabetes, aging and other neurodegenerative diseases: Parkinson's. Concept of stem cell transplantation.

Learning Outcomes:

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

- Understand the applications of stem cells in gene therapy.
- Learn the various applications of stem cells in the treatment of myocardial infraction.
- Study the applications of stem cells in the treatment of cancer.
- Study the applications of stem cells in the treatment of neurodegenerative diseases.
- Learn the concepts of stem cell transplantation.

UNIT - IV

Stem Cells in Drug Screening and Toxicology. Disease Modeling with Stem Cells. Stem Cells in Tissue Remodeling. Introduction to regenerative medicine.

Learning Outcomes:

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

- Understand the applications of stem cells in drug screening.
- Learn the various applications of stem cells toxicology.
- Study the concept of disease modelling using stem cells.
- Study the role of stem cells in tissue remodeling.
- Learn the concepts of regenerative medicine.

UNIT – V

Stem cells from cord blood and their cryopreservation. Maintenance of stem cells. Animal models in stem cell research. Ethical and regulatory issues involving stem cell research.

Learning Outcomes:

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

- Understand the applications of stem cells collected from cord blood.
- Learn the methods of cryopreservation of stem cells
- Learn the concepts of maintenance of stem cells.
- Study the role of animal models in stem cell research
- Study the ethical and regulatory issues involving stem cell research.

REFERENCES

1. Stem Cells: Basics and Applications by Koushik k Deb, Satish M Totey Tata McGraw-Hill Education, 2009.
2. Stem Cells: From Mechanisms to Technologies edited by Michal K. Stachowiak, Emmanuel Tzanakaki, Publishers: World Scientific.
3. Stem Cells: From Basic Research to Therapy, Volume 1 by Federico Calegari, Claudia Waskow, CRC Press.