

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. Microbiology

(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

- To expose students to the theory and laboratory skills in microbiology
- To make students competent in Microbiology and allied areas by providing them hands-on experience.
- To instill the ability for research and entrepreneurship in the students
- To increase the students ability in integrating various aspects of microbiology

Program Outcomes:

Students will be able to:

- Will gain basic knowledge about microbiology principles with an understanding of bacteriology, cell biology, molecular biology, virology, mycology, immunology, pathogenesis, laboratory diagnosis, prevention, and control of common diseases in the country.
- They will also acquire laboratory safety knowledge and routine and specialized microbiological skills applicable to clinical research, including accurately reporting observations and analysis.
- Relate and include the principles of microbiology in practical, real-world situations and problems.

Program Specific Outcomes:

- Will implement basic principles of bacteriology, cell biology, molecular biology, virology, mycology, and immunology in real-world situations and problems.
- Learn the detailed principles, procedures, and applications of chromatographic, electrophoretic, and spectrophotometric techniques to purify proteins to homogeneity and quantitate the concentrations successfully.

CURRICULUM STRUCTURE OF B.Sc. MICROBIOLOGY

(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 to 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
PHYS1041	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
MFST1051	1	Introductory Microbiology	3	0	0	0	0	3
MFST1061	1	Introductory Microbiology Practical	0	0	2	0	0	1
MFST1071	1	Microbial Genetics	3	0	0	0	0	3
MFST1081	1	Microbial Genetics Practical	0	0	2	0	0	1
MFST2061	2	Cell and Molecular Biology	3	0	0	0	0	3
MFST2071	2	Microbial Physiology and Biochemistry	3	0	0	0	0	3
MFST2091	2	Cell and Molecular Biology Practical	0	0	2	0	0	1
MFST2081	2	Microbial Physiology and Biochemistry Practical	0	0	2	0	0	1
MFST2101	2	RDNA Technology	3	0	0	0	0	3
MFST2111	2	RDNA Technology Practical	0	0	2	0	0	1
MFST3061	3	Immunology	3	0	0	0	0	3
MFST3071	3	Industrial Microbiology	3	0	0	0	0	3
MFST3081	3	Immunology Practical	0	0	2	0	0	1
MFST3091	3	Industrial Microbiology Lab	0	0	2	0	0	1
MFST3101	3	Medical Microbiology	3	0	0	0	0	3
MFST3111	3	Medical Microbiology Practical	0	0	2	0	0	1

Programme Elective (PE)*

Course code	Level	Course title	L	T	P	S	J	C
MFST2301	2	Biofilms	3	0	0	0	0	3
MFST2321	2	Biofilms Practical	0	0	2	0	0	1
MFST2311	2	Microbes in Sustainable Agriculture	3	0	0	0	0	3
MFST2331	2	Microbes in Sustainable Agriculture Practical	0	0	2	0	0	1
MFST2341	2	Marine Microbiology	3	0	0	0	0	3
MFST2351	2	Food Microbiology	3	0	0	0	0	3
MFST2361	2	Bioenergy and Biofuels	3	0	0	0	0	3
MFST2371	3	Virology	3	0	0	0	0	3
MFST3221	3	Bioremediation	3	0	0	0	0	3
MFST3231	3	Instrumentation and Biotechniques	3	0	0	0	0	3
MFST3241	3	Microbial Biotechnology	3	0	0	0	0	3

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

Note 2: Theory and corresponding lab course are co-requisites (For example if a student opts to study MFST2301 then he/she has to study MFST2321 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 Microbiology Program

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

Minor Courses in Biochemistry*

Course code	Level	Course title	L	T	P	S	J	C
BCBI1021	1	Protein Chemistry and Enzymology	3	0	0	0	0	3
BCBI1031	1	Protein Chemistry and Enzymology Lab	0	0	2	0	0	1
BCBI2001	2	Metabolism and Bioenergetics	3	0	0	0	0	3
BCBI2021	2	Biochemical Techniques	3	0	0	0	0	3
BCBI2041	2	Molecular Biology	3	0	0	0	0	3
BCBI2051	2	Molecular Biology Lab	0	0	2	0	0	1
BCBI3001	3	Genetic Engineering	3	0	0	0	0	3
BCBI3021	3	Clinical Biochemistry	3	0	0	0	0	3
BCBI3031	3	Clinical Biochemistry Lab	0	0	2	0	0	1
BCBI3041	3	Immunology	3	0	0	0	0	3

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 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

[illegible]

Minor Courses in Food Science and Technology*

[illegible]

Minor Courses in Environmental Science

[illegible]

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

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

- 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.

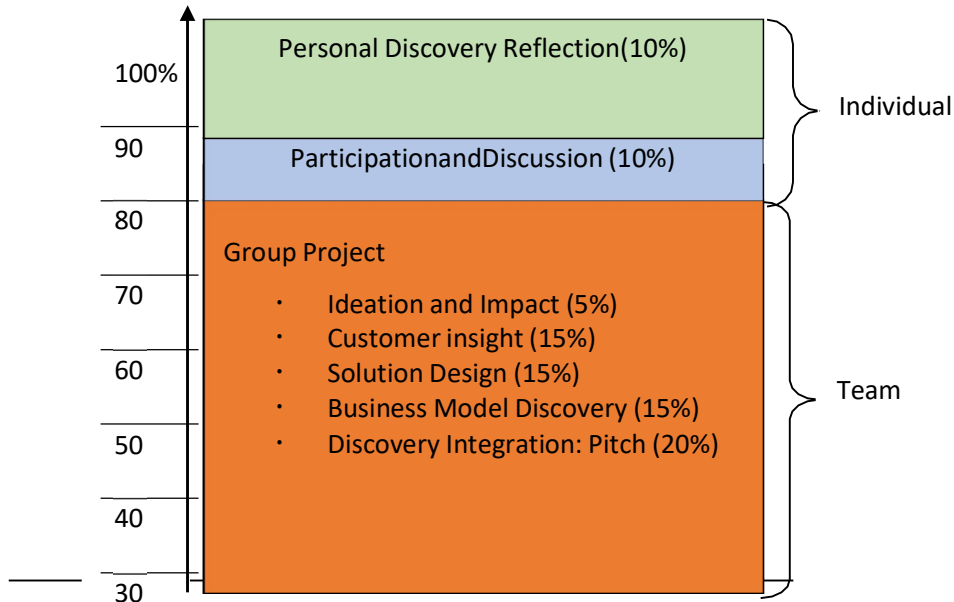
“Design” is fun, particularly when you merge customer insight with your own creativity. Enjoy! In this book, we provide structured methods to be an active listener and learner from customers as well as a product or service designer.

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

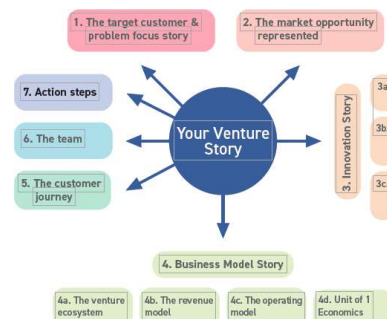
Week	Session	Topics and Steps	Key CONCEPTS Introduced in Class	Class Focus Activity
1	1	Course Overview	<ol style="list-style-type: none"> 1. Why is entrepreneurship important? 2. What is Personal Discovery through Entrepreneurship? 3. Four Stages; Personal Discovery, Solution Discovery, Business Model 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			

We ek	Sess ion	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
We ek	Sess ion	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.

CHEM1011: CHEMISTRY I

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.

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.

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.

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.

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).

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.

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

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.

UNIT – I: 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.

UNIT – II: 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).

UNIT – III: 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.

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 $-\text{COOH}$ group, acetylation of $-\text{NH}_2$ 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.

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.

Textbook(s):

1. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).

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

CSCI1001: BASICS TO INFORMATION TECHNOLOGY

UNIT – I

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

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

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

UNIT – II

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

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

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

UNIT – III

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

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

UNIT – IV

Computer Networks: Introduction, Local Area Network (LAN), Applications of LAN, Wide Area Network (WAN), Internet, Naming computers connected to Internet, Future of Internet Technology. **Computer Software:** Introduction, Operating system, Programming languages, Classification of programming languages, Classification of Programming Languages based on applications.

UNIT-V

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

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

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

Text Books:

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, 6th edition, 2006.
2. Fundamentals of Computers by E.Balagurusamy, Tata McGraw Hill, 2009.

CHEM1021: CHEMISTRY I LAB

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

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 $\text{Na}_2\text{S}_2\text{O}_3$.

Section B: Organic Chemistry

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

Reference book(s):

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

CHEM1051: CHEMISTRY III

Preamble

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.

Unit I **9L**

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.

Unit II **9L**

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^-).

Unit III **9L**

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. **Unit**

IV **9L**

Electroanalytical methods: Basic principle, Instrumentation and applications of pH metric, potentiometric and conductometric titrations.

Unit V **9L**

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

Text Books

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.

PHYS1041: BIOPHYSICS

UNIT I

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

UNIT II

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

UNIT III

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

UNIT IV

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

UNIT V

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

RECOMMENDED BOOKS:

1. Essentials of Biophysics: P.Narayanan. New Age India Intl.
2. Handbook of Radiobiology by KT Jaypee Brothers, Medical Publishers Pvt. Ltd.
3. An Introduction to radiation protection by A Martin & SA Harbison, 4th 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, 1st Edition, CRC press.

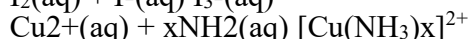
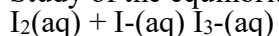
CHEM1041: CHEMISTRY II LAB

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

Section A: Physical Chemistry

Distribution

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



Conductance

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

Potentiometry

Perform the following potentiometric titrations:

i. Strong acid vs. strong base

ii. Weak acid vs. strong base

iii. Potassium dichromate vs. Mohr's salt

Section B: Organic Chemistry

I

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

II

1. Separation of amino acids by paper chromatography

2. Determination of the concentration of glycine solution by formylation method.

3. Titration curve of glycine

4. Action of salivary amylase on starch

5. Effect of temperature on the action of salivary amylase on starch.

6. Differentiation between a reducing and a nonreducing sugar.

Textbook(s):

1. 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.

2. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

3. Khosla, B. D.; Garg, V. C. & Gulati,

A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

4. Ahluwalia, V.K. & Aggarwal, R.

Comprehensive Practical Organic Chemistry, Universities Press

PHYS1101: BIOPHYSICS LAB

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

RECOMMENDED BOOKS:

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

Program Core/Major Core (PC/MaC)

MFST1051: INTRODUCTORY MICROBIOLOGY (THEORY)

Preamble:

This course introduces the students to the basic concepts of microbiology, history and development of microbiology. Additionally, they learn about isolation identification classification of microorganisms. Introducing the subject to all the applied aspects of microbiology.

Course Objectives:

- To learn the subject of microbiology by its history, microscopy, aseptic techniques, sterilization, isolation of bacteria, study of morphological characters, identifying and classification of bacteria.
- To know the preservation of microbes, staining techniques, understanding nutritional types of bacteria.
- To learn the details of some clinically important bacteria
- To understand the importance of study of microbiology of water, milk and microbial interactions in nature.

Unit1

History of Development of Microbiology, Spontaneous generation vs. biogenesis, Germ theory of disease, golden era of microbiology, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner

Learning Outcomes:

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

- To understand the history and importance of Microbiology
- To learn the contributions of eminent personalities for microbiology

Unit 2

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and

Protozoa) with emphasis on distribution and occurrence, morphology, nutrition, mode of reproduction and economic importance.

Learning Outcomes:

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

- To know how to classify the microbes
- To understand the basic structure and characteristics of microbes

Unit 3

Morphology and ultrastructure of bacterial cell, endospore: Structure, formation, stages of sporulation. Introduction to Bergey's manual of systematic bacteriology.

Learning Outcomes:

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

- To Understand the structure of bacterial cell
- To learn about the systemic bacteriology

Unit 4

Sterilization Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation. Chemical methods of microbial control: disinfectants, types and mode of action. Isolation, cultivation, enumeration and preservation of microorganisms; Microscopic identification: staining methods- simple, differential, structural and special staining. Bacterial reproduction and growth. Synchronous, batch and continuous cultures.

Learning Outcomes:

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

- To learn the methods for microbial control
- To understand the bacterial growth and reproduction

Unit 5

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Scanning and Transmission Electron Microscope

Learning Outcomes:

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

- To understand and apply the knowledge of microscopy in the study of microbes
- To understand different types of microscopes used for microbiology

Course Outcomes:

- By the end of the course students will
- Learn the history of Microbiology, microscopy, aseptic techniques, sterilization,
- Learn about the isolation of bacteria, study of morphological characters, identifying and classification of bacteria.
- Learn the preservation of microbes, staining techniques, understanding nutritional types of bacteria.
- Know the details of some clinically important bacteria
- Understand the importance of study of microbiology of water, milk and microbial interactions in nature.

RECOMMENDED BOOKS

- Microbiology 5th edition by Pelczar, Chan and Krieg.
- General Microbiology, 5th edition by Stanier, Deudroff and Adelberg.
- Bergey's Manual of Systematic Bacteriology 9th edition, volumes I to VI.
- Brock Biology of Microorganism 9th edition by Madigan, Martinko and Parker.

MFST1061: INTRODUCTORY MICROBIOLOGY (PRACTICAL)

1. Microbiology Good Laboratory Practices and Biosafety.
2. To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter used in the microbiology laboratory.
3. Morphological identification of bacteria.
4. Morphological identification of Fungi using permanent slides/wet mounts.
5. Morphological identification of algae using permanent slides/wet mounts.
6. Preparation of different media: synthetic media BG-11, Complex media-nutrient agar, McConkey agar, EMB agar.
7. Simple staining
8. Negative staining
9. Gram's staining
10. Acid fast staining-permanent slide only.
11. Capsule staining
12. Endospore staining.
13. Isolation of pure cultures of bacteria by streaking method.
14. Preservation of bacterial cultures by various techniques.
15. Estimation of CFU count by spread plate method/pour plate method.
16. Motility by hanging drop method.

SUGGESTED READINGS

- Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
- Black J G .(2008).Microbiology: Principles and Explorations. 7th edition. Prentice Hall
- Madigan M T, and Martinko J M. (2014). Brock Biology of Micro-organisms.14thedition.ParkerJ. Prentice Hall International, Inc.
- Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology.5th edition Tata Mc Graw Hill.
- Srivastava S and Srivastava PS. (2003).Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

Course Outcomes:

After the completion of the above experiments the students will be able to perform

- Isolation of various microorganisms (bacteria, fungi) from different sources (water, soil, food)
- Identification of physiological characteristics such as gram, capsule, spore and flagella by microscopic techniques
- Identification of the biochemical characteristics of the bacteria
- Preparation of various types of media for culturing of microorganism

MFST1071: MICROBIAL GENETICS (THEORY)

Preamble

While Fidelity in genome replication allows for stability of a species, changes in genome are important for variability of individuals and evolution of species. The changes can be brought about through processes inherent to the cell or as an effect of outside factors. This course deals with the molecular mechanisms, such as mutation, recombination and transpositions, which allow for the incorporating variations in the genome.

Course Objectives

- To teach the students the types of mutations
- To elucidate the Plasmids structure, function and types
- To provide a detailed information on Recombination in bacteria
- To describe the Genetic mapping using recombination
- To teach the students about mobile genetic elements

UNIT--I

Genome organization: *E. coli*, *Saccharomyces*, *Tetrahymena*. Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertants; Intra- and inter-genic suppression; Ames test; Mutator genes

Learning Outcomes:

By the end of this Unit, the student will know about:

- Genome organization of type species
- Mutations: cause and types
- Molecular basis of mutations

UNIT-II

Plasmids and their types, – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast-2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Learning Outcomes:

By the end of this Unit, the student will know about:

- Plasmids general characters
- Functional types of plasmids

- Replication and regulation

Unit-III

Genetic exchange in prokaryotes, Transformation - Discovery, mechanism, Conjugation- Discovery, mechanism, Hfr and F' strains, Transduction-Generalized transduction, specialized transduction,

Learning Outcomes:

By the end of this Unit, the student will know about:

- Transformation and mechanism
- Conjugation
- Transduction and types

Unit-IV

Phage Genetics: Genetic Mapping- Interrupted mating technique and time of entry mapping, co-transduction of markers, Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda

Learning Outcomes:

By the end of this Unit, the student will know about:

- Genetic mapping
- Interrupted mating
- Lytic lysogenic switch

Unit- V

Transposable elements: Prokaryotic transposable elements–Insertion Sequences, composite and non-Replicative transposition, Mu transposon. Eukaryotic transposable elements-Yeast (Ty1 transposon), Drosophila (P elements), Maize (Ac/Ds). Uses of transposons and transposition.

Learning Outcomes:

By the end of this Unit, the student will know about:

- Define transposons, and types
- Know the characters of transposons in type studies
- List the advantages of transposons

RECOMMENDED BOOKS:

- Watson JD, Baker TA, Bell SP, Gann A, Levine M and LosickR (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

- Becker WM, Kleinsmith L.J, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
- DeRobertis EDP and DeRobertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

Course Outcomes

After completion of the course, students will:

- Learn about the types of mutations
- Elucidate the Plasmids structure, function, and types
- Gather detailed information on Recombination in bacteria
- Understand the process of genetic mapping using recombination
- Learn the concepts of mobile genetic elements

MFST1081: MICROBIAL GENETICS (PRACTICAL)

- Preparation of Master and Replica Plates
- Study the effect of physical (UV) mutagens on bacterial cells
- Study survival curve of bacteria after exposure to ultraviolet (UV) light
- Isolation of Plasmid DNA from E.coli
- Demonstration of Bacterial Conjugation
- Demonstration of bacterial transformation/transduction
- Demonstration of AMES test

SUGGESTED READINGS

- Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley& Sons. Inc.
- Sambrook J and Russell DW.(2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
- Cell biology: Practical manual, 2018 by Renu Gupta et al
- Cell And Molecular Biology: A Lab Manual, 2013, PHI learning India Limited.
- Laboratory Manual of Microbiology and Biotechnology , 2014, K.R.Aneja. publisher Med. Tech.

Course Outcomes:

After the completion of the above experiments the students will be able to perform:

- Isolation of various microorganisms (bacteria, fungi) from different sources (water, soil, food)
- Identification of physiological characteristics such as gram, capsule, spore and flagella by microscopic techniques
- Identification of the biochemical characteristics of the bacteria
- Preparation of various types of media for culturing of microorganism

MFST2061: CELL AND MOLECULAR BIOLOGY

Preamble:

The Cell and Molecular Biology course is designed to help understand how the cells are organized, in prokaryotes and eukaryotes. It helps the students grasp the correlation of the structure of the cell organelles to the function they carry out. They will learn the process of replication, transcription and translation in prokaryotes and Eukaryotes. The course provides understanding of how cells divide, while maintaining the genomic integrity, and how variations occur through meiosis.

Course Objectives:

1. To understand the structures and purpose of basic components of prokaryotic and eukaryotic cells
2. To understand how the genetic material is faithfully replicated and transferred to the daughter cells yet allowing for variation in population
3. To learn the methods and importance of protein regulation and transport.

Unit1

Plasma membrane Structure: sandwich, fluid-mosaic models. Nutrient transport- passive and facilitated diffusion, active transport, group translocation. Cell Wall: Eukaryotic cell wall, Extra cellular matrix. Cell-Cell junctions and plasmodesmata (only structural aspects)

Learning Outcomes: By the end of this Unit, the student will know

- To learn about types of cell organization
- To understand about Plasma membrane structure
- To study about Nutrient transport

Unit-2

Mitochondria, chloroplasts and peroxisomes; Cytoskeleton: Structure and organization, Nucleolus, organization of Ribosomes, Endoplasmic Reticulum structure, and protein targeting. Golgi Apparatus, protein glycosylation, protein sorting and export from Golgi Apparatus, Lysosomes.

Learning Outcomes: By the end of this Unit, the student will know about

- To learn about Cell organelles and their function
- To know about Nuclear organization
- To understand about Cytoskeleton structure

- To learn about protein sorting and transport

Unit III

DNA Structure: Miescher to Watson and Crick- historic perspective. Salient features of double helix, Types of DNA. Types of genetic material. Denaturation and renaturation, cot curves. Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA—mitochondria and chloroplast DNA.

Learning Outcomes: By the end of this Unit, the student will know about

- The deciphering DNA as genetic material, and structure elucidation
- Types and organization of genetic material
- Extra genomic DNA

Unit IV

Bidirectional and unidirectional replication, semi-conservative, semi-discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase, Various models of DNA replication-rolling circle, Θ (theta) mode. Mismatch and excision repair

Learning Outcomes: By the end of this Unit, the student will know about

- DNA replication
- Characters and function of enzymes of replication
- Plasmid DNA replication
- Repair of DNA

Unit V

Transcription: Definition, promoter-concept and strength of promoter, transcription in prokaryotes and eukaryotes. Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of translation in prokaryotes.

Learning Outcomes: By the end of this Unit, the student will know about

- Transcription factors, promoters and transcription process

- Charging of tRNA
- Mechanism of translation in prokaryotes
- Mechanism of translation in eukaryotes

RECOMMENDED BOOKS

1. Molecular Biology of the Cell (5th edition) by B. Alberts *et. al.*
2. Molecular Cell Biology (6th edition) by H. Lodish *et. al.*
3. Cell and Molecular Biology (8th edition) by E.D.P.DeRobertis
4. The Cell: A molecular approach (6th edition). by G.M Cooper

Course outcomes:

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

- To learn about types of cell organization
- To learn about Cell organelles and their function
- DNA replication and characters and function of enzymes of replication.

MFST2071: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Preamble

This course is familiarizes the student with various physiological aspects and metabolic pathways operating in microorganisms. The concept of microbial growth, factors that govern the growth and survival of microbes under various conditions shall be explained. The detailed mechanism of metabolism of carbohydrates, fats, and proteins shall be elucidated comprehensively. The diversity of metabolic pathways with special reference to microbial physiology shall be covered.

Course Objectives

- To understand mechanism of growth and survival strategies operating in microbes
- To learn the nutrient transport mechanisms in bacteria
- To understand types of heterotrophic metabolism viz. aerobic, anaerobic respiration and fermentation
- To appreciate the photosynthetic and nitrogen assimilation mechanism operating in microbes.

Unit I

Microbial Growth and Effect of Environment on Microbial Growth

Nutritional classification of microorganisms. Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve, Factors affecting microbial growth-Temperature, pH, solute and water activity, Oxygen, atmospheric pressure.

Learning outcomes

After completion of this unit the students will be able to:

- Differentiate microbes based on their mode of nutrition
- Comprehend concept of growth in microbes
- Understand the effect of various factors on microbial growth

UNIT II

Nutrient uptake and transport- passive and facilitated diffusion, primary and secondary active transport, concept of uniport, symport and antiport, group translocation, iron uptake.

Learning outcomes

After completion of this unit the students will be able to:

- Learn mechanism of nutrient transport operating in microbes
- Appreciate the efficiency of nutrient transport system in microbes

Unit III

Chemoheterotrophic Metabolism-Aerobic Respiration, Concept of aerobic respiration, anaerobic respiration and fermentation Glucose metabolism-*viz.* EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain. Anaerobic respiration with special reference to dissimilatory nitrate reduction. Fermentation–alcohol fermentation and Pasteur effect

Learning outcomes

After completion of this unit the students will be able to

- Learn mechanisms of aerobic and anaerobic respiration operating in microbes
- Understand the fundamental process of glucose metabolism

Unit IV

Chemolithotrophic and Phototrophic Metabolism Introduction to aerobic and anaerobic chemolithotrophy with examples. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Photosynthesis- Anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.

Learning outcomes

After completion of this unit the students will be able to

- Understand fundamental principles of chemolithotrophy
- Comprehend the diversity of phototrophic bacteria

UNIT V

Bacterial Chemotaxis, Quorum sensing & biofilms. - Properties of nitrogenase, and ammonia assimilation. Genetics of nitrogen fixation and regulation of nitrogenase activity and synthesis.

Learning outcomes

After completion of this unit the students will be able to

- Appreciate the mechanism of bacterial response to chemical stimuli

- Understand the mechanism of biological nitrogen fixation

Course Outcomes:

By the end of the course, students will

- Understand the mechanism of growth and survival strategies operating in microbes
- Learn the nutrient transport mechanisms in bacteria
- Understand different types of heterotrophic metabolism viz. aerobic, anaerobic respiration and fermentation
- Appreciate the photosynthetic and nitrogen assimilation mechanism operating in microbes.

MFST2081: CELL AND MOLECULAR BIOLOGY PRACTICAL

1. Microscopic study of plant and animal cell
2. Study of the structure of cell organelles through electron micrographs
3. Study of different stages of Mitosis.
4. Study of different stages of Meiosis
5. Study of different types of DNA and RNA using micrographs and model/schematic representations
6. Isolation of genomic DNA from plant material.
7. Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)
8. Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement)
9. Resolution and visualization of DNA by Agarose Gel Electrophoresis.
10. Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

RECOMMENDED BOOKS

1. Cell biology: Practical manual, 2018 by Renu Gupta et al
2. Cell And Molecular Biology: A Lab Manual, 2013, PHI learning India Limited.
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
4. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
5. DeRobertis EDP and DeRobertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
6. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons Inc.
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

Course Outcomes:

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

- Microscopic study of plant and animal cell
- Different stages of mitosis and meiosis

MFST2091: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY PRACTICAL

1. Study and plot the growth curve of *E.coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data
3. Effect of temperature on growth of *E.coli*
4. Effect of pH on growth of *E.coli*
5. Effect of carbon and nitrogen sources on growth of *E.coli*
6. Effect of salt on growth of *E.coli*
7. Demonstration of alcoholic fermentation
8. Demonstration of the thermal death time and decimal reduction time of *E.coli*

RECOMMENDED BOOKS

1. Madigan MT, and Martinko JM (2014). Brock Biology of Microorganisms. 14th edition. Prentice Hall International Inc.
2. Reddy S R and Reddy S M.(2005).Microbial Physiology. Scientific Publishers India.
3. Gottschalk G. (1986). Bacterial Metabolism. 2nd edition. Springer Verlag
4. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology.9th edition. McGraw Hill Higher Education.

Course Outcomes:

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

- Understand the importance of bacterial growth curve
- Demonstrate the role of temperature, pH, salt, carbon and nitrogen sources on the growth of *E coli*

MFST2101: RECOMBINANT DNA TECHNOLOGY

Preamble

The discovery of restriction endonucleases, brought on a never ending advent and improvement of the molecular biological techniques and their application in day to day life. This course aims to enhance the understanding of the various tool and methodologies involved in molecular cloning. The course starts with enzymes, cloning vectors, and DNA manipulation, through the amplification of DNA, screening methods, finger printing etc., leading to the microarray techniques

Course objectives

- To teach the students the types of enzymes important in Recombinant DNA technology, with mechanism and applications.
- To make them understand the various types of cloning vectors, and their usage
- Let the students learn of various analysis methods, for screening of clones
- Make the students appreciate the importance of microarray methods

Unit-1

Restriction modification systems: Types I, II and III. Modification, nomenclature, applications; Function and application of DNA polymerases. Terminal deoxynucleotidyl transferase, kinases and phosphatases, and DNA ligases. Use of linkers and adaptors

Learning Outcomes:

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

1. Know the types and function of DNA nucleases
2. Understand mechanism of DNA modifying enzymes
3. Learn the importance and types of DNA polymerases

Unit- 2

Cloning Vectors: Definition and Properties Plasmid vectors: pBR and pUC series Bacteriophage lambda and M13 based vectors Cosmids, BACs, YACs, , SV40-based expression vectors

Learning Outcomes:

By the end of this Unit, the student will

1. Understand the requirements of a vector
2. Know the characters of important cloning vectors
3. Appreciate the use of expression vectors

Unit-3

Transformation of DNA: Chemical method, Electroporation, Gene delivery: Microinjection, electroporation, biolistic method (gene gun), liposome and viral- mediated delivery, Agrobacterium - mediated delivery. DNA, RNA and Protein analysis: Agarose gel electrophoresis, Southern - and Northern - blotting techniques, dot blot, SDS-PAGE and Western blotting.

Learning Outcomes:

By the end of this Unit, the student will

1. Understand the various methods for transforming DNA
2. Know the analytical technique for DNA analysis
3. Learn the protein analysis techniques

Unit-4

DNA Amplification and DNA sequencing, PCR: Basics of PCR, RT-PCR, Real-Time PCR, Sanger's method of DNA Sequencing: traditional and automated sequencing Primer walking and shot gun sequencing

Learning Outcomes:

By the end of this Unit, the student will

1. Learn the amplification techniques
2. Know about the DNA sequencing
3. Understand the genome sequencing

Unit-5

Genomic and cDNA libraries: Preparation and uses, Screening of libraries: Colony hybridization and colony PCR, Chromosome walking and chromosome jumping, Applications of Recombinant DNA Technology, microarray technology

Learning Outcomes:

By the end of this Unit, the student will

1. Know about types of DNA libraries
2. Making of and use of library
3. Application of recombinant DNA technology

Course outcomes:

By the end of the course, students will

1. Learn about the types of enzymes important in Recombinant DNA technology, with mechanism and applications.
2. Understand the various types of cloning vectors, and their usage
3. Learn of various analysis methods, for screening of clones
4. Appreciate the importance of microarray methods

RECOMMENDED BOOKS

1. Genetic Engineering: Principles and Practice (2015) by S. Mitra
2. Molecular Cloning (1989) J. Sambrook et. al.
3. Microbiology – A Laboratory Manual (10th edition) by J.G. Cappuccino and Sherman.
4. Methods in Molecular Biotechnology: Experimental Analysis (2010) by V. Gomase et.al.

MFST2111: RECOMBINANT DNA TECHNOLOGY PRACTICAL

1. Preparation of competent cells for transformation
2. Demonstration of Bacterial Transformation
3. Digestion of DNA using restriction enzymes and analysis by agarose gel electrophoresis
4. Ligation of DNA fragments
5. Cloning of DNA insert and Blue white screening of recombinants.
6. Interpretation of sequencing gel electropherograms
7. Designing of primers for DNA amplification
8. Amplification of DNA by PCR
9. Demonstration of Southern blotting

RECOMMENDED BOOKS

1. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons, Inc.
2. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
3. Cell biology: Practical manual, 2018 by Renu Gupta et al
4. Cell And Molecular Biology: A Lab Manual, 2013, PHI learning India Limited.
5. Laboratory Manual of Microbiology and Biotechnology, 2014, K.R.Aneja. publisher Medtech

Course Outcomes:

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

- Prepare competent cells
- Bacterial transformation
- Perform PCR and southern blotting

MFST3061: IMMUNOLOGY

Preamble:

Immunology course provides the knowledge about structure and function of immune system. This course provides the basic fundamentals of Antigens, antibodies, antigen and antibody interactions along with complement activation and MHC.

Course Objectives:

- To provide ground knowledge about the immune system and its functions
- To provide key components of the innate and adaptive immune responses
- To Provide fundamental working knowledge of the basic principles of immunology and diagnostic immunology
- To provide mechanism of complement system activation pathways and structure and functions of Major Histo Compatible complex ,
- To provide Basic principles of immunization.

Unit 1

Concepts and Types of immunity- Innate immunity, Adaptive immunity, immunological response, contributions of Scientists in the field of immunology- Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff

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

- Concepts and types of immune systems
- By the end of this unit, the student will be able to gain knowledge regarding
- Structure and functions of Organs and Cells involved in immune system

Unit 2

Structure, Functions and Properties of organs involved in immune system- Primary lymphoid organs and secondary lymphoid organs, Structure and functions of Immune Cells – T cell, B cell, NK cell, Macrophages, Neutrophils, Eosinophil, Basophil, Mast Cell, Dendritic cells

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

- Structure and functions of Cells involved in immune system
- Primary and secondary lymphoid organs and their functions.
- Immunological memory

Unit 3

Characteristics and nature of antigen- epitopes, haptens, Structure and characteristics and types of antibodies- Ig G, Ig A, Ig M, Ig E, Ig D. Monoclonal antibodies and polyclonal antibodies, Hybridoma technology

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

- Nature of antigens
- Types, structure, and functions of antibodies
- Concept of monoclonal antibodies and hybridoma Technology

Unit 4

Antigen- antibody reactions: principles and applications of precipitation, agglutination, Immunodiffusion, Immunofluorescence, Immunoelectrophoresis, ELISA, RIA, Western blotting, Complement system-Complement activation pathways- classical, alternative and lectin pathways, biological consequences of complement action

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

- Antigen antibody reactions and their principles
- Antigen and antibodies role in diagnostic tests
- Concept of complement system
- Activation pathways and biological consequences of complement system

Unit 5

Major histocompatibility complex, Structure and functions of Class I MHC and Class II MHC, Antigen processing and antigen presentation by cytosolic and endocytic pathways, Principles of Immunization

Learning Outcomes: By the end of this unit, the student will be able to learn about

- Major Histocompatibility Complex (MHC)
- Structure and functions of Class I and Class II MHC
- Fundamentals of antigen processing and presentation pathways
- Principles of immunization

RECOMMENDED BOOKS

- Abbas AK, Lichtman AH, Pillai S.(2007).Cellular and Molecular Immunology. 6th edition Saunders Publication ,Philadelphia.
- Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
- Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

Course Outcomes:

At the end of the course, students will

- Develop ground knowledge about the immune system and its functions
- Learn key components of the innate and adaptive immune responses
- Gain fundamental working knowledge of the basic principles of immunology and diagnostic immunology
- Learn mechanism of complement system activation pathways and structure and functions of Major Histo-Compatible complex ,
- Learn Basic principles of immunization.

MFST3071: INDUSTRIAL MICROBIOLOGY

Preamble:

This course provides an overview about the study of range of fermentation processes, design of fermentors and types of fermentors, fermentation economics, and production of valuable products by fermentation technology such as antibiotics, beverages and organic acids and enzymes including downstream processing methods.

Course Objectives:

- To familiarize students with the range of fermentation processes
- To provide knowledge on fermentor design and types of bioreactors
- To give knowledge about fermentation medium selection, importance of growth kinetics
- To make students understand about the production of ethanol, organic acids, vitamins, enzymes and immobilization technique

Unit 1

Significance of industrial microbiology in various fields, Industrially important microorganism and their source, Screening and strain development methods, Isolation and preservation methods of industrially important microbial strains, Media formulation for industrial fermentations, crude and synthetic media

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

- Significance of industrial microbiology
- Screening and Strain development methods
- Media formulation

Unit 2

Types of fermentation process, solid state and liquid state fermentations, Growth kinetics, batch, fed batch, continuous fermentations, dual and multiple fermentation process, scale-up and fermentation economics

Learning Outcomes: By the end of this unit, the student will be able to gain knowledge on the

- Types of fundamental fermentation process
- Significance of scale-up process
- Fermentation economics

Unit 3

Design and components of typical bioreactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, stirred tank and air lift bioreactor, control of fermentation parameters-pH, temperature, dissolved oxygen and foaming and aeration

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

- Design and components of typical bioreactor
- Types of bioreactors
- Control of fermentation parameters

Unit 4

Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and applications)-Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12 Enzymes (amylase, protease, lipase) Wine, beer

Learning Outcomes: By the end of this unit, the student will be understand the processes related to the

- Microbial production of organic acids and beverages
- Microbial production process of enzymes and vitamins
- Applications and fermentation conditions for fermented products

Unit 5

Down-stream processing- cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying, enzyme immobilization method and their advantages and limitations

Learning Outcomes: By the end of this unit, the student will be gain knowledge on

- Various downstream processing methods used for fermented products
- Basic concepts of immobilization technology and their types

RECOMMENDED BOOKS

1. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
2. Okafor N. (2007). Modern Industrial Microbiology and Biotechnology. 1st edition. BiosScientific Publishers Limited. USA
3. Waites M.J., Morgan N.L., Rockey J.S. and Highton G. (2001). Industrial Microbiology: An Introduction. 1st edition. Wiley –Blackwell

Course Outcomes:

By the end of the course, students will

- Be familiarized with the range of fermentation processes
- Gain knowledge on fermentor design and types of bioreactors
- Develop concepts on fermentation medium selection, importance of growth kinetics
- Understand about the production of ethanol, organic acids, vitamins, enzymes and immobilization technique.

MFST3081: IMMUNOLOGY PRACTICAL

1. Identification of human blood groups.
2. Perform Total Leukocyte Count of the given blood sample.
3. Perform Differential Leukocyte Count of the given blood sample.
4. Separate serum from the blood sample(demonstration).
5. Perform immunodiffusion by Ouchterlony method.
6. Perform DOTELISA.
7. Perform immunoelectrophoresis.

RECOMMENDED BOOKS

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology. 11th edition Wiley- Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA.(2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immuno biology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D.(2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Course Outcomes:

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

- Learn about blood groups.
- Separate serum from blood sample.

MFST3091: INDUSTRIAL MICROBIOLOGY PRACTICAL

- Study different parts of fermenter
- Microbial fermentations for the production and estimation (qualitative and quantitative) of:
 - Enzymes: Amylase and Protease
 - Amino acid: Glutamic acid
 - Organic acid: Citric acid
 - Alcohol: Ethanol
- A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.

RECOMMENDED BOOKS

1. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
2. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
3. Rueger W and Crueger A. (2000). Biotechnology: A text book of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

Course outcomes:

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

- Learn about different fermenters used in the industry
- Production and estimation of amylases, glutamic acid and citric acid

MFST3101: MEDICAL MICROBIOLOGY

Preamble:

To teach the concepts related to the pathogenesis of microbes belonging to bacteria, viruses, fungi and protozoa. Laboratory diagnosis, epidemiology of the diseases caused due to these pathogens

Course Objectives:

- To study normal flora of human body, host-pathogen interaction and pathogenicity
- To gain knowledge on the pathogenic bacteria and their detailed study
- To provide access to study of medically important viruses.
- To learn about fungal and protozoan diseases.

Unit 1

Normal microflora of the human body and host pathogen interaction. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.

Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

Learning Outcomes: By the end of this unit, the student will be learn about

- Normal flora of human body
- Host-pathogen interactions
- Pathogenicity and toxigenicity

Unit 2

Bacterial diseases: Symptoms, mode of transmission, prophylaxis and control

Respiratory Diseases: *Streptococcus pneumonia*, *Mycobacterium tuberculosis*, *Neisseria meningitis*, *Corynebacterium diphtheria*, *Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*, Others: *Staphylococcus aureus*, *Clostridium tetani*, *Treponema pallidum*.

Learning Outcomes: By the end of this unit, the student will

- Know list of pathogenic bacteria, symptoms and mode of their transmission
- Have completed a detailed study of bacteria involved in respiratory diseases.

Unit 3

Viral diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control

Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Learning Outcomes: By the end of this unit, the student will

- Know list of viruses, symptoms and mode of their transmission
- Have completed a detailed study of viral diseases

Unit 4

Fungal and Protozoan diseases. Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention. Cutaneous mycoses: *Tinea pedis* (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis.

Protozoan diseases: Symptoms, mode of transmission, prophylaxis and control of Malaria, Kala-azar

Learning Outcomes: By the end of this unit, the student will

- Know list of fungal and protozoan pathogens, symptoms and mode of their transmission
- Have completed a detailed study of cutaneous mycosis and protozoan diseases

Unit 5

Antimicrobial agents. General characteristics and mode of action. Antibacterial agents: Mechanism of action Penicillin, Streptomycin, Imipenem, Gentamycin, Moxifloxacin, Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin, Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine, Antibiotic resistance, MDR, XDR, MRSA, NDM-1.

Learning Outcomes: By the end of this unit, the student will

- Know about antimicrobial and antibacterial agents.
- Mechanism of their action

RECOMMENDED BOOKS

1. Textbook of Microbiology (6th edition) by Ananthanarayan and C. K. J. Paniker.
2. Textbook of Medical Parasitology (2013) by S. C. Panija.

3. Textbook of Medical Parasitology (6th edition) by C.K.JPaniker.
4. Medical Microbiology (26th edition) by Jawetz et. al.
5. Medical Microbiology (26th edition) by Melnick and Adelberg
6. Medical Microbiology (16th edition) by D. Greenwood et.al.
7. Medical Microbiology (7th edition) by P. R.Murray et.al.

Course Outcomes:

By the end of the course, students will

- Study normal flora of human body, host-pathogen interaction and pathogenicity
- Gain knowledge on the pathogenic bacteria and their detailed study
- Study medically important viruses.
- Learn about fungal and protozoan diseases.

MFST3111: MEDICAL MICROBIOLOGY PRACTICAL

1. Identify bacteria (any three of *E.coli*, *Pseudomonas*, *Staphylococcus*, and *Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests.
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS.
3. Study of bacterial flora of skin by swab method.
4. Perform antibacterial sensitivity by Kirby-Bauer method.
5. Determination of minimal inhibitory concentration (MIC) of antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chickenpox, HPV warts, AIDS (candidiasis), dermatomycoses (ringworms).
7. Study of various stages of malarial parasite in RBCs using permanent mounts.

RECOMMENDED BOOKS

1. Ananthanarayan R. and Paniker C.K.J. (2009) Text book of Microbiology. 8th edition, University Press Publication
2. Brooks G.F., Carroll K. C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
4. Willey J.M., Sherwood L.M., and Woolverton C.J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education
5. Madigan M.T., Martinko J.M., Dunlap P.V. and Clark D.P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.

Course Outcomes:

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

- Identify and screen bacteria using different media
- Study symptoms of the diseases

Program Elective (PE)*

MFST2301: BIOFILMS

Preamble

This course will examine the microbial quorum Sensing and biofilm, a ubiquitous form of life thriving in a wide range of environments wherever interfaces are found on earth. The broad utilization of biofilm knowledge in engineering includes applications in bioreactors for degradation of pollutant substances, in bioenergy production systems for advantageous surface reactions, in heat exchangers or cooling water towers and on reverse osmosis membranes or ships' hauls for preventing additional heating transfer, mass transfer and frictional resistances. Biofilms also cause contamination problems in food processing industry and on teeth, implants and prosthetic devices, leading to serious or even fatal consequences. This course will provide students better understanding of science and technologies associated with biofilms behind these applications. This course is aimed to meet deeper learning needs of MS and PhD students from Environmental Engineering, Biosystems Engineering, Food Science and Technology, Ocean Engineering, and Biomedical Engineering, etc., that share the same knowledge basis related to biofilms.

Course Objectives: Upon completion of this course, students should be able to:

- Evaluate the benefits of bacterial communication and the risks of biofilms.
- Utilize mathematical models for describing the quorum sensing biofilm growth kinetics.
- Restate biofilm formation mechanism.
- Design basic biofilm reactors for wastewater treatment or bioenergy production.
- Relate biofilm formation knowledge to appropriate control measures used in medicine and food

processing.

Unit I

Bacterial communication - Quorum sensing (QS); signalling molecules - HSLs, AI-2, Pheromones, AIP. Role of QS in promoting microbial virulence and resistance to drugs.

Learning outcome: On successful completion of this module, students should be able to describe quorum sensing and role of QS in virulence.

Unit II

QS in Gram positive bacteria - Staphylococcus, Streptococcus, Bacillus; QS in Gram negative bacteria - Chromobacterium, Agrobacterium, Pseudomonas, Serratia, Vibrio; Virulence traits regulated by QS in bacteria.

Learning outcome: On successful completion of this module, students should be able to describe in the quorum sensing in Gram positive and Gram negative bacteria.

Unit III

Biofilm: Definition, Composition, Structural organization and mechanism of biofilm formation. Importance of biofilm on environmental, industrial and medical perspectives. Resistance development in biofilm inhabitants. Characteristics of biofilm in clinical devices. The role of biofilm in the dissemination of bacterial virulence. Impact of biofilm in aquaculture. Industrial importance of biofilm prevention. Consequences of biofilm in environment – biofouling and biocorrosion.

Learning outcome: On successful completion of this module, students should be able to

- Describe, evaluate benefits and risks of biofilms.
- Utilize mathematical models to describe the quorum sensing biofilm growth kinetics. Restate biofilm formation mechanism.

Unit IV

Biosensor strains used for QS based study - *Chromobacterium violaceum*, *Agrobacterium tumefaciens*, *Pseudomonas aeruginosa* and its mutants. Role of QS on biofilm. Assays to measure the QS regulated virulence traits - Violacein production, LasA protease, LasB elastase, Pyocyanin, Pyoverdine, Prodigiosin, Serratia total protease, Lipase, Bioluminescence, Swarming and Swimming motility.

Learning outcome: On successful completion of this module,

- To study the various biosensor strains in QS
- To understand the importance of assays to measure the QS regulated virulence traits.

Unit V

In vitro biofilm formation; Quantification of *in vitro* and *in vivo* formed biofilms; Microscopical analysis of biofilm architecture - EPS, proteins, e-DNA; Fluorophores used for staining biofilms; Live- dead staining; Confocal microscopy for biofilm studies - Z-stack analysis, Optical sectioning.

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

- To understand the quantification of biofilms *in vitro* and *in vivo*

- To learn the composition of biofilms
- To study the thickness of biofilms by confocal microscopy

RECOMMENDED BOOKS

- Kievit, TR & Iglewski BH. Bacterial Quorum Sensing in Pathogenic Relationships. *Infect. Immun.* 68(9): 4839 (2000).
- Stoodley, LH et al. Bacterial Biofilms: From the Natural Environment to Infectious Diseases. *Microbiology*.2 (2004).
- Choi et al., Implication of Quorum Sensing in Salmonella enteric Serovar Typhimurium Virulence: the luxS Gene Is Necessary for Expression of Genes in Pathogenicity Island. 75, p. 4885–4890 (2007).
- Rasmussen TB, Givskov M, Quorum-sensing inhibitors as anti-pathogenic drugs, *International Journal of Medical Microbiology*, 296, Pages 149-161, 2006.
- Di Cagno R, De Angelis M, Calasso M, Gobbetti M. Proteomics of the bacterial crosstalk by quorum sensing. *J Proteomics*. 74(1):19-34. 2011.

Course Outcomes:

With the completion of this course, students will

- Evaluate the benefits of bacterial communication and the risks of biofilms.
- Utilize mathematical models for describing the quorum sensing biofilm growth kinetics.
- Restate biofilm formation mechanism.
- Design basic biofilm reactors for wastewater treatment or bioenergy production.
- Relate biofilm formation knowledge to appropriate control measures used in medicine and food processing.

MFST2321: BIOFILMS PRACTICAL

1. Kirby-Bauyer method (disc-diffusion method) to study antibiotic sensitivity of a bacterial culture
2. Demonstrate the Quorum Sensing Experiment
3. Detection of Biofilm by Congo red method
4. Detection of biofilm by crystal violet tube test method
5. Spectroscopic evaluation of biofilm in a microtitre plate
6. Detection of biofilm on different surface- food, industrial equipment, medical device etc.
7. Antimicrobial Susceptibility of Monoculture Biofilms of a Clinical Isolate.

RECOMMENDED BOOKS

1. Kievit, TR & Iglewski BH. Bacterial Quorum Sensing in Pathogenic Relationships. *Infect. Immun.* 68(9): 4839 (2000).
2. Stoodley, LH et al. Bacterial Biofilms: From the Natural Environment to Infectious Diseases. *Microbiology*.2 (2004).
3. Choi et al., Implication of Quorum Sensing in Salmonella enteric Serovar Typhimurium Virulence: the luxS Gene Is Necessary for Expression of Genes in Pathogenicity Island. 75, p. 4885–4890 (2007).
4. Rasmussen TB, Givskov M, Quorum-sensing inhibitors as anti-pathogenic drugs, *International Journal of Medical Microbiology*, 296, Pages 149-161, 2006.
5. Di Cagno R, De Angelis M, Calasso M, Gobbetti M. Proteomics of the bacterial crosstalk by quorum sensing. *J Proteomics*. 74(1):19-34. 2011.

Course Outcomes:

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

- Understand the importance of quorum sensing method
- Detection of biofilm by Congo red method and crystal violet method

MFST2311: MICROBES IN SUSTAINABLE AGRICULTURE

Preamble:

This course is designed to explore the role of microorganisms in the maintenance of soil and agriculture. It discusses the soil structure and its relation to the microbial distribution. Sustainable methods of biocontrol and biofertilizers to overcome chemical burden and and explains the pivotal role of microorganisms in degradation and nutrient release.

Course objectives:

For the student to learn about

- The soil properties, and its microbial population
- To teach students about problems with agro-chemicals and to impart knowledge of biological alternatives
- To make them know of symbiotic and non symbiotic biofertilizers
- To divulge the biocontrol phenomenon and modes

Unit- 1

Soil as Microbial Habitat, Soil profile and properties, Soil formation, Diversity and distribution of microorganisms in soil. Rhizosphere microorganisms, PGPR. Mineralization of cellulose, hemicelluloses, lignocelluloses, lignin and humus, phosphate, nitrate, silica, potassium

Learning objectives: At the end of the Unit the student should be able to understand

- The soil profile
- Role of soil as microbial habitat
- Rhizosphere and PGPR
- Mineralization of various biological wastes

Unit- 2

Biofertilizers-General account, advantages over chemical fertilizers. Symbiotic N₂ fixers: Rhizobium- Isolation, characteristics, types, inoculum production and field application, Frankia. Cyanobacteria- *Azolla*, characteristics, types, inoculum production

Learning objectives: At the end of the Unit the student should be able to understand

- Superiority of biological over chemical fertilizers

- Rhizome legume association, types and applications
- *Azolla- Anabaena* association in rice cultivation

Unit- 3

Non - Symbiotic N₂ fixers Free living *Azospirillum*, *Azotobacter* – free living cyanobacteria, isolation, characteristics, mass inoculum production and field application. Phosphate solubilizers

Learning objectives: At the end of the Unit the student should be able to understand

- Nitrogen fixation by Free living microorganisms
- Mass production and application
- Phosphate solubilisation

Unit- 4

Mycorrhizal biofertilizers-Importance of mycorrhizal inoculum, types of mycorrhizae and associated plants, Mass inoculum production of VAM, field applications of Ectomycorrhizae and VAM.

Learning objectives: At the end of the Unit the student should be able to understand

- Importance of mycorrhizal biofertilizers
- Types of mycorrhizae
- Field application

Unit- 5

Biocontrol definition, advantages over chemical control, Microorganisms used as biocontrol agents - *Bacillus thuringiensis*, production, Field applications; *Beauveria* sp., *Trichoderma* species- characters, uses and mass production, Viruses – cultivation and field applications

Learning objectives: At the end of the Unit the student should be able to understand

- Biocontrol concept
- Types of biocontrol agents
- Cultivation and field application

RECOMMENDED BOOKS

2. Agrios GN. (2006). Plant Pathology. 5th edition. Academic press, San Diego,
3. Singh RS. (2017). Introduction to principles of plant pathology. Oxford & IBH, New Delhi.

4. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
5. Campbell RE. (1983). Microbial Ecology. Blackwell Scientific Publication, Oxford, England.
6. Mahendra K. Rai (2005). Hand Book of Microbial Biofertilizers, The Haworth Press, Inc. New York.
7. Reddy, S.M. et. al. (2002). Bioinoculants for Sustainable Agriculture and Forestry, Scientific Publishers.
8. Saleem F and Shakoori AR (2012) Development of Bioinsecticide, Lap Lambert Academic Publishing GmbH KG

Course Outcomes:

At the end of the course, students will

- Learn about the soil properties, and its microbial population
- Learn about problems with agro-chemicals and to impart knowledge of biological alternatives
- Know about symbiotic and non-symbiotic biofertilizers
- Divulge the biocontrol phenomenon and modes

MFST2331: MICROBES IN SUSTAINABLE AGRICULTURE PRACTICAL

1. Study soil profile
2. Study microflora of different types of soils
- 3 Isolation of symbionts from Azolla
4. *Rhizobium* isolation and culture characterization
5. *Cyanobacteria*- soil isolation and culture characterization
6. Isolation of cellulose degrading organisms

SUGGESTED READINGS

- Laboratory manual of Microbiology, 2009. AK Roy, MM Prasad. New India Publishing Agency.
- Laboratory manual in Microbiology, 2007, Gunasekaran. New age International Publishers
- Laboratory Manual of Microbiology and Biotechnology , 2014, K.R.Aneja. publisher Medtech.

Course Outcomes:

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

- Analyze the profile of the soil
- Isolate cellulose degrading organisms

MFST2341: MARINE MICROBIOLOGY

Preamble

This course will make the students familiar with the profile of marine environment, its composition and diversity of microbial communities inhabiting marine ecosystems. The students will also learn the strategies adopted by microbes surviving in extreme marine environments and economic importance of marine microbial products.

Course Objectives

- To learn the stratification of marine ecosystems and understand marine microbial diversity
- To appreciate the marine metabolic diversity underlying survival of marine extremophiles
- To study the importance of marine pathogens and their control
- To appreciate the economic importance of marine microbial products

UNIT- I

Marine environment—properties of seawater, chemical and physical factors of marine environment.
Marine habitat- zonation of marine ecosystems. Significance of Marine micro flora

Learning Outcomes

After completion of this unit the student will be able to

- Understand structure of marine ecosystems
- Appreciate the significance of marine microflora

UNIT- II

Metabolic diversity of microbial communities. Methods of studying marine microorganisms- sample collection- isolation and identification: Cultural, Morphological, physiological, biochemical and Molecular characteristics- Preservation methods of marine microbes.

Learning Outcomes

After completion of this unit the student will be able to

- Elucidate the principles of metabolic diversity of marine ecosystems
- Characterize marine microorganisms based on cultural characteristics

UNIT- III

Survival at extreme environments – starvation – adaptive mechanisms in thermophilic, alkalophilic,

osmophilic and barophilic, psychrophilic microorganisms – hyperthermophiles, halophiles and their importance.

Learning Outcomes

After completion of this unit the student will be able to

- Understand the strategies of marine extremophiles

UNIT- IV

Pathogenic microorganisms, distribution, indicator organisms, prevention and control of water pollution. Microbiology of processed finfish and shellfish products.

Learning Outcomes

After completion of this unit the student will be able to

- Identify the diseases caused by marine microorganisms
- Understand the prevention and control of water pollution

UNIT- V

Marine microbial products – Carrageenan, agar-agar, sea weed fertilizers – Astaxanthin, β carotene, antibiotics, polysaccharides, biosurfactants and pigments. Preservation methods of sea foods.

Learning Outcomes

After completion of this unit the student will be able to

- Appreciate the economic importance of marine microbial products
- Explain seafood preservation methods

Course Outcomes

With the end of the course, students will

- Learn the stratification of marine ecosystems and understand marine microbial diversity
- Appreciate the marine metabolic diversity underlying survival of marine extremophiles
- Study the importance of marine pathogens and their control
- Appreciate the economic importance of marine microbial products

RECOMMENDED BOOKS:

- Microbiology (2005) L.M. Prescott *et.al.*
- Marine Microbiology: Ecology and Applications (2nd edition) by C.Munn.

- Marine Microbiology (2005) by J. H. Paul.
- Microbiology: Principles and Explorations (7th edition) by J. G. Black.
- Ocean and Health: Pathogens in the marine environment (2006) by S. Belkin and R. R. Colwell
- Bioactive Marine Natural Products (2005) D.S. Bhakuni and D.S.Rawat.

MFST2351: FOOD MICROBIOLOGY

Preamble:

Food microbiology is the scientific study of microorganisms, both in food and used for the production of food. This includes microorganisms that contaminate food, as well as those used in its production; for example to produce yoghurt, cheese, beer and wine.

Course Objectives:

- To know the important genera of microorganisms associated with food and their characteristics.
- To understand the role of microbes in fermentation, spoilage and food borne diseases.

Unit I

Food microbiology- definition and importance, Microbial growth in food- intrinsic and extrinsic factors affecting the growth of microorganisms in food, bacterial growth curve. Beneficial role of microorganisms in food. Probiotics, prebiotics and synbiotics.

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

- Learn about the morphological characteristics important in food bacteriology
- Understand about the importance of microbiology and its relevance to everyday life.

Unit II

Microorganisms associated with food- Bacteria, molds, yeast, virus- General characteristics, structure, morphological characteristics, growth, and cultural characteristics. Endospore - structure and significance in food microbiology

Learning Outcomes:

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

- Learn about general characteristics of bacteria, fungi and virus.
- Know procedures of identification of microorganisms

Unit III

Classification of foods by ease of spoilage, Factors affecting food spoilage, sources of microorganisms in foods, spoilage of different food groups- milk and dairy products, eggs, meat, fish, cereal and cereal products, canned products, fruits, and vegetables.

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

- Understand about spoilage. Contamination sources, types, effect of cereals, sugar, vegetables and fruits, meat, milk, canned foods.

Unit IV

Importance of food preservation, Classification of Food preservation methods, Food preservation methods – High temperature, (Pasteurization, canning), low temperature, (refrigeration, freezing), dehydration, irradiation, biopreservation.

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

- Learn about sterilization methods, pure culture techniques, methods of isolation
- Understand about control of microorganisms in foods, and preservation and maintenance of microbial cultures.

UNIT V

Food infection and food intoxication. Food and water borne diseases by – *Salmonella*, *E. coli*, *Clostridium*, *Listeria*, *Shigella*, *Bacillus*, *Campylobacter*, *Vibrio*. Trends in Food Microbiology-rapid methods of detection, recent Advances

Learning Outcomes:

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

- Understand about the sources of contamination of food, mycotoxins, toxin production and physiological action, sources of infection of food by pathogenic organisms.
- Learn about water, soil and air borne diseases.

Course outcomes:

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

- Learn about the morphological characteristics important in food bacteriology.
- Understand about spoilage, contamination sources, types, effect of cereals, sugar, vegetables and fruits, meat, milk, and canned foods.

MFST2361: BIOENERGY AND BIOFUELS (THEORY)

Preamble

This course aims to provide an overview of the fundamental concepts of biofuels, bioenergy. Biofuel production by biomass conversion process. Biodiesel production using oil seeds and algae.

Course Objectives:

- To provide a thorough understanding of various renewable feed stocks and their availability and attributes for biofuels
- To provide a thorough understanding of the broad concept alternative biofuel production from biomass and other low-cost agri-residues and biowastes.
- To provide students with tools and knowledge about advantages and limitations of biofuels facility operations.
- To teach our students to analyze and design processes for biofuel production.

UNIT-I

Fundamental concepts of biofuels, bioenergy, renewable feedstocks, current energy consumption, Microbial Fuel Cells. Applications and limitations of biofuels, bioenergy and biogas

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

- To understand fundamental concepts of biofuels and bioenergy
- To know the availability and attributes for biofuel and bioenergy production
- To study about microbial fuel cells in the generation of bioelectricity.

UNIT-II

Raw material stocks availability, Properties of biomass- calorific value, density, moisture content, types of biomass: lignocellulosic, starchy, sugar, oilseeds, and Municipal residual waste, organic waste, sewage sludge, manure.

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

- To know the availability and properties of biomass
- To understand various types of biomass with proper examples and their utilization.

UNIT III

Conversion of biomass-Preprocessing or pretreatment of biomass: drying and size reduction, Biochemical conversion to ethanol: biomass pretreatment, Different enzymes, enzyme hydrolysis, and their applications in ethanol production and enzymatic hydrolysis, Detoxification methods

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

- To know the synthesis of biofuel from biomass conversion process
- To understand the details of preprocessing or pretreatment of biomass
- To learn the significance of Enzymatic hydrolysis and detoxification methods

UNIT-IV

Biomass conversion to heat and power, Thermal gasification of biomass, chemical hydrolysis of biomass-pyrolysis, biological process by anaerobic digestion and fermentation, Biodiesel production from oil seeds waste oils and algae.

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

- To understand the biomass conversion to heat and power
- To learn the thermochemical, process for biomass conversion
- To know the biological conversion process of biomass conversion

UNIT-V

Market demand, economics, Energy balance and life-cycle analysis of biodiesel, Environmental impacts of biofuel and biodiesel production, Value added processing of biofuel residues and co- products

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

- To study the market demand of alternative fuels
- To understand the economics and life-cycle analysis of biofuel production
- To learn the production of value-added processing of biofuel residues and co-products

RECOMMENDED BOOKS:

1. Biofuel and Bioenergy, Edited by John Love and John A Bryant, Wiley Blackwell publishers
2. Handbook of biofuel production, Process and Technologies, Edited by Rafael Luque, Juan Champelo and James Clark, Woodhead publishers
3. Biofuel Technologies, recent developments, edited by Vijai Kumar Gupta, Maria G Tuohy, Springer publishers

4. Bioenergy, biomass to biofuel, edited by Anju Dhahia , Elsevier
5. Advances in Biofuel, Edited by Ravindra Pogaku, Rosalam Hj. Sarbately, Springer.

MFST2371: VIROLOGY

Preamble:

This course makes the student to understand about the structure and life cycle of viruses as well as cultivation methods of viruses. Additionally, it details of epidemiology and emerging viral infection and preventive measures.

Course Objectives:

- To provide knowledge about distinctive characteristics of viruses.
- To provide the knowledge about principles of viral taxonomy.
- To provide the basic knowledge about replication cycles of bacteriophages.
- To provide basic knowledge regarding viral nucleic acids and viral cultivation methods
- To provide basic concepts of epidemiological concepts and emerging viral infections

Unit 1

Introduction: Structure and general properties of viruses, Viral taxonomy: Classification and nomenclature of viruses. Concept of viroids, virusoids, satellite viruses and Prions.

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

- To understand the structure and general properties of viruses
- To learn the classification of ICTV and Baltimore classifications.

UNIT-II

Bacteriophages-structure, lytic and lysogenic phages (lambda phage) concept of early and late proteins, regulation of transcription in lambda phage. Applications of virology- Use of viral vectors in cloning and expression, Phage therapy

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

- To learn about Lytic and lysogenic cycles of bacteriophages
- To understand the applications of virology in various fields

UNIT-III

Salient features of viral Nucleic acids- Unusual bases, overlapping genes, alternate splicing, terminal redundancy, terminal cohesive ends, partial double stranded genomes, long terminal repeats, segmented and non-segmented. Outline on Replication strategies of DNA and RNA virus.

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

- To learn about salient features of viral nucleic acids
- To understand and know about replication strategies of DNA viruses
- To know about replication strategies of RNA viruses

UNIT –IV

Isolation and cultivation methods of animal viruses, cell cultures, animal inoculation and embryonated eggs, Cellular cytopathic effects (CPE), purification of viruses and inactivation of viruses

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

- To learn about isolation methods of viruses
- To study about Cultivation methods of viruses
- To know about Purification and inactivation methods of viruses

Unit -V

Epidemiological concepts of viral infections, Epidemics, endemics, pandemics, new emerging viral infections, Viral transmission, prevention and control of emerging viral infections, Influenza, SARS, COVID 19, Viral vaccines, antiviral drugs.

Learning Outcomes:

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

- To learn about epidemiological concepts of viral infections
- To study about emerging viral infections and preventive strategies

Recommended Books

- Basic Virology (3rd edition) by Wagner and Hewlett.
- Microbiology (5th edition) Pelczar, Chan and Krieg.
- Principles of Virology (3rd edition) by S.J. Flint et. Al.
- Introduction to Modern Virology (6th edition) Dimmock et. Al.
- Principles of Molecular Virology (5th edition) by A. Cann.
- Medical Virology (4th edition) by D.O. White and F.J.Fenner.
- Plant Virology (5th edition) by R. Hull..
- Fundamental Virology (6th edition) by D.M. Knipe and P.M.Howley.

Course outcomes:

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

To understand the structure and general properties of viruses

To learn about salient features of viral nucleic acids

To learn about epidemiological concepts of viral infections

MFST3221: BIOREMEDIATION

Preamble

Bioremediation utilizes microorganisms to improve environmental quality. These improvements include treatment of contaminated waters and wastewaters, cleanup of industrial waste streams, and remediation of soils contaminated with hazardous and toxic chemicals.

Course Objectives

To develop fundamental understanding of Applications of Biotechnology in Environment science and Environmental related problems

- To understand the Concept of environment and importance of its preservation.
- To understand the Concept of pollution and methods to control it.
- To understand the Concept of Bioremediation and its applications.
- To understand many types of energy sources.

Unit I

Environment and its importance. Ground water contamination. Bacterial metabolism in waste water treatment systems, industrial waste water sources and treatment strategies, overview of waste water treatment process

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

- Understand the importance of environment and its cleanup
- Understand the sources of waste water and its treatment strategies

Unit II

Biotechnology and waste: Composting of Organic Waste, Anaerobic Fermentation of Wet and Semidry Garbage Waste Fractions, Process Engineering of biological waste gas Purification, Commercial Applications of biological waste gas Purification, Perspectives of waste water, waste, off-gas and soil treatment.

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

- Types of industrial waste
- Purification process for industrial waste

Unit III

Cleaner Technologies: fermentation technology, paper industry and plastic industry, ISO14000 and Environment Management System, Reducing environment impact of industrial effluents.

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

- Cleaning technologies of industrial waste
- Environmental management system

Unit IV

Bioremediation using naturally occurring microorganism, Removal of spilled oil and grease deposits (Use of oleophilic fertilizers, Use of a mixture of bacterial strains, Use of genetically engineered microbes) Biosensor to detect environmental pollutants (In situ bioremediation of both soil and ground water).

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

- Bioremediation using microbes in the nature
- Bioremediation using genetically modified microbes

Unit V

Bioremediation of contaminated soil, contaminated surface waters (pits, ponds and lagoons) Treatment of toxic wastes before they reach environment, Bioremediation using Genetically Engineered Microbes (GEM) Phytoremediation, Naturally occurring plants for Phytoremediation.

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

- Bioremediation of soils
- Phytoremediation.

RECOMMENDED BOOKS

1. Environmental Biotechnology: Principles and Applications, Rittmann, B. E., and McCarty, P. L., McGraw Hill, 2001
2. Applied Environmental Microbiology and Case Studies, prepared by M. Pirbazari, 2002.
3. Prescott, L. M., Harley, 3. P., and Klein, D. A., Microbiology, Second Edition, Wm. C. Brown

Publishers, Dubuque, Iowa, 1993

Course Outcomes:

With the end of the course, students will

1. Develop fundamental understanding of Applications of Biotechnology in Environment science and Environmental related problems
2. Understand the Concept of environment and importance of its preservation.
3. Understand the Concept of pollution and methods to control it.
4. Understand the Concept of Bioremediation and its applications.
5. Understand many types of energy sources.

MFST3231: INSTRUMENTATION AND BIOTECHNIQUES

Preamble

This paper gives student an idea about principles of microscopy, centrifuges, and procedures in performing different chromatographic techniques like in purifying the proteins to homogeneity, testing the purity levels by different electrophoretic techniques, and quantitating the same by spectrophotometric methods.

Course Objectives:

- To understand the detailed principles, procedures and applications of various chromatographic techniques for example in learning the purification of proteins by using ion exchange and affinity chromatography, and molecular weight determination by size exclusion chromatography.
- To learn the principles, procedures and applications of various electrophoretic techniques, importantly knowing the difference between SDS and native PAGE, and isoelectric focussing in analyzing the proteins.
- To study the principles, procedures and applications of various spectrophotometric methods especially in quantitation of desired compound in the given solutions.

UNIT-I

Microscopy- Brightfield and darkfield microscopy, Fluorescence Microscopy, Phase contrast Microscopy, Confocal Microscopy, Electron Microscopy (Scanning and Transmission Electron Microscopy) and Micrometry.

Learning Outcomes:

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

- To study and understand the function of each part of the microscope in knowing the

structure of microorganisms.

- To know the importance of electron microscopy in getting the high resolution images to know the detailed structure of microbes.

UNIT-II

Chromatography-Principles and applications of paper chromatography, thin layer chromatography. Column packing and fraction collection. Gel filtration chromatography, ion- exchange chromatography and affinity chromatography, GLC, HPLC.

Learning Outcomes:

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

- To understand the principles, procedures and applications of various chromatographic techniques.
- To imbibe with the basics of isolation of proteins to the purification of the proteins to homogeneity, and especially with the usage of high end chromatography columns, and purification procedures.
- Proficient with the prerequisites for making recombinant protein for ease in purification of proteins with tags such as his-tag etc.
- Identify carbohydrates and amino acids by techniques like paper and thin layer chromatography

UNIT-III

Electrophoresis-Principle and applications of native polyacrylamide gel electrophoresis, SDS-polyacrylamide gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Zymogram preparation and Agarose gel electrophoresis.

Learning Outcomes:

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

- To understand the principles, components, and applications of various electrophoretic techniques.
- To know the difference between SDS-PAGE and native PAGE techniques with respect to proteins
- To understand the importance of agarose gel electrophoresis with respect to molecular biology techniques like PCR and molecular cloning

- To visualize the purity of proteins those are purified to homogeneity using various chromatography columns.

UNIT-IV

Spectrophotometry-Principle and use of study of absorption spectra of biomolecules. Analysis of biomolecules using UV and visible range. Colorimetry and turbidometry.

Learning Outcomes:

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

- To know the principles, components, and applications of various spectrometry techniques.
- To apply the utilization of UV-visible spectrophotometer to know the concentrations of the different solutions.
- To understand the importance of colorimetry and turbidometry in knowing the concentration of solutions

UNIT-V

Centrifugation-Preparative and analytical centrifugation, fixed angle and swinging bucket rotors. RCF and sedimentation coefficient, differential centrifugation, density gradient centrifugation and ultracentrifugation.

Learning Outcomes:

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

- To know the importance of method of separating molecules having different densities and molecular weights at high speed centrifuge.
- To study the importance of pelleting the cells for the isolation of recombinant proteins and exploiting the supernatant for the study of biochemical reactions.

Course Outcomes

By the completion of the course, students will

- Understand the detailed principles, procedures and applications of various chromatographic techniques
- Learn the principles, procedures and applications of various electrophoretic

techniques.

- Understand the principles, procedures and applications of various spectrophotometric methods especially in quantitation of desired compound in the given solutions.

RECOMMENDED BOOKS

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press.
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company.
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 9th Ed., McGraw Hill.
4. Karp G. (2010) Cell and Molecular Biology: Concepts and Experiments. 6th edition. John Wiley & Sons. Inc.
5. De Robertis EDP and De Robertis EMF. (2006). Cell and Molecular Biology. 8th edition. Lipincott Williams and Wilkins, Philadelphia.

MFST3241: MICROBIAL BIOTECHNOLOGY

Preamble:

Microbial biotechnology course provides applications of microbiology in various fields using biotechnological concepts. Applications in agricultural fields as Biofertilizers and Biopesticides. Microbial biotechnological production of biofuels using microorganisms. Microorganisms used as food and applied as bioremediation purpose.

Course Objectives: To Provide knowledge of

- Concepts of role and applications of microbial metabolites
- Concepts and production of metabolites
- Basic principles and production strategies of biofuels using microorganism
- Role of microorganisms in food industry and used as food
- Bioremediation strategies using microbial biotechnology

UNIT- I

Introduction and history of industrial microbiology. Isolation and selection of Industrially important microbes. Over production of microbial metabolites. Preservation and maintenance of microbial cultures.

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

- Importance of Industrial Microbiology
- Applications of microbial metabolites in the industry
- Concepts related to the microbial metabolic pathways

UNIT-II

Microbial substrates, Media composition and growth conditions. Components of microbial fermentation. Types of fermentation processes. Design of bioreactor. Types of Bioreactor.

Learning Outcomes: By the end of this unit, the student will know of

- Microbial fermentation process
- Concept of bioreactor with proper examples

UNIT-III

Production of baker's Yeast, Mushroom and their applications. Production of fermented foods, Alcoholic beverages. Production of ethanol, citric acid, amino acids, vitamins, Application of microbial enzymes for food, detergent and pharma industry.

Learning Outcomes: By the end of this unit, the student will be knowledgeable of

- Production of fermented foods and beverages.
- Production of industrially important citric acid, vitamins, etc. using microbes.

UNIT-IV

Production of penicillin and pigments. production of insulin, interleukin, growth hormones, using recombinant DNA technology.

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

- The production of penicillin
- Recombinant DNA technology for the production of hormones

UNIT- V

Biopesticides and biofertilizers, Bio-weapons and Bioshields, Single Cell Protein (SCP) production from spirulina, Microbial toxins and mycoparasitism. Microbial leaching of ores.

Learning Outcomes: By the end of this unit, the student will understand

- Biopesticides and biofertilizers
- SCP and microbial toxins
- Bio-sorption and biodegradation

REFERENCE BOOKS:

1. Microbial Biotechnology: Fundamentals of Applied Microbiology (2nd edition) A. Glazer. and H. Nikaido
2. Basic Biotechnology (3rd edition) by C. Ratledge and B. Kristiansen.
3. Manual of Industrial Microbiology and Biotechnology (2010) by R. H. Baltz et. al.
4. Molecular Biotechnology (2004) by B. R. Glick and J. J. Pasternak.
5. Applied Microbiology (2015) by S. Saxena.
6. Basic and Applied Aspects of Biopesticides (2014) by K. S. Raj. 71
7. Handbook of Microbial Biofertilizers (2006) by M. Rai.

Course Outcomes:

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

- Know the importance of Industrial Microbiology
- Microbial fermentation process
- The production of penicillin

MINOR COURSES IN MICROBIOLOGY

MFST1051: INTRODUCTORY MICROBIOLOGY (THEORY)

Preamble:

This course introduces the students to the basic concepts of microbiology, history and development of microbiology. Additionally, they learn about isolation identification classification of microorganisms. Introducing the subject to all the applied aspects of microbiology.

Course Objectives:

- To learn the subject of microbiology by its history, microscopy, aseptic techniques, sterilization, isolation of bacteria, study of morphological characters, identifying and classification of bacteria.
- To know the preservation of microbes, staining techniques, understanding nutritional types of bacteria.
- To learn the details of some clinically important bacteria
- To understand the importance of study of microbiology of water, milk and microbial interactions in nature.

Unit1

History of Development of Microbiology, Spontaneous generation vs. biogenesis, Germ theory of disease, golden era of microbiology, Contributions of Anton von Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner

Learning Outcomes:

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

- To understand the history and importance of Microbiology
- To learn the contributions of eminent personalities for microbiology

Unit 2

Binomial Nomenclature, Whittaker's five kingdom and Carl Woese's three kingdom classification systems and their utility. Difference between prokaryotic and eukaryotic microorganisms General characteristics of different groups: Acellular microorganisms (Viruses, Viroids, Prions) and Cellular microorganisms (Bacteria, Algae, Fungi and

Protozoa) with emphasis on distribution and occurrence, morphology, nutrition, mode of reproduction and economic importance.

Learning Outcomes:

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

- To know how to classify the microbes
- To understand the basic structure and characteristics of microbes

Unit 3

Morphology and ultrastructure of bacterial cell, endospore: Structure, formation, stages of sporulation. Introduction to Bergey's manual of systematic bacteriology.

Learning Outcomes:

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

- To Understand the structure of bacterial cell
- To learn about the systemic bacteriology

Unit 4

Sterilization Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation. Chemical methods of microbial control: disinfectants, types and mode of action. Isolation, cultivation, enumeration and preservation of microorganisms; Microscopic identification: staining methods- simple, differential, structural and special staining. Bacterial reproduction and growth. Synchronous, batch and continuous cultures.

Learning Outcomes:

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

- To learn the methods for microbial control
- To understand the bacterial growth and reproduction

Unit 5

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Scanning and Transmission Electron Microscope

Learning Outcomes:

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

- To understand and apply the knowledge of microscopy in the study of microbes
- To understand different types of microscopes used for microbiology

Course Outcomes:

- By the end of the course students will
- Learn the history of Microbiology, microscopy, aseptic techniques, sterilization,
- Learn about the isolation of bacteria, study of morphological characters, identifying and classification of bacteria.
- Learn the preservation of microbes, staining techniques, understanding nutritional types of bacteria.
- Know the details of some clinically important bacteria
- Understand the importance of study of microbiology of water, milk and microbial interactions in nature.

RECOMMENDED BOOKS

- Microbiology 5th edition by Pelczar, Chan and Krieg.
- General Microbiology, 5th edition by Stanier, Deudroff and Adelberg.
- Bergey's Manual of Systematic Bacteriology 9th edition, volumes I to VI.
Brock Biology of Microorganism 9th edition by Madigan, Martinko and Parker.

MFST1061: INTRODUCTORY MICROBIOLOGY (PRACTICAL)

- Microbiology Good Laboratory Practices and Biosafety.
- To study the principle and applications of important instruments (biological safety cabinets, autoclave, incubator, BOD incubator, hot air oven, light microscope, pH meter used in the microbiology laboratory.
- Morphological identification of bacteria.
- Morphological identification of Fungi using permanent slides/wet mounts.
- Morphological identification of algae using permanent slides/wet mounts.
- Preparation of different media: synthetic media BG-11, Complex media-nutrient agar, McConkey agar, EMB agar.
- Simple staining
- Negative staining
- Gram's staining
- Acid fast staining-permanent slide only.
- Capsule staining
- Endospore staining.
- Isolation of pure cultures of bacteria by streaking method.
- Preservation of bacterial cultures by various techniques.
- Estimation of CFU count by spread plate method/pour plate method.
- Motility by hanging drop method.

SUGGESTED READINGS

- Atlas RM. (1997). Principles of Microbiology. 2nd edition. WM.T. Brown Publishers.
- Black J G .(2008).Microbiology: Principles and Explorations. 7th edition. Prentice Hall
- Madigan M T, and Martinko J M. (2014). Brock Biology of Micro-organisms.14thedition.ParkerJ. Prentice Hall International, Inc.
- Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology.5th edition Tata Mc Graw Hill.
- Srivastava S and Srivastava PS. (2003).Understanding Bacteria. Kluwer Academic Publishers, Dordrecht

Course Outcomes:

After the completion of the above experiments the students will be able to perform

- Isolation of various microorganisms (bacteria, fungi) from different sources (water, soil, food)
- Identification of physiological characteristics such as gram, capsule, spore and flagella by microscopic techniques
- Identification of the biochemical characteristics of the bacteria
- Preparation of various types of media for culturing of microorganism

MFST1071: MICROBIAL GENETICS (THEORY)

Preamble

While Fidelity in genome replication allows for stability of a species, changes in genome are important for variability of individuals and evolution of species. The changes can be brought about through processes inherent to the cell or as an effect of outside factors. This course deals with the molecular mechanisms, such as mutation, recombination and transpositions, which allow for the incorporating variations in the genome.

Course Objectives

- To teach the students the types of mutations
- To elucidate the Plasmids structure, function and types
- To provide a detailed information on Recombination in bacteria
- To describe the Genetic mapping using recombination
- To teach the students about mobile genetic elements

UNIT--I

Genome organization: *E. coli*, *Saccharomyces*, *Tetrahymena*. Definition and types of Mutations; Physical and chemical mutagens; Molecular basis of mutations; Functional mutants (loss and gain of function mutants); Uses of mutations. Reversion and suppression: True revertants; Intra-and inter-genic suppression; Ames test; Mutator genes

Learning Outcomes:

By the end of this Unit, the student will know about:

- Genome organization of type species
- Mutations: cause and types
- Molecular basis of mutations

UNIT-II

Plasmids and their types, – F plasmid, R Plasmids, colicinogenic plasmids, Ti plasmids, linear plasmids, yeast-2 μ plasmid, Plasmid replication and partitioning, Host range, plasmid-incompatibility, plasmid amplification, Regulation of copy number, curing of plasmids

Learning Outcomes:

By the end of this Unit, the student will know about:

- Plasmids general characters
- Functional types of plasmids

- Replication and regulation

Unit-III

Genetic exchange in prokaryotes, Transformation - Discovery, mechanism, Conjugation-Discovery, mechanism, Hfr and F' strains, Transduction-Generalized transduction, specialized transduction,

Learning Outcomes:

By the end of this Unit, the student will know about:

- Transformation and mechanism
- Conjugation
- Transduction and types

Unit-IV

Phage Genetics: Genetic Mapping- Interrupted mating technique and time of entry mapping, co-transduction of markers, Features of T4 genetics, Genetic basis of lytic versus lysogenic switch of phage lambda

Learning Outcomes:

By the end of this Unit, the student will know about:

- Genetic mapping
- Interrupted mating
- Lytic lysogenic switch

Unit- V

Transposable elements: Prokaryotic transposable elements–Insertion Sequences, composite and non-Replicative transposition, Mu transposon. Eukaryotic transposable elements-Yeast (Ty1 transposon), Drosophila (P elements), Maize (Ac/Ds). Uses of transposons and transposition.

Learning Outcomes:

By the end of this Unit, the student will know about:

- Define transposons, and types
- Know the characters of transposons in type studies
- List the advantages of transposons

RECOMMENDED BOOKS:

- Watson JD, Baker TA, Bell SP, Gann A, Levine M and LosickR (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication

- Becker WM, Kleinsmith L.J, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
- DeRobertis EDP and DeRobertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
- Krebs J, Goldstein E, Kilpatrick S (2013). Lewin's Essential Genes, 3rd Ed., Jones and Bartlett Learning
- Gardner EJ, Simmons MJ, Snustad DP (2008). Principles of Genetics. 8th Ed. Wiley-India

Course Outcomes

After completion of the course, students will:

- Learn about the types of mutations
- Elucidate the Plasmids structure, function, and types
- Gather detailed information on Recombination in bacteria
- Understand the process of genetic mapping using recombination
- Learn the concepts of mobile genetic elements.

MFST2061: CELL AND MOLECULAR BIOLOGY

Preamble:

The Cell and Molecular Biology course is designed to help understand how the cells are organized, in prokaryotes and eukaryotes. It helps the students grasp the correlation of the structure of the cell organelles to the function they carry out. They will learn the process of replication, transcription and translation in prokaryotes and Eukaryotes. The course provides understanding of how cells divide, while maintaining the genomic integrity, and how variations occur through meiosis.

Course Objectives:

1. To understand the structures and purpose of basic components of prokaryotic and eukaryotic cells
2. To understand how the genetic material is faithfully replicated and transferred to the daughter cells yet allowing for variation in population
3. To learn the methods and importance of protein regulation and transport.

Unit1

Plasma membrane Structure: sandwich, fluid-mosaic models. Nutrient transport- passive and facilitated diffusion, active transport, group translocation. Cell Wall: Eukaryotic cell wall, Extra cellular matrix. Cell-Cell junctions and plasmodesmata (only structural aspects)

Learning Outcomes: By the end of this Unit, the student will know

- To learn about types of cell organization
- To understand about Plasma membrane structure
- To study about Nutrient transport

Unit-2

Mitochondria, chloroplasts and peroxisomes; Cytoskeleton: Structure and organization, Nucleolus, organization of Ribosomes, Endoplasmic Reticulum structure, and protein targeting. Golgi Apparatus, protein glycosylation, protein sorting and export from Golgi Apparatus, Lysosomes.

Learning Outcomes: By the end of this Unit, the student will know about

- To learn about Cell organelles and their function
- To know about Nuclear organization
- To understand about Cytoskeleton structure
- To learn about protein sorting and transport

Unit III

DNA Structure: Miescher to Watson and Crick- historic perspective. Salient features of double helix, Types of DNA. Types of genetic material. Denaturation and renaturation, cot curves. Organization of DNA Prokaryotes, Viruses, Eukaryotes. RNA Structure, Organelle DNA—mitochondria and chloroplast DNA.

Learning Outcomes: By the end of this Unit, the student will know about

- The deciphering DNA as genetic material, and structure elucidation
- Types and organization of genetic material
- Extra genomic DNA

Unit IV

Bidirectional and unidirectional replication, semi-conservative, semi-discontinuous replication Mechanism of DNA replication: Enzymes and proteins involved in DNA replication –DNA polymerases, DNA ligase, primase, telomerase, Various models of DNA replication-rolling circle, Θ (theta) mode. Mismatch and excision repair

Learning Outcomes: By the end of this Unit, the student will know about

- DNA replication
- Characters and function of enzymes of replication
- Plasmid DNA replication
- Repair of DNA

Unit V

Transcription: Definition, promoter-concept and strength of promoter, transcription in prokaryotes and eukaryotes. Translational machinery, Charging of tRNA, aminoacyl tRNA synthetases, Mechanisms of initiation, elongation and termination of translation in prokaryotes.

Learning Outcomes: By the end of this Unit, the student will know about

- Transcription factors, promoters and transcription process
- Charging of tRNA
- Mechanism of translation in prokaryotes
- Mechanism of translation in eukaryotes

RECOMMENDED BOOKS

1. Molecular Biology of the Cell (5th edition) by B. Alberts *et. al.*
2. Molecular Cell Biology (6th edition) by H. Lodish *et. al.*
3. Cell and Molecular Biology (8th edition) by E.D.P.DeRobertis
4. The Cell: A molecular approach (6th edition). by G.M Cooper

Course outcomes:

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

- To learn about types of cell organization
- To learn about Cell organelles and their function
- DNA replication and characters and function of enzymes of replication.

MFST2071: MICROBIAL PHYSIOLOGY AND BIOCHEMISTRY

Preamble

This course is familiarizes the student with various physiological aspects and metabolic pathways operating in microorganisms. The concept of microbial growth, factors that govern the growth and survival of microbes under various conditions shall be explained. The detailed mechanism of metabolism of carbohydrates, fats, and proteins shall be elucidated comprehensively. The diversity of metabolic pathways with special reference to microbial physiology shall be covered.

Course Objectives

- To understand mechanism of growth and survival strategies operating in microbes
- To learn the nutrient transport mechanisms in bacteria
- To understand types of heterotrophic metabolism viz. aerobic, anaerobic respiration and fermentation
- To appreciate the photosynthetic and nitrogen assimilation mechanism operating in microbes.

Unit I

Microbial Growth and Effect of Environment on Microbial Growth

Nutritional classification of microorganisms. Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve, Factors affecting microbial growth- Temperature, pH, solute and water activity, Oxygen, atmospheric pressure.

Learning outcomes

After completion of this unit the students will be able to:

- Differentiate microbes based on their mode of nutrition
- Comprehend concept of growth in microbes
- Understand the effect of various factors on microbial growth

UNIT II

Nutrient uptake and transport- passive and facilitated diffusion, primary and secondary

active transport, concept of uniport, symport and antiport, group translocation, iron uptake.

Learning outcomes

After completion of this unit the students will be able to:

- Learn mechanism of nutrient transport operating in microbes
- Appreciate the efficiency of nutrient transport system in microbes

Unit III

Chemoheterotrophic Metabolism-Aerobic Respiration, Concept of aerobic respiration, anaerobic respiration and fermentation Glucose metabolism-viz. EMP, ED, Pentose phosphate pathway, TCA cycle, Electron transport chain. Anaerobic respiration with special reference to dissimilatory nitrate reduction. Fermentation—alcohol fermentation and Pasteur effect

Learning outcomes

After completion of this unit the students will be able to

- Learn mechanisms of aerobic and anaerobic respiration operating in microbes
- Understand the fundamental process of glucose metabolism

Unit IV

Chemolithotrophic and Phototrophic Metabolism Introduction to aerobic and anaerobic chemolithotrophy with examples. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction) Photosynthesis- Anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria.

Learning outcomes

After completion of this unit the students will be able to

- Understand fundamental principles of chemolithotrophy
- Comprehend the diversity of phototrophic bacteria

UNIT V

Bacterial Chemotaxis, Quorum sensing & biofilms. - Properties of nitrogenase, and ammonia assimilation. Genetics of nitrogen fixation and regulation of nitrogenase activity and synthesis.

Learning outcomes

After completion of this unit the students will be able to

- Appreciate the mechanism of bacterial response to chemical stimuli
- Understand the mechanism of biological nitrogen fixation

Course Outcomes:

By the end of the course, students will

- Understand the mechanism of growth and survival strategies operating in microbes
- Learn the nutrient transport mechanisms in bacteria
- Understand different types of heterotrophic metabolism viz. aerobic, anaerobic respiration and fermentation
- Appreciate the photosynthetic and nitrogen assimilation mechanism operating in microbes.

MFST2081: CELL AND MOLECULAR BIOLOGY PRACTICAL

- Microscopic study of plant and animal cell
- Study of the structure of cell organelles through electron micrographs
- Study of different stages of Mitosis.
- Study of different stages of Meiosis
- Study of different types of DNA and RNA using micrographs and model/schematic representations
- Isolation of genomic DNA from plant material.
- Estimation of salmon sperm / calf thymus DNA using colorimeter (diphenylamine reagent) or UV spectrophotometer (A260 measurement)
- Estimation of RNA using colorimeter (orcinol reagent) or UV spectrophotometer (A260 measurement)
- Resolution and visualization of DNA by Agarose Gel Electrophoresis.
- Resolution and visualization of proteins by Polyacrylamide Gel Electrophoresis (SDS-PAGE).

RECOMMENDED BOOKS

1. Cell biology: Practical manual, 2018 by Renu Gupta et al
2. Cell And Molecular Biology: A Lab Manual, 2013, PHI learning India Limited.
3. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 6th edition, Cold Spring Harbour Lab. Press, Pearson Publication
4. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco
5. DeRobertis EDP and DeRobertis EMF (2006) Cell and Molecular Biology, 8th edition. Lippincott Williams and Wilkins, Philadelphia
6. Karp G (2010) Cell and Molecular Biology: Concepts and Experiments, 6th edition, John Wiley & Sons Inc.
7. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

Course Outcomes:

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

- Microscopic study of plant and animal cell
- Different stages of mitosis and meiosis

MFST3061: IMMUNOLOGY

Preamble:

Immunology course provides the knowledge about structure and function of immune system. This course provides the basic fundamentals of Antigens, antibodies, antigen and antibody interactions along with complement activation and MHC.

Course Objectives:

- To provide ground knowledge about the immune system and its functions
- To provide key components of the innate and adaptive immune responses
- To Provide fundamental working knowledge of the basic principles of immunology and diagnostic immunology
- To provide mechanism of complement system activation pathways and structure and functions of Major Histo Compatible complex ,
- To provide Basic principles of immunization.

Unit 1

Concepts and Types of immunity- Innate immunity, Adaptive immunity, immunological response, contributions of Scientists in the field of immunology- Edward Jenner, Karl Landsteiner, Robert Koch, Paul Ehrlich, Elie Metchnikoff

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

- Concepts and types of immune systems
- By the end of this unit, the student will be able to gain knowledge regarding
- Structure and functions of Organs and Cells involved in immune system

Unit 2

Structure, Functions and Properties of organs involved in immune system- Primary lymphoid organs and secondary lymphoid organs, Structure and functions of Immune Cells – T cell, B cell, NK cell, Macrophages, Neutrophils, Eosinophil, Basophil, Mast Cell, Dendritic cells

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

- Structure and functions of Cells involved in immune system
- Primary and secondary lymphoid organs and their functions.

- Immunological memory

Unit 3

Characteristics and nature of antigen- epitopes, haptens, Structure and characteristics and types of antibodies- Ig G, Ig A, Ig M, Ig E, Ig D. Monoclonal antibodies and polyclonal antibodies, Hybridoma technology

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

- Nature of antigens
- Types, structure, and functions of antibodies
- Concept of monoclonal antibodies and hybridoma Technology

Unit 4

Antigen- antibody reactions: principles and applications of precipitation, agglutination, Immunodiffusion, Immunofluorescence, Immunoelectrophoresis, ELISA, RIA, Western blotting, Complement system-Complement activation pathways- classical, alternative and lectin pathways, biological consequences of complement action

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

- Antigen antibody reactions and their principles
- Antigen and antibodies role in diagnostic tests
- Concept of complement system
- Activation pathways and biological consequences of complement system

Unit 5

Major histocompatibility complex, Structure and functions of Class I MHC and Class II MHC, Antigen processing and antigen presentation by cytosolic and endocytic pathways, Principles of Immunization

Learning Outcomes: By the end of this unit, the student will be able to learn about

- Major Histocompatibility Complex (MHC)
- Structure and functions of Class I and Class II MHC
- Fundamentals of antigen processing and presentation pathways
- Principles of immunization

RECOMMENDED BOOKS

- Abbas AK, Lichtman AH, Pillai S.(2007).Cellular and Molecular Immunology. 6th edition Saunders Publication ,Philadelphia.
- Delves P, Martin S, Burton D, Roitt I M. (2006). Roitt's Essential Immunology.11th edition Wiley- Blackwell Scientific Publication, Oxford.
- Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

Course Outcomes:

At the end of the course, students will

- Develop ground knowledge about the immune system and its functions
- Learn key components of the innate and adaptive immune responses
- Gain fundamental working knowledge of the basic principles of immunology and diagnostic immunology
- Learn mechanism of complement system activation pathways and structure and functions of Major Histo-Compatible complex ,
- Learn Basic principles of immunization.

MFST3071: INDUSTRIAL MICROBIOLOGY

Preamble:

This course provides an overview about the study of range of fermentation processes, design of fermentors and types of fermentors, fermentation economics, and production of valuable products by fermentation technology such as antibiotics, beverages and organic acids and enzymes including downstream processing methods.

Course Objectives:

- To familiarize students with the range of fermentation processes
- To provide knowledge on fermentor design and types of bioreactors
- To give knowledge about fermentation medium selection, importance of growth kinetics
- To make students understand about the production of ethanol, organic acids, vitamins, enzymes and immobilization technique

Unit 1

Significance of industrial microbiology in various fields, Industrially important microorganism and their source, Screening and strain development methods, Isolation and preservation methods of industrially important microbial strains, Media formulation for industrial fermentations, crude and synthetic media

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

- Significance of industrial microbiology
- Screening and Strain development methods
- Media formulation

Unit 2

Types of fermentation process, solid state and liquid state fermentations, Growth kinetics, batch, fed batch, continuous fermentations, dual and multiple fermentation process, scale-up and fermentation economics

Learning Outcomes: By the end of this unit, the student will be able to gain knowledge on the

- Types of fundamental fermentation process
- Significance of scale-up process
- Fermentation economics

Unit 3

Design and components of typical bioreactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, stirred tank and air lift bioreactor, control of fermentation parameters-pH, temperature, dissolved oxygen and foaming and aeration

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

- Design and components of typical bioreactor
- Types of bioreactors
- Control of fermentation parameters

Unit 4

Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and applications)-Citric acid, ethanol, penicillin, glutamic acid, VitaminB12 Enzymes (amylase, protease, lipase) Wine, beer

Learning Outcomes: By the end of this unit, the student will be understand the processes related to the

- Microbial productions of oraganic acids and beverages
- Microbial production process of enzymes and vitamins
- Applications and fermentation conditions for fermented products

Unit 5

Down-stream processing- cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying, enzyme immobilization method and their advantages and limitations

Learning Outcomes: By the end of this unit, the student will be gain knowledge on

- Various downstream processing methods used for fermented products
- Basic concepts of immobilization technology and their types

RECOMMENDED BOOKS

4. Patel A.H. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited
5. Okafor N. (2007).Modern Industrial Microbiology and Biotechnology.1stedition.BiosScientific Publishers Limited. USA

6. Waite M.J., Morgan N.L., Rockey J.S. and Higon G. (2001).Industrial Microbiology: An Introduction. 1st edition. Wiley –Blackwell

Course Outcomes:

By the end of the course, students will

- Be familiarized with the range of fermentation processes
- Gain knowledge on fermentor design and types of bioreactors
- Develop concepts on fermentation medium selection, importance of growth kinetics
- Understand about the production of ethanol, organic acids, vitamins, enzymes and immobilization technique.

MFST3091: INDUSTRIAL MICROBIOLOGY PRACTICAL

- Study different parts of fermenter
- Microbial fermentations for the production and estimation (qualitative and quantitative) of:
 - Enzymes: Amylase and Protease
 - Amino acid: Glutamic acid
 - Organic acid: Citric acid
 - Alcohol: Ethanol
- A visit to any educational institute/ industry to see an industrial fermenter, and other downstream processing operations.

RECOMMENDED BOOKS

1. Glaze A.N. and Nikaido H. (1995). Microbial Biotechnology: Fundamentals of Applied Microbiology. 1st edition. W.H. Freeman and Company
2. Casida L.E. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
3. Rueger W and Rueger A. (2000). Biotechnology: A text book of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
4. Stanbury P.F., Whitaker A and Hall S.J. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

Course outcomes:

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

- Learn about different fermenters used in the industry
- Production and estimation of amylases, glutamic acid and citric acid

MFST3101: MEDICAL MICROBIOLOGY

Preamble:

To teach the concepts related to the pathogenesis of microbes belonging to bacteria, viruses, fungi and protozoa. Laboratory diagnosis, epidemiology of the diseases caused due to these pathogens

Course Objectives:

- To study normal flora of human body, host-pathogen interaction and pathogenicity
- To gain knowledge on the pathogenic bacteria and their detailed study
- To provide access to study of medically important viruses.
- To learn about fungal and protozoan diseases.

Unit 1

Normal microflora of the human body and host pathogen interaction. Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract.

Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiologic effects of LPS

Learning Outcomes: By the end of this unit, the student will be learn about

- Normal flora of human body
- Host-pathogen interactions
- Pathogenicity and toxigenicity

Unit 2

Bacterial diseases: Symptoms, mode of transmission, prophylaxis and control

Respiratory Diseases: *Streptococcus pneumoniae*, *Mycobacterium tuberculosis*, *Neisseria meningitidis*, *Corynebacterium diphtheriae*, *Mycobacterium tuberculosis* Gastrointestinal Diseases: *Escherichia coli*, *Salmonella typhi*, *Vibrio cholerae*, *Helicobacter pylori*, Others: *Staphylococcus aureus*, *Clostridium tetani*, *Treponema pallidum*.

Learning Outcomes: By the end of this unit, the student will

- Know list of pathogenic bacteria, symptoms and mode of their transmission

- Have completed a detailed study of bacteria involved in respiratory diseases.

Unit 3

Viral diseases: List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikun gunya, Japanese Encephalitis

Learning Outcomes: By the end of this unit, the student will

- Know list of viruses, symptoms and mode of their transmission
- Have completed a detailed study of viral diseases

Unit 4

Fungal and Protozoan diseases. Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention. Cutaneous mycoses: *Tinea pedis* (Athlete's foot) Systemic mycoses: Histoplasmosis Opportunistic mycoses: Candidiasis.

Protozoan diseases: Symptoms, mode of transmission, prophylaxis and control of Malaria, Kala-azar

Learning Outcomes: By the end of this unit, the student will

- Know list of fungal and protozoan pathogens, symptoms and mode of their transmission
- Have completed a detailed study of cutaneous mycosis and protozoan diseases

Unit 5

Antimicrobial agents. General characteristics and mode of action. Antibacterial agents: Mechanism of action Penicillin, Streptomycin, Imipenem, Gentamycin, Moxifloxacin, Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin, Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine, Antibiotic resistance, MDR, XDR, MRSA, NDM-1.

Learning Outcomes: By the end of this unit, the student will

- Know about antimicrobial and antibacterial agents.
- Mechanism of their action

RECOMMENDED BOOKS

1. Textbook of Microbiology (6th edition) by Ananthanarayan and C. K. J.Paniker.
2. Textbook of Medical Parasitology (2013) by S. C. Panija.
3. Textbook of Medical Parasitology (6th edition) by C.K.JPaniker.
4. Medical Microbiology (26th edition) by Jawetz et. al.
5. Medical Microbiology (26th edition) by Melnick and Adelberg
6. Medical Microbiology (16th edition) by D. Greenwood et.al.
7. Medical Microbiology (7th edition) by P. R.Murray et.al.

Course Outcomes:

By the end of the course, students will

- Study normal flora of human body, host-pathogen interaction and pathogenicity
- Gain knowledge on the pathogenic bacteria and their detailed study
- Study medically important viruses.
- Learn about fungal and protozoan diseases.