ADAMAS UNIVERSITY

Department of Biotechnology

School of Life Science & Biotechnology

B.Tech. Biotechnology

Course Structure
Program Code: BIT3403

Total Credit 170

2026-2027

Proposed curriculum of B.Tech. Biotechnology
Aligned with the model curriculum of AICTE 2020
THIRD SEMESTER ONWARDS

GENERAL COURSE STRUCTURE & THEME

A. *Definition of Credit:*

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: 163 credits need to be covered by a student to be eligible to get an Undergraduate Degree in Biotechnology.

C. Structure of Undergraduate Biotechnology Program: The structure of Biotechnology program shall have essentially the following categories of courses with the breakup of credits as given:

S. No.	Code	Category	Suggested Breakup of Credits (Total 163)	Revised Breakup of Credits (Total 170)
1	HS	Humanities and Social Sciences including Management, Regulatory courses.	15*	18
2	BSC	Basic Science courses.	19*	16
3	ESC	Engineering Science Courses	16*	20
4	BS	Biological Science courses including laboratory	16*	17
5	PC	Professional Core Courses	43*	45
6	PE	Professional Elective Courses	18*	18
7	OS	Open Subjects - Electives from cross discipline technical and / or emerging subjects	18*	18
8	PS	Project work, seminar and internship in industry or elsewhere.	18*	18
9	AU	Audit Courses	(non-credit)	(non-credit)
		TOTAL	**163***	**170**

**: Minor variation is allowed.*

D. *Course Code and Definitions:*

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credit
C.A.	Continuous Assessment
E.S.A.	End Semester Assessment
HS	Humanities & Social Sciences Courses
BSC	Basic Science Courses
ESC	Engineering Science Courses
BS	Biological Science Courses
PC	Program Core Courses
PE	Program Elective Courses
OS	Open Subjects
PS	Project Work, Seminar, Internship
AU	Audit Courses

E. Course Level Coding Scheme: Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course e.g.
101, 102 … etc. for first year
201, 202 …. Etc. for second year
301, 302 … for third year

F. Category-wise Courses

HUMANITIES & SOCIAL SCIENCES COURSES [HS]

(i) Number of Humanities & Social Sciences Courses: 9
(ii) Credits: 18

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	AEC408/ AEC409/ AEC410	French I/ German I/ Spanish I	2	0	0	2	I	2
2	CLL103	Soft Skills and Aptitude I	0	0	1	2	II	1
3	AEC503/AEC504/AEC 505	French II/German II/ Spanish II	2	0	0	2	II	2
4	ENG11053	English Communication	2	0	0	2	II	2
5	XXXXXX	Effective Technical Communication	2	0	0	2	III	2
6	PSG11021	Human Values and Professional Ethics	2	1	0	3	VI	3

7	ECO11505	Economics for Engineers	2	0	0	2	IV	2
8	XXXXXX	Entrepreneurships & Startups	1	1	0	2	V	2
9	XXXXXX	Intellectual Property Rights (IPR) & Regulatory	1	1	0	2	VII	2
TOTAL			**14**	**3**	**1**	**19**		**18**

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BASIC SCIENCES COURSES [BSC]

(i) Number of Basic Sciences Courses: 5
(ii) Credits: 16

Sl. No.	**Code**	**Name**	**L**	**T**	**P**	**H**	**Semester**	**C**
1	MTH11501	Engineering Mathematics I	4	0	0	4	I	4
2	PHY13201	Applied Science	2	0	1	4	I	3
3	BIT11003	Life Sciences	2	0	0	2	II	2
4	MTH11502	Engineering Mathematics II	4	0	0	4	II	4
5	MTH11527	Probability, Statistics and Numerical Methods	2	0	1	4	III	3
TOTAL			14	0	2	18		**16**

ENGINEERING SCIENCES COURSES [ESC]

(i) Number of Engineering Sciences Courses: 9
(ii) Credits: 20

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	CSE11001	Introduction to Programming	2	0	0	2/3	I	2
2	GEE11001	Electrical and Electronics Technology	2	1	0			3
3	CSE12002	Programming Lab	0	0	2	3/2	I	2
4	GEE12002	Electrical and Electronics Technology Lab	0	0	1			1
5	DGS11002	Design Thinking & Prototyping	3	0	0	3	I	3
6	EIC11001	Venture Ideation	2	0	0	2	II	2
7	MEE11002	Engineering Mechanics	3	0	0	3	II	3
8	CEE12001	Engineering Drawing and CAD	0	0	2	3	II	2
9	MEE12001	Engineering Workshop	0	0	2	3	II	2
TOTAL			12	0	8	19		**20**

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BIOLOGICAL SCIENCES COURSES [BS]

(i) Number of Biological Sciences Courses: 6
(ii) Credits: 17

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	BBT201	Biochemistry	2	0	1	4	III	3
2	BBT202	Microbiology	2	0	1	4	III	3
3	BBT203	Genetics	2	0	1	4	III	3
4	BBT204	Biophysics	2	0	0	2	III	2
5	BBT205	Cell & Molecular Biology	2	0	1	4	III	3
6	BBT206	Animal & Plant Biology	2	0	1	4	III	3
TOTAL			12	0	5	22		**17**

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PROFESSIONAL CORE COURSES [PC]

(i) Number of Professional Core Courses: 15

(ii) Credits: 45

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	BIT15115	Applications of AI in Biotechnology	2	0	0	2	I	2
2	BBT226	Bioprocess engineering	2	0	1	4	IV	3
3	BBT227	Green Biotechnology and Pollution Abetment	2	0	0	2	IV	2
4	BBT228	Immunology & Immuno-technology	2	0	1	4	IV	3
5	BBT229	rDNA technology	2	0	1	4	IV	3
6	BBT230	Structural Biology	2	1	0	3	IV	3
7	BBT231	Bioinformatics & Computational Biology	2	0	1	4	IV	3
8	BBT326	Metabolic Engineering	2	0	1	4	V	3
9	BBT327	Analytical Techniques	2	0	1	4	V	3
10	BBT328	Cheminformatics & Medicinal Chemistry	2	0	1	4	V	3
11	BBT329	Good Manufacturing and Laboratory Practice	2	1	0	3	V	3
12	BBT330	Bioseparation Engineering	2	0	1	4	VI	3
13	BBT331	Synthetic & Systems Biology	3	0	1	5	VI	4
14	BBT332	Animal & Plant Biotechnology	2	0	2	6	VI	4
15	BBT426	Data Analysis and Simulations	2	0	1	3	VII	3
			31	2	12	56		**45**
TOTAL								**45**

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PROFESSIONAL ELECTIVE COURSES [PE] *

(i) Number of Professional Elective Courses: 4 x 3 = 12

(ii) Credits: 18

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	BBT351	Food Biotechnology	3	1	1	5	V	5
2	BBT352	Genomics, Proteomics & Metabolomics	3	1	1	5		
3	BBT353	Bioenergy for Sustainable Development	3	1	1	5		
4	BBT354	Biomaterials	3	1	1	5		
5	BBT355	Food Process Technology	3	1	1	5		
6	BBT356	Rational Drug Discovery	3	1	1	5		
7	BBT357	Environmental Biotechnology	3	1	1	5		
8	BBT358	Nano Biotechnology	3	1	1	5		

9	BBT451	Food Packaging Technology	3	1	1	5	VII	5
10	BBT452	Precision Medicine & Wellness	3	1	1	5		
11	BBT453	Advances in Microbial Biotechnology	3	1	1	5		
12	BBT454	Stem-Cell Technology	3	1	1	5		
13	BBT 455	Food Safety and Regulation	2	1	0	3	VII	3
14	BBT 456	Medical Biotechnology	2	1	0	3		
15	BBT 457	Waste Management & Upcycling	2	1	0	3		
16	BBT 458	Tissue Engineering	2	1	0	3		
17	BBT 459	Protein Engineering	2	1	0	3		
18	BBT 460	Bioterrorism and National Security	2	1	0	3		
		TOTAL						**18**

**Students have to select one from each group of I (BBT 351, BBT 352, BBT 353, BBT 354), II (BBT 356, BBT 357, BBT 358), III (BBT 451, BBT 452, BBT 453, BBT 454), IV (BBT 455, BBT 456, BBT 457, BBT 458, BBT 459, BBT 460)*

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OPEN SUBJECTS [OS]*

(i) Number of Open Subjects: 3 x 4+1 x 2 = 14

(ii) Credits: 18

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	OS301	3D Printing & Design	3	1	1	5	V	5
2	OS303	Internet of Things	3	1	1	5		
3	OS305	Image Processing	3	1	1	5		
5	OS302	Artificial Intelligence	3	1	1	5	VI	5
6	OS304	Quantum Computing	3	1	1	5		
7	OS306	Cyber Security	3	1	1	5		
9	OS401	Robotics	3	1	1	5	VII	5
10	OS403	Virtual Reality	3	1	1	5		
11	OS405	Data Sciences	3	1	1	5		
12	OS406	Block Chain	2	1	0	3	VII	3
13	OS407	Food and Nutrition Technology	2	1	0	3		
								18

**Students have to select one from each group of I (OS301, OS303, OS305, OS307), II (OS302, OS304, OS306, OS308), III (OS401, OS403, OS405), IV (OS406, OS407)*

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PROJECT WORK, SEMINAR, INTERNSHIP [PS]

(i) Number of Open Subjects: 6

(ii) Credits: 18

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	BBT291	Technical Seminar	0	0	1	2	III	1
2	BBT391	Summer Internship-I	0	0	2	4	V	2
3	BBT392	Comprehensive *viva voce*	0	0	1	2	VI	1
4	BBT498	Project-I	0	0	2	4	VII	2
5	BBT491	Summer Internship-II	0	0	3	6	VII	3
6	BBT499	Project-II (Biotech Industrial or Biotech In-house Project or Bio-Entrepreneurship)	0	0	9	18	VIII	9
TOTAL								**18**

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AUDIT COURSES [AU]

Note: These are mandatory non-credit courses.

Sl. No.	Code	Name	L	T	P	H	Semester	C
1	AU102	Sports and Yoga	2	0	0	2	II	0
2	AU202	Environmental Science	2	0	0	2	IV	0
3	AU301	Indian Constitution	2	0	0	2	V	0
TOTAL								0

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SEMESTER WISE
CREDIT DISTRIBUTION

SEMESTER I

S. No.	Course Code	Course Title	L	T	P	H	Credit
	3 WEEKS COMPULSORY INDUCTION PROGRAM						
1	MTH11501	Engineering Mathematics I	4	0	0	4	4
2	AEC408/ AEC409/ AEC410	French I/ German I/ Spanish I	2	0	0	2	2
3	PHY13201	Applied Science	2	0	1	4	3
4	CSE11001	Introduction to Programming	2	0	0	2	2/3
5	GEE11001	Electrical and Electronics Technology	2	1	0	3	
6	CSE12002	Programming Lab	0	0	2	3	2/1
7	GEE12002	Electrical and Electronics Technology Lab	0	0	1	2	
8	ENG11053	English Communication	2	0	0	2	2
9	BIT15115	Applications of AI in Biotechnology	2	0	0	2	2
10	DGS11002	Design Thinking & Prototyping	3	0	0	3	3
11	CEE12001	Engineering Drawing and CAD	0	0	2	3	2
12	MEE12001	Engineering Workshop	0	0	2	3	
		TOTAL	**19**	**0**	**9**	**33**	**22**

SEMESTER II

S. No.	Course Code	Course Title	L	T	P	H	Credit
1	MTH11502	Engineering Mathematics II	4	0	0	4	4
2	CSE11001	Introduction to Programming	2	0	0	2	2/3
3	GEE11001	Electrical and Electronics Technology	2	1	0	3	
4	CSE12002	Programming Lab	0	0	2	3	2/1
5	GEE12002	Electrical and Electronics Technology Lab	0	0	1	2	
6	EIC11001	Venture Ideation	2	0	0	2	2
7	BIT11003	Life Sciences	2	0	0	2	2
8	MEE11002	Engineering Mechanics	3	0	0	3	3
9	CEE12001	Engineering Drawing and CAD	0	0	2	3	2

10	MEE12001	Engineering Workshop	0	0	2	3	
11	AEC503/AEC 504/AEC 505	French II/German II/ Spanish II	2	0	0	2	2
12	CLL103	Soft Skills and Aptitude I	0	0	1	2	1
13	AU102	Sports and Yoga	2^	0	0	2	0
		TOTAL	**17+ 2^**	**0**	**9**	**33**	**20**

SEMESTER III

S. No.	Course Code	Course Title	L	T	P	C	Contact Hours Per Week	Max. Marks	
								C.A	E.S.A
1	MTHXXXXX	Probability, Statistics and Numerical Methods	2	0	1	3	4	50	50
2	HS201	Effective Technical Communication	2	0	0	2	2	50	50
3	BBT201	Biochemistry	2	0	1	3	4	50	50
4	BBT202	Microbiology	2	0	1	3	4	50	50
5	BBT203	Genetics	2	0	1	3	4	50	50
6	BBT204	Biophysics	2	0	0	2	2	50	50
7	BBT205	Cell & Molecular Biology	2	0	1	3	4	50	50
8	BBT206	Animal & Plant Biology	2	0	1	3	4	50	50
9	BBT291	Technical Seminar	0	0	2	1	2	--	100
TOTAL			**16**	**0**	**8**	**23**	**30**	**400**	**500**

Commented [AB1]: Yet to receive subject name and code

Commented [BB2]: Include the syllabus in third semester

SEMESTER IV

S. No.	Course Code	Course Title	L	T	P	C	Contact Hours Per Week	Max. Marks	
								C.A	E.S.A
1	BBT226	Bioprocess Engineering	2	0	1	3	4	50	50
2	BBT227	Green Biotechnology and Pollution Abetment	2	0	0	2	2	50	50
3	BBT228	Immunology & Immuno-technology	2	0	1	3	4	50	50
4	BBT229	rDNA Technology	2	0	1	3	4	50	50
5	BBT230	Structural Biology	2	1	0	3	3	50	50
6	BBT231	Bioinformatics & Computational Biology	2	0	1	3	4	50	50
7	EVS11112	Environmental Science	2^	0	0	0	2	50	50
8	ECO11505	Economics for Engineers	2	0	0	2	2	50	50
TOTAL			**14+2^**	**1**	**4**	**19**	**25**	**400**	**400**

Note: ^ represents related to Audit Course.

SEMESTER V

S. No.	Course Code	Course Title	L	T	P	C	Contact Hours Per Week	Max. Marks	
								C.A	E.S.A
1	XXXXXX	Entrepreneurship and Startups	1	1	0	2	2	50	50
2	BBT326	Metabolic Engineering	2	0	1	3	4	50	50
3	BBT327	Analytical Techniques	2	0	1	3	4	50	50
4	BBT328	Cheminformatics & Medicinal Chemistry	2	0	1	3	4	50	50
5	BBT329	Good Manufacturing and Laboratory Practice	2	1	0	3	3	50	50
6	BBT351-380	Professional Elective-I	3	1	1	5	6	50	50

7	OSXXX	Open Subject-I	3	1	1	5	6	50	50
8	AU301	Indian Constitution	2^	0	0	0	2	--	--
9	BBT391	Summer Internship-I	0	0	2	2	--	--	100
TOTAL			**15+2^**	**4**	**7**	**26**	**31**	**350**	**450**

Note: ^ represents related to Audit Course.

SEMESTER VI

S. No.	Course Code	Course Title	L	T	P	C	Contact Hours Per Week	Max. Marks	
								C.A	E.S.A
1	BBT330	Bioseparation Engineering	2	0	1	3	4	50	50
2	BBT331	Synthetic & Systems Biology	3	0	1	4	5	50	50
3	BBT332	Animal & Plant Biotechnology	2	0	2	4	6	50	50
4	BBT351-380	Professional Elective-II	3	1	1	5	6	50	50
5	OSXXX	Open Subject-II	3	1	1	5	6	50	50
6	PSG11021	Universal Human Values 2: Understanding Harmony	2	1	0	3	3	50	50
7	BBT392	Comprehensive *viva voice*	0	0	1	1	---	---	100
TOTAL			**15**	**3**	**7**	**25**	**30**	**300**	**400**

SEMESTER VII

S. No.	Course Code	Course Title	L	T	P	C	Contact Hours Per Week	Max. Marks	
								C.A	E.S.A
1	XXXXXX	Intellectual Property Rights (IPR) & Regulatory	1	1	0	2	2	50	50
2	BBT426	Data analysis and simulations	2	0	1	3	4	50	50
3	BBT451-	Professional	3	1	1	5	6	50	50

	480	Elective-III							
4	BBT451-480	Professional Elective-IV	2	1	0	3	3	50	50
5	OSXXX	Open Subject-III	3	1	1	5	6	50	50
6	OSXXX	Open Subject-IV	2	1	0	3	3	50	50
7	BBT498	Project-I	0	0	2	2	--	--	100
8	BBT491	Summer Internship-II	0	0	3	3	--	--	100
TOTAL			**13**	**5**	**8**	**26**	**24**	**300**	**500**

SEMESTER VIII

S. No.	Course Code	Name	L	T	P	C	Contact Hours Per Week	Max. marks	
								C.A	E.S.A
1	BBT499	Project-II (Biotech Industrial or Biotech In-house Project or Bio-Entrepreneurship/ startups)	0	0	9	9	--	--	100
TOTAL			**0**	**0**	**9**	**9**	**--**	**--**	**100**

SEMESTER I

SEMESTER – I

MTH11501 Engineering Mathematics-I

Course Code	:	**MTH11501**
Course Title	:	**Engineering Mathematics-I**
Number of Credits	:	4 (L: 4, T: 0, P: 0)
Course Category	:	BSC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To help the student to understand basic concept of abstract and vector algebra with its uses in engineering science. To give emphasis about concepts of differential calculus and enable students to apply these topics in real life problems. To give the students a perspective to learn integral calculus and its importance in advanced study in engineering science. To enable students acquire fundamental concept of ordinary differential equation and it's applications in engineering science.

Course Content:

Unit I: Differential Calculus: Introduction to limit, continuity, derivative for function of one variable, Successive differentiation, Leibnitz's theorem; Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders, Indeterminate forms, Concavity and convexity of a curve, Points of inflexion

Limit, continuity, and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, chain rule, total derivative, derivatives of composite and implicit functions, homogeneous function, Euler's theorem on homogeneous functions, Jacobian of variable transformation, maxima and minima of functions of several variables, Lagrange's method of multipliers.

Unit II: Integral Calculus: Reduction formulae, Improper integral, convergence of improper integrals, tests of convergence, Beta and Gamma functions, elementary properties, Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double integrals, applications

Unit III: Linear Algebra: Symmetric and skew-symmetric matrices, orthogonal matrices, complex matrices, Hermitian and skew-Hermitian matrices, Unitary matrices, Elementary row and column operations on a matrix, Rank, echelon form, Inverse of a matrix using elementary operations, solution of system of linear equations, Consistency, Characteristic equation, Caley-Hamillton theorem, eigenvalues and eigenvectors, algebraic and geometric multiplicity, diagonalization.

Unit IV: Vector Algebra: Scalar and vector fields, Vector product, Scalar triple product and their interpretation, directional derivative, gradient, Curl, divergence

Text Books/References:

1. Erwyn Kreyszig : Advanced Engineering Mathematics, John Wiley and Sons

2. B.V. Ramana, Higher Engineering Mathematics Tata McGraw-Hill.

3. B.S.Grewal : Higher Engineering Mathematics, Khanna Publications

4. C B Gupta, S R Singh, Mukesh Kumar: Engineering Mathematics, McGraw Hill Publication.

5. R.K.Jain and S.R.K.Iyengar : Advanced Engineering Mathematics, Narosa Publishing House, 2002

AEC408 French I

Course Code	:	**AEC408**
Course Title	:	**French I**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Educational Objectives (PEO) :

The French Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Equip students with essential French language skills for basic communication in everyday contexts.

PEO2 – Strengthen linguistic competence through a structured progression of vocabulary, grammar and writing skills

PEO3 – Foster an appreciation of Francophone cultures, enhancing intercultural sensitivity and global perspectives

Course Content:

Module 1: French Communication

- French alphabets, pronunciation and accents
- Basic expressions of greetings, expressions of politeness
- Numbers (cardinal, ordinal), Counting
- Communication in the class
  Asking and giving information about someone
  Saying the date and asking and telling the time
  Colours
  Days of the week and months of the year

Module 2: Grammar

- Definite and Indefinite Articles, Subject Pronouns
- Countries and nationalities
- Common adjectives to describe someone
- Irregular Verbs: être, avoir, aller, s'appeler
- Regular Verbs: ER, IR, RE group, Expressions with être and avoir
- Negative sentences

Module 3: French Culture and Civilisation

- French gastronomy: French cheese and wines

- Famous French perfumes
- French cities and tourist places
- Francophone countries
- Renowned French personalities
- Significance of the French flag and currency

Module 4: Writing

- Self-introduction
- Introducing someone else
- Basic conversation between two persons expressing their likes and dislikes

Text Books/References:

N.A

AEC409 German I

Course Code	:	**AEC409**
Course Title	:	**German I**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Educational Objectives (PEO):

The German Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Develop foundational skills in speaking, reading, writing, and listening, enabling effective communication in German

PEO2 – Gain insight into German cultural practices, traditions and social etiquette

PEO3 – Acquire the ability to use German in real-life contexts, such as introducing oneself, in restaurant interactions, in supermarkets, in commuting and in formal writing

PEO4 – Develop competence in German grammar, understanding articles, pronouns, conjunctions, verb conjugations and sentence structures

Course Content:

Module 1: Introduction

- Overview of the Indo-European Family of Languages
- Concept of Germanic, Romance and Slavic Languages

- European Countries where German is spoken:

Germany, Austria, Switzerland, Luxembourg, Lichtenstein et. al.

- Variation of German accents across Germany, Austria and Switzerland

Hochdeutsch, Österreichisches Deutsch and Schweizerdeutsch

Module 2: The German Alphabet

- Letter by Letter – Building Blocks of a New Language

- A Fun Intro to German Letters

- The four special German characters – ä, ö, ü, ß and their significance

Module 3: Pronunciation Rules (From Bahnhof to Brötchen – Speaking Like a Local)

- Rules for Vowels: a, o, e
- Rules for Special characters: ä, ö, ü
- Rules for Diphthongs: ie, ei, ai, au, aü, eu
- Rules for Consonants: b/d/g, h, j, r, s, v, y, z
- Rules for Consonant Clusters: ch, sch, tsch, chs, sp/st, pf, ck, tz, ng
- Rule for ig

Activities: Pronouncing unknown German words from a Word Montage

Reading elementary, unknown German texts with correct pronunciation

Module 4: German Numbers

- High-Five to German!

- The eins, zwei, drei of German numbers: counting from 1 to 100

- Activity: Listening Exercises on Numbers

Module 5: Reading the Clock like a Native German – Tick-Tock auf Deutsch

- Formal Time
- Informal Time
- Exercise: Telling the time by looking at pictures of clocks

Module 6: Grammar - Mission: Grammatik Possible

- Definite and Indefinite Articles in the Nominativ
- Personal Pronouns in the Nominativ

Module 7: Speaking German – Basic German Greetings and Expressions

- Hallo or Guten Tag?

Navigating the Art of First Impressions - Mastering German Greetings

- From Tschüss to Bis Bald! – Saying Goodbye

Farewell in German

- Wie Geht's? – How are you?

Conversational Starters

- Danke, Bitte, Entschuldigung – The Magic Words You'll Use Every Day Essential German Politeness
- Ja, Nein, Vielleicht – Yes, No, Perhaps Common Responses & Reactions
- Jawohl! Ach So! – Expressions That Make You Sound Like a Local Authentic German Exclamations

Module 8: German Culture

- Why Germans Love Punctuality – And How to Never Be 'Zu Spät!' Again!

(Understanding Social Etiquette)

- Dining Etiquette: How to say "Guten Appetit!" and "Prost!" correctly
- The 'Feierabend' Philosophy – How Germans Unwind After Work

Work-Life Balance & Leisure Culture

- "Kuchen und Kaffee" – What Germans eat and drink Traditional German Food and Everyday Eating Habits
- Karneval , Oktoberfest, Ostern, Christmas Markets & Silvester German Festivals and Seasonal Events

Module 9: Elementary Vocabulary

- Schwarz, Weiss & everything in between – A Colourful Dive into German! - Making colours fun
- From Oma to Onkel – Who's Who in the Family Tree? -Navigating Family Vocabulary
- From Küche to Keller – A Tour of Your House in German -Essential Home Vocabulary
- Hop On, Hop Off – Mastering German Transport Without Missing Your Bus - Understanding Transport Terms
- Audio Comprehensions

Text Books/References:

N.A

AEC410 Spanish I

Course Code	:	**AEC410**
Course Title	:	**Spanish I**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50

End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Specific Outcomes (PSO):

The Spanish Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Equip students with the ability to communicate effectively in basic spoken and written Spanish in familiar contexts

PEO2 – Provide a strong foundation in Spanish grammar, vocabulary and pronunciation

PEO3 – Develop cross-cultural awareness and appreciation of Hispanic cultures and global diversity

PEO4 – Enable students to engage in real-life situations using Spanish through listening, speaking, reading and writing practice

Course Content:

Module 1: Introduction

- Introduction to Spanish Language and Alphabet

Module 2: Expressions

- Greetings and Farewell
- Introducing yourself: name, nationality, profession

Module 3: Gender and Number

- Introduction to gender and number
  (masculine/feminine, singular/plural)

Module 4: Spanish Number System

- Counting from 1 to 100

Module 5: Time in Spanish

- Units of Time: Days, Months, Seasons
- Telling Time and Date

Module 6: Basic Vocabulary

- Colours and Shapes
- Food and Drinks
- Travel and Directions
- Classroom and University

Module 7: Elementary Grammar

- Regular verb conjugations in the present tense (ar, er, ir)
- Verb "ser" and nationalities
  Verb "estar" and location

- Personal Pronouns
- Articles (Definite / Indefinite)

Text Books/References:

N.A

PHY13201 Applied Science

Course Code	:	**PHY13201**
Course Title	:	**Applied Science**
Number of Credits	:	3 (L: 2, T: 0, P:1)
Course Category	:	BSC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To develop the capability of the students for understanding fundamental aspects of physics. To give students theoretical background, the key prerequisite for performing laboratory experiments. To build up the foundations for further studies in physics and engineering. Learn to analyze and evaluate various thermodynamic cycles used for energy production - work and heat, within the natural limits of conversion. To impart the knowledge of measurement of the rate of a chemical reaction and to gain knowledge of electrochemical procedure

Course Content:

Module 1Mechanics: Basic ideas of Vector Calculus Potential energy function, Conservative and non-conservative forces. Conservation laws of energy & momentum. Central and non-central forces, Gravitation, Kepler's Laws, Angular Velocity and Torque, Moment of Inertia, SHM, Damped, Undamped and forced Oscillations (no derivations).

Modul 2 Optics: Principle of Superposition and Interference from parallel thin films, Single slit and Double slit diffraction, Diffraction grating, dispersive power of Grating, resolving power of prism and grating.production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Nicol prism, specific rotation.

Module 3 Electromagnetic Theory: Gauss's Law in Electrostatics, Boundary Value problems, Dielectrics, Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focussing, Gauss law, continuity equation, Biot-Savart Law and its applications, inconsistency in Ampere's Law, Maxwell's equations (differential and integral forms), Poynting vector, Poynting Theorem (Statement only).

Module 4Thermodynamics: Importance and scope, definition of system and surroundings: type of systems (isolated, closed and open); extensive and intensive properties; steady state versus equilibrium state; concept of thermal equilibrium and the zeroth law of thermodynamics; thermodynamic coordinates, state of a system, equation of state, state functions and path functions; concept of heat and work (IUPAC convention); first law of thermodynamics, internal energy (U) as a state function; enthalpy as a state function; energy conservation in the living organism; heat changes at constant volume and constant pressure; relation between Cp and Cv using ideal gas; Thermodynamics of Chemical Processes, Concept of entropy, 2nd law of thermodynamics, Idea of Chemical potential, Equilibrium conditions for closed systems.

Module 5 Reaction Kinetics, Catalysis & Electrochemistry: Rate laws, 1stOrder reaction & 2ndorder reaction, Arrhenius equation, Mechanism and Theories of reaction rates, kinetic and thermodynamic control of reaction; idea of rate determining step; steady-state approximation; Characteristics and types of Catalyst, Theories of Catalysis, Electrode potential, Redox reaction & Nernst Equation.

Text Books/References:

1. Principles of Engineering Physics by S. P. Kuila, (Volume I) New Central Book Agency (P) Ltd.

2. Principles of Engineering Physics by S. P. Kuila, (Volume II) New Central Book Agency (P) Ltd.

3. Engineering Physics by Partha Pratim Das and Abhishek Chakraborty

4. Engineering Physics I by S. K. Bhattacharya and Soumen Pal

5. Engineering Physics II by S. K. Bhattacharya and Soumen Pal

6. Engineering Chemistry (Cambridge University Press-Ist Edition) –Shikha Agarwal

7. P. W. Atkins, Physical Chemistry, ELBS/Oxford, 10th Edition, 2014

8. Optics by Ajoy Ghatak, Mc-graw Hill

9. Introduction to Electrodynamics, David J. Griffiths, Pearson Education Limited

10. Engineering Chemistry (Pearson Ed.)- K. Sesha Maheswaramma and MridulaChugh

11. Physical Chemistry (Sarat Book House)- P. C. Rakshit

CSE11001 Introduction to Programming

Course Code	:	**CSE11001**
Course Title	:	**Introduction to Programming**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To understand the nature of programming as human activity. To practice the programming construct to solve multi-dimensional problems. To relate and implement mathematical concepts through programming in order to solve computational problems. To enable students to acquire structure and written expression required for their profession. To understand the principles of data storage and manipulation.

Course Content:

Unit I Basic Concepts of Programming: Introduction to components of a Computer System (disks, memory, processor, where a program is stored and executed, operating systems, compilers, etc.), Idea of Algorithm: steps to solve logical and numerical problems, Representation of Algorithms: Flowchart/Pseudocode with examples, From Algorithms to Programs; source code, variables and memory locations, Syntax and Logical Errors in compilation, Object and Executable code.

Unit II Basics of C Programming: Characters used in C, Identifiers, Keywords, Data type & sizes, Constants & Variables, Various Operators used such as Arithmetic Operators, Relational & Logical Operators, Increment & Decrement Operators, Assignment Operators, Conditional or Ternary Operators, Bitwise Operators & Expressions; Standard Input & Output, formatted input scanf( ), formatted output printf( ); Flow of Control, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto, label and exit( ) function.

Unit III Functions and Pointers: Definition of Function, Declaration or Prototype of Function, Various types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion, Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer.

Unit IV Arrays and String: Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations. Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example. Structures and Unions: Definition of a Structure, Declaration of a Structure & Structure Variable, Initialization of a Structure, Operators used in Structure, Structure within Structures, Union, Difference between a Structure and a Union. Files: Types of File, File Processing, Handling Characters, Handling Integers, Random File Accessing, Errors During File Processing.

Unit V Overview of Stacks and Queues: Introduction to Stack, Primitive operations on Stack, Real-life applications of Stack, Introduction to Queues, Primitive operations on Queues, Real-life applications of Queues.

Text Books/References:

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: mcgraw-hill.

2. Gotfreid (196) Schaum's Outline of Programming with C, 2 edn., USA: McGraw-Hill

3. Brian W. Kernighan, Dennis Ritchie (1988) C Programming Language, 2 edn., : Prentice Hall.

4. Al Kelley, Ira Pohl (1988) A Book on C, 4 edn., : Addision Wesley Longman

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GEE11001 Electrical and Electronics Technology

Course Code	:	**GEE11001**
Course Title	:	**Electrical and Electronics Technology**
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To familiarize with passive components, active components and measuring instruments. To familiarize the working of diodes, transistors, MOSFETS and integrated circuits. To implement mini projects based on concept of electronics circuit concepts. To understand d.c network theorems and apply these theorems to calculate the voltage, current and power for a given circuit. To explain the concept of active power, reactive power, power factor, quality factor, steady state sinusoids.

Course Content:

Unit I D.C. Circuit Analysis and Network Theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, Land C as linear elements, source transformation, Kirchoff's Law, mesh analysis and nodal analysis, star-delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem, network analysis with dependent sources.

Unit II 7 Steady State Analysis of Single Phase A.C. Circuits: Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasor, phasor representation of sinusoidal voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, causes and problems of low power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors.

Unit III Three Phase A. C. Circuits: Its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements, two wattmeter method.

Unit IV Basics of Semi-Conductors and PN Junction: Introduction; Carrier Concentrations- the Fermi Level; Electron and Hole Concentration at Equilibrium; Temperature Dependence of Carrier Concentration; Drift and diffusion current; The Hall Effect; Optical Absorption, Luminescence; PN Junction Diode in Equilibrium Conditions; PN Junction Diode in Forward Biased and Reverse Biased Condition; Breakdown in PN Junction Diodes.

Unit V Bipolar Junction Transistors: Introduction, Types: NPN and PNP; Current Components; Early Effect Ebber's Moll Model; Different Configurations of a Transistor and its Characteristics; Transistor as an Amplifier (CE, CB, CC); Transistor as a Switch.

Unit VI Field Effect Transistors: Introduction, JFET and MOSFET, Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.), Realization of switching circuit using MOSFET

Unit VII Electronics Instruments & Digital Electronics Fundamental: Signal generator, Multimeter, operation of CRO and its application.Number systems, Conversions and codes, Logic gates and truth tables.

Text Books/References:

1. Electronic Circuits, Discrete and Integrated- Charles Belove and Donald L. Schilling

2. Principles of Electrical Engineering and Electronics- V K Mehta, Rohit Mehta, S Chand and Company, New Delhi

3. Solid State Electronic Devices- Ben G. Streetman and Sanjay Kumar Banerjee, PHI.

4. Fundamental of Digital Circuits by Anand Kumar 2nd Eddition,PHI LearningPal, Rajendra

and Korlahalli, J.S. (2011) Essentials of Business Communication. Sultan Chand & Sons. ISBN: 9788180547294.

5. Theodore Wildi,ElectricMachines, Drives and Power Systems, Pearson, 2005.

6. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd Ed., Prentice Hall India Learning Pvt. Ltd., 1989.

7. J. Millman, C. Halkias and C. D. Parikh, Millman's Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Ed., McGraw Hill Education, 2017.

8. D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications, 8th Ed., McGraw Hill Education, 2014.5. Electronic Devices & Circuit Theory: Boyelstad & Nashelsky

9. Electronics Fundamental and application: D.Chattopadhyay and P C Rakshit

10. Electronic Principle: Albert Paul Malvino

11. Digital circuits and design by S Salivahanan and S Arivazhagan

12. V. N. Mittal and A. Mittal, Basic Electrical Engineering, Tata McGraw-Hill Publishing Company Ltd, 2006.

CSE12002 Programming Lab

Course Code	:	**CSE12002**
Course Title	:	**Programming Lab**
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To comprehend the practical nature of programming by solving through computer systems. To practice the programming construct to solve multi-dimensional problems. To relate and implement mathematical concepts through programming in order to solve computational problems. To enable students to acquire structure and written expression required for their profession. To understand the principles of data storage and manipulation.

Course Content:

Experiments:

1. Familiarization with LINUX commands and vi editor. [8h]

2. Programs to demonstrate Decision Making, Branching and Looping, Use of break and continue statement etc. [8h]

3. Implementation involving the use of Arrays with subscript, String operations and pointers.

[8h]

4. Implementation involving the use Functions and Recursion. [8h]

5. Implementation involving the use Structures and Files. [8h]

6. Implementation based on Stack Queues and Linked List for example Insertion and Deletion. [5h]

Text Books/References:

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: McGraw-hill.

2. Gotfreid (196) Schaum's Outline of Programming with C, 2nd ed., USA: McGraw-Hill

3. Brian W. Kernighan, Dennis Ritchie (1988) C Programming Language, 2nd ed., : Prentice Hall.

4. Das Sumitabha, UNIX Concepts and Applications, 4th Ed., New Delhi, Tata McGraw-Hill

5. Al Kelley, Ira Pohl (1988) A Book on C, 4th ed. Addision Wesley Longman

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GEE12002 Electrical and Electronics Technology Lab

Course Code	:	**GEE12002**
Course Title	:	**Electrical and Electronics Technology Lab**
Number of Credits	:	1 (L: 0, T: 0, P: 1)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To study basic electronic components. To observe characteristics of electronic devices. To study basic electrical circuits

Course Content:

List of experiments (Electrical Part):

1. Verification of Thevenin's theorem and Norton's theorem.

2. Verification of Superposition theorem.

3. Verification of Maximum power transfer theorem.

4. Study of R-L-C series circuit.

5. Study of R-L-C parallel circuit.

6. Performance study of fluorescent, LED, tungsten and carbon lamps.

7. Measurement of power in a three-phase circuit using two-wattmeter method.

List of experiments (Electronics Part):

1. Familiarization of bread board and electronics elements such as R, L, C, diode, and BJT etc.

2. Familiarization of Function generator and measuring instruments such as CRO and multimeter.

3. Study the V-I characteristic of PN junction diode and find knee voltage.

4. Study the input and output characteristic of bipolar junction transistor (BJT): Common emitter (CE) configuration

5. Study the transfer and drain characteristic of junction field-effect transistor (JFET), hence determine the drain resistance, transconductance factor, amplification factor.

6. Study the transfer and drain characteristic of MOSFET, hence determine the drain resistance, transconductance factor, amplification factor.

7. Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.).

Text Books/References: N.A

ENG11053 English Communication

Course Code	:	**ENG11053**
Course Title	:	**English Communication**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To know the importance and techniques of communication skills in order to improve professional skills. To enhance the knowledge of the students on vocabulary, syntax, and grammatical skills. To improve writing skills by applying writing techniques, tools in practice sessions. To achieve an overall enhancement in terms of reading, listening and speaking

Course Content:

Module I Communication Level 1: Basics of Communication, Means of Communication, Barriers of Communication

Module II Grammar and Syntax Level 1: Tense: types and uses, Idioms, One Word Substitutes, Discussion on the use of Articles and related exercises, Discussion on the use of Prepositions and related exercises, Exercises on Sentence –Making (Syntax), Practice exercises on Voice change, Class Exercises on Synonyms and Antonyms.

Module II Reading and Listening Skills Level 1: Introduction to listening skills: purposes and practice, Discussion on types of listening: difference between listening and hearing, Active listening: introduction listening exercises, Elementary level listening exercise, Intermediate level listening exercise, Advance level listening exercise, Introduction to Reading Skills, Strategies of reading, Skimming, Scanning and Summarizing, Comprehension exercises.

Module IV Speaking Skills Level 1: Introduction to Speaking Skills: Mother tongue influence, Discussion on various kinds of narrative styles and techniques: Welcome speech, Vote of Thanks, Farewell Speech, Debate and Elocution, Class Exercises on Descriptive narration, Practical Exercises on Narration styles, Presentation of small skits, Practicing Extempore in the class, Mock practices of Group discussion, Practicing speaking in pairs, Mock practice of job interviews.

Module V Writing Skills Level 1: Business letters: definition, types and format, Practice exercises, Business reports: definition, types and format, Practice exercises, CV and Application letters: types and formats, Practice exercises, Compositions: Essays, precis paragraph writing

Text Books/References:

1.Kaul Asha. Effective Business Communication. PHI Learning Pvt Ltd. 2014.

2.Wren and Martin. High School Grammar And Composition. S. Chand, 1995.

3.Gupta, A. English Reading Comprehension. Ramesh Publishing House, 2009.

4. Lewis, Norman. Word Power Made Easy. Anchor: 2014.

5. Riordan, Daniel G & Pauley Steven A. :Technical Report Writing Today. 2004.

6. Hamp-Lyons and Heasely, B . Study Writing; A Course in Written English. For Academic and Professional Purposes, Cambridge Univ. Press, 2006.

7. Quirk R., Greenbaum S., Leech G., and Svartik, J. A Comprehensive Grammar of the 5.English language, Longman:London, 1985.

8. Balasubramaniam, T. A Textbook of English Phonetics for Indian Students. Macmillan: 2012.

BIT15115 Applications of AI in Biotechnology

Course Code	:	**BIT15115**
Course Title	:	**Applications of AI in Biotechnology**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To provide fundamental knowledge of Artificial Intelligence concepts and project lifecycle. To explore applications of AI in biotechnology, agriculture, environment, and healthcare. To train students in no-code AI tools for practical problem-solving. To engage students in project-based learning for real-world biotechnology applications. To create awareness of ethical, societal, and professional aspects of AI in life sciences.

Course Content:

Unit I Fundamentals of Artificial Intelligence: Introduction to Artificial Intelligence, AI vs Human Intelligence, Data-driven learning concepts, AI Project Lifecycle (Intel Framework): Problem Definition, Data, Training, Testing, Deployment.

Unit II AI Applications in Biotechnology: Case Studies: Drug Discovery, Diagnostic Tools, Microbiome Analysis, Laboratory Automation, AI in Societal Development (literature, education, healthcare).

Unit III AI in Agriculture, Environment, and Healthcare: AI in Agriculture: Plant Disease Detection Soil & Crop Health Analysis, AI in Healthcare & Diagnostics: Disease Risk Prediction, AI-powered Chatbots, Skin/Eye Disease Classification.

Unit IV No-Code AI Tools & Hands-On Applications: Introduction to No-Code AI Tools: Teachable Machine, ML for Kids, Pictoblox AI, IBM Watson. Use Cases (Hands-on): Predictive Maintenance, Image Classification, Social Media Virality Prediction, HR Analytics (Employee Attrition).

Unit V Ethics, Mini Project & Career Readiness: Ethics in Bio-AI: Data Bias, Privacy, Surveillance, Bioethics in Genomics & Automation. Mini Project: Problem Identification, Data Collection, Model Training, Presentation. Career Insights: AI in Biotechnology and Future Skills.

Text Books/References:

1. Russell, S. & Norvig, P. Artificial Intelligence: A Modern Approach.

2. Nilsson, N.J. Artificial Intelligence: A New Synthesis.

3. Chng, E. & Coiera, E. Artificial Intelligence in Healthcare.

4. Research papers and case studies from Nature Biotechnology, AI in Healthcare Journal, etc.

DGS11002 Design Thinking & Prototyping

Course Code	:	**DGS11002**
Course Title	:	**Design Thinking & Prototyping**
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To enable students to understand Design Thinking Fundamentals. To enable students to master the Design Thinking Process. To enable students to develop User-Centered Solutions. To make them prototype the model.

Course Content:

Unit 1 Introduction to Design Thinking: What is Design Thinking?, History and Evolution of Design Thinking, Key Principles of Design, Thinking: Empathy, Collaboration, and Experimentation, Case Studies of Successful Design Thinking Applications

Unit 2 Design Thinking Process and Frameworks: The Design Thinking Model: Overview of the Phases, Different Frameworks: Stanford d.school, IDEO, and Double Diamond, Comparison of Design Thinking with Other Problem-Solving

Unit 3 Discover and Define Phases: Discover Phase, Research Methods: Interviews, Surveys, Observations, and Ethnography. Identifying User Needs and Pain Points, Tools: Empathy Maps, User Personas. Define Phase: Synthesizing Research Findings, Framing the Problem: How Might We Statements. Tools: Journey Maps, Problem Statements

Unit 4: Develop Phase: Ideation Techniques: Brainstorming, Mind Mapping, SCAMPER, Collaborative Design: Co-creation with Stakeholders, Concept Development: Sketching, Storyboarding, and Wireframing. Tools: Idea Boards, Concept Sheets, Brainstorming sessions, and mind mapping exercises. Creating storyboards and wireframes for proposed solutions.

Unit 5: Prototyping: Importance of Prototyping in Design Thinking, Types of Prototypes: Low-Fidelity vs. High-Fidelity, Tools and Techniques: Paper Prototypes, Digital Prototypes, 3D Printing, Testing, Refining and Improving Prototypes,

Text Books/References:

1. Brown, Tim. “What We Can Learn from Barn Raisers.” Design Thinking: Thoughts by Tim Brown. Design Thinking, 16 January 2015. Web. 9 July 2015.

2. Knapp, Jake. "The 8 Steps to Creating a Great Storyboard." Co.Design. Fast Company & Inc., 21 Dec. 2013. Web. 9 July 2015.

3. van der Lelie, Corrie. "The Value of Storyboards in the Product Design Process." Journal of Personal and Ubiquitous Computing 10.203 (2006): 159–162. Web. 9 July 2015. [PDF].

4. Millenson, Alisson. "Design Research 101: Prototyping Your Service with a Storyboard." Peer Insight. Peer Insight, 31 May 2013. Web. 9 July 2015.

CEE12001 Engineering Drawing and CAD

Course Code	:	**CEE12001**
Course Title	:	**Engineering Drawing and CAD**
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects in two-dimensional views. To understand the application of industry standards and techniques applied in engineering drawing. To apply auxiliary or sectional views to most practically represent engineered parts. To Dimension and annotate two-dimensional engineering drawings. To employ freehand 3D pictorial sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course Content:

Module I: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module II: Orthographic Projections covering, Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Module III: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

Module IV: Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Module V: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Text Books/References:

1. Engineering Drawing, N. D. Bhat, Charotar Publishing House (2012).

2. Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education.

3. Engineering Drawing & Graphics using Autocad, T. Jeyapoovan, Vikas Publishing House Pvt. Ltd.-Noida; Third edition (2010).

4. https://nptel.ac.in/courses/112103019/

MEE12001 Engineering Workshop

Course Code	:	**MEE12001**
Course Title	:	**Engineering Workshop**
Number of Credits	:	2 (L: 0, T: 0, P:2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To develop general machining skills in the students. To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude

Course Content:

List of Experiments (Any ten)

1. To make a single piece pattern from the given work piece and dimensions.
2. To make a double piece match pattern from the given dimensions.
3. To make a single piece cylindrical (solid) pattern from the given dimensions.
4. To make a cone from sheet metal as per given dimensions.
5. To make a frustum from sheet metal as per given dimensions.
6. To prepare a sand mould, given the single piece pattern and casting.
7. To prepare a sand mould, given the double piece match pattern and casting with different dimensions and shape
8. To make a square fitting from the given mild steel piece and the dimensions.
9. To make a square fitting from the given mild steel piece and the dimensions.
10. To make a single 'V' butt joint between two metal plates by using ARC welding.
11. To make a square butt joint between metal plates by using gas welding.
12. To perform various types of machining operations (cantering, facing and turning) on a given mild steel rod followed by the given dimensions.
13. To perform various types of machining operations (chamfering, grooving, thread cutting, and knurling) on a given mild steel rod followed by the given dimensions.

Text Books/References:

1. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
2. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.
3. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
4. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi

5. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
6. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

SEMESTER II

SEMESTER – II

MTH11502 Engineering Mathematics II

Course Code	:	**MTH11502**
Course Title	:	**Engineering Mathematics II**
Number of Credits	:	4 (L: 4, T: 0, P: 0)
Course Category	:	BSC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To help the student to understand the basic concepts of matrix theory with its uses in engineering science. To give emphasis about concepts of Eigen value and Eigen vector, vector space and linear transformation and enable students to apply these topics for analysing engineering problems. To help the student to understand the use of vector calculus in engineering. To give the students a perspective to learn about functions of complex variables, pole, and residues and their importance in advanced study of engineering science. To enable students to acquire the knowledge of different transformation techniques and their applications in engineering science.

Course Content:

Unit I Linear Algebra: Elementary row and column operations on a matrix, Rank, echelon form, normal form, Inverse of a matrix using elementary operations, solution of system of algebraic equation, consistency, Caley-Hamillton theorem, eigenvalues and eigenvectors, Symmetric and skew-symmetric matrices, orthogonal matrices, complex matrices, Hermitian and skew- Hermitian matrices, algebraic and geometric multiplicity, diagonalization, vector spaces, linear dependence of vectors, basis, linear transformations.

Unit II Vector Calculus: Ordinary Integrals of Vectors, Multiple integrals, Jacobian, Line, surface and volume integrals of Vector fields, Gauss' divergence theorem, Green's and Stokes Theorems and their applications. Complex Variables: Limit, continuity, differentiability and analyticity of functions, Cauchy- Riemann equations, line integrals in complex plane, Cauchy s integral theorem, independence of path, existence of indefinite integral, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, zeros and singularities, Residue theorem, evaluation of real integrals.

Unit III Fourier Series: Periodic functions, Definition of Fourier series, Euler's formulae, Dirichlet conditions, Change of interval, Even and odd functions, half range Fourier Sine & Cosine series.

Unit IV Introduction to Transform Calculus: Introduction to Laplace transform and its properties (without proof), Inverse Laplace transform, Definition of Fourier integrals, Fourier Sine & Cosine integrals, complex form of Fourier integral, Fourier sine & cosine transforms, inverse Fourier transform, introduction to Z- Transform and its properties, Inverse Z- Transform, Inverse Z- transform by partial fraction and residue methods.

Text Books/References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley and Sons

2. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill

3. David C. Lay, Linear algebra and its application, (Latest edition), Pearson publication, New Delhi

4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publications

5. C B Gupta, S R Singh, and Mukesh Kumar, Engineering Mathematics, Mc Graw Hill Publication

6. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing House

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CSE11001 Introduction to Programming

Course Code	:	**CSE11001**
Course Title	:	**Introduction to Programming**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To understand the nature of programming as human activity. To practice the programming construct to solve multi-dimensional problems. To relate and implement mathematical concepts through programming in order to solve computational problems. To enable students to acquire structure and written expression required for their profession. To understand the principles of data storage and manipulation.

Course Content:

Unit I Basic Concepts of Programming: Introduction to components of a Computer System (disks, memory, processor, where a program is stored and executed, operating systems, compilers, etc.), Idea of Algorithm: steps to solve logical and numerical problems, Representation of Algorithms: Flowchart/Pseudocode with examples, From Algorithms to Programs; source code, variables and memory locations, Syntax and Logical Errors in compilation, Object and Executable code.

Unit II Basics of C Programming: Characters used in C, Identifiers, Keywords, Data type & sizes, Constants & Variables, Various Operators used such as Arithmetic Operators, Relational & Logical Operators, Increment & Decrement Operators, Assignment Operators, Conditional or Ternary Operators, Bitwise Operators & Expressions; Standard Input & Output, formatted input scanf( ), formatted output printf( ); Flow of Control, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto, label and exit( ) function.

Unit III Functions and Pointers: Definition of Function, Declaration or Prototype of Function, Various types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion, Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer.

Unit IV Arrays and String: Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations. Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example. Structures and Unions: Definition of a Structure, Declaration of a Structure & Structure Variable, Initialization of a Structure, Operators used in Structure, Structure within Structures, Union, Difference between a Structure and a Union. Files: Types of File, File Processing, Handling Characters, Handling Integers, Random File Accessing, Errors During File Processing.

Unit V Overview of Stacks and Queues: Introduction to Stack, Primitive operations on Stack, Real-life applications of Stack, Introduction to Queues, Primitive operations on Queues, Real-life applications of Queues.

Text Books/References:

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: mcgraw-hill.

2. Gotfreid (196) Schaum's Outline of Programming with C, 2 edn., USA: McGraw-Hill

3. Brian W. Kernighan, Dennis Ritchie (1988) C Programming Language, 2 edn., : Prentice Hall.

4. Al Kelley, Ira Pohl (1988) A Book on C, 4 edn., : Addision Wesley Longman

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GEE11001 Electrical and Electronics Technology

Course Code	:	**GEE11001**
Course Title	:	**Electrical and Electronics Technology**
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To familiarize with passive components, active components and measuring instruments. To familiarize the working of diodes, transistors, MOSFETS and integrated circuits. To implement mini projects based on concept of electronics circuit concepts. To understand d.c network theorems and apply these theorems to calculate the voltage, current and power for a given circuit. To explain the concept of active power, reactive power, power factor, quality factor, steady state sinusoids.

Course Content:

Unit I D.C. Circuit Analysis and Network Theorems: Concept of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, Land C as linear elements, source transformation, Kirchoff's Law, mesh analysis and nodal analysis, star-delta transformation, network theorems: Thevenin's theorem, Norton's theorem, maximum power transfer theorem, network analysis with dependent sources.

Unit II 7 Steady State Analysis of Single Phase A.C. Circuits: Sinusoidal, square and triangular waveforms-average and effective value, form the peak factors, concept of phasor, phasor representation of sinusoidal voltage and current, analysis of series-parallel RLC circuits. Apparent, active and reactive powers, power factor, causes and problems of low power factor, power factor improvement, resonance in series and parallel circuits, bandwidth and quality factors.

Unit III Three Phase A. C. Circuits: Its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relation, three phase power measurements, two wattmeter method.

Unit IV Basics of Semi-Conductors and PN Junction: Introduction; Carrier Concentrations- the Fermi Level; Electron and Hole Concentration at Equilibrium; Temperature Dependence of Carrier Concentration; Drift and

diffusion current; The Hall Effect; Optical Absorption, Luminescence; PN Junction Diode in Equilibrium Conditions; PN Junction Diode in Forward Biased and Reverse Biased Condition; Breakdown in PN Junction Diodes.

Unit V Bipolar Junction Transistors: Introduction, Types: NPN and PNP; Current Components; Early Effect Ebber's Moll Model; Different Configurations of a Transistor and its Characteristics; Transistor as an Amplifier (CE, CB, CC); Transistor as a Switch.

Unit VI Field Effect Transistors: Introduction, JFET and MOSFET, Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.), Realization of switching circuit using MOSFET

Unit VII Electronics Instruments & Digital Electronics Fundamental: Signal generator, Multimeter, operation of CRO and its application.Number systems, Conversions and codes, Logic gates and truth tables.

Text Books/References:

1. Electronic Circuits, Discrete and Integrated- Charles Belove and Donald L. Schilling

2. Principles of Electrical Engineering and Electronics- V K Mehta, Rohit Mehta, S Chand and Company, New Delhi

3. Solid State Electronic Devices- Ben G. Streetman and Sanjay Kumar Banerjee, PHI.

4. Fundamental of Digital Circuits by Anand Kumar 2nd Eddition,PHI LearningPal, Rajendra

and Korlahalli, J.S. (2011) Essentials of Business Communication. Sultan Chand & Sons. ISBN: 9788180547294.

5. Theodore Wildi,ElectricMachines, Drives and Power Systems, Pearson, 2005.

6. Vincent Del Toro, Electrical Engineering Fundamentals, 2nd Ed., Prentice Hall India Learning Pvt. Ltd., 1989.

7. J. Millman, C. Halkias and C. D. Parikh, Millman's Integrated Electronics: Analog and Digital Circuits and Systems, 2nd Ed., McGraw Hill Education, 2017.

8. D. P. Leach, A. P. Malvino and G. Saha, Digital Principles and Applications, 8th Ed., McGraw Hill Education, 2014.5. Electronic Devices & Circuit Theory: Boyelstad & Nashelsky

9. Electronics Fundamental and application: D.Chattopadhyay and P C Rakshit

10. Electronic Principle: Albert Paul Malvino

11. Digital circuits and design by S Salivahanan and S Arivazhagan

12. V. N. Mittal and A. Mittal, Basic Electrical Engineering, Tata McGraw-Hill Publishing Company Ltd, 2006.

CSE12002 Programming Lab

Course Code	:	**CSE12002**
Course Title	:	**Programming Lab**
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To comprehend the practical nature of programming by solving through computer systems. To practice the programming construct to solve multi-dimensional problems. To relate and implement mathematical concepts through programming in order to solve computational problems. To enable students to acquire structure and written expression required for their profession. To understand the principles of data storage and manipulation.

Course Content:

Experiments:

1. Familiarization with LINUX commands and vi editor. [8h]

2. Programs to demonstrate Decision Making, Branching and Looping, Use of break and continue statement etc. [8h]

3. Implementation involving the use of Arrays with subscript, String operations and pointers.

[8h]

4. Implementation involving the use Functions and Recursion. [8h]

5. Implementation involving the use Structures and Files. [8h]

6. Implementation based on Stack Queues and Linked List for example Insertion and Deletion. [5h]

Text Books/References:

1. Balagurusamy, E., n.d. Programming In ANSI C. 5th ed. Bangalore: McGraw-hill.
2. Gotfreid (196) Schaum's Outline of Programming with C, 2nd ed., USA: McGraw-Hill
3. Brian W. Kernighan, Dennis Ritchie (1988) C Programming Language, 2nd ed., : Prentice Hall.
4. Das Sumitabha, UNIX Concepts and Applications, 4th Ed., New Delhi, Tata McGraw-Hill
5. Al Kelley, Ira Pohl (1988) A Book on C, 4th ed. Addision Wesley Longman

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GEE12002 Electrical and Electronics Technology Lab

Course Code	:	**GEE12002**
Course Title	:	**Electrical and Electronics Technology Lab**
Number of Credits	:	1 (L: 0, T: 0, P: 1)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To study basic electronic components. To observe characteristics of electronic devices. To study basic electrical circuits

Course Content:

List of experiments (Electrical Part):

1. Verification of Thevenin's theorem and Norton's theorem.

2. Verification of Superposition theorem.

3. Verification of Maximum power transfer theorem.

4. Study of R-L-C series circuit.

5. Study of R-L-C parallel circuit.

6. Performance study of fluorescent, LED, tungsten and carbon lamps.

7. Measurement of power in a three-phase circuit using two-wattmeter method.

List of experiments (Electronics Part):

1. Familiarization of bread board and electronics elements such as R, L, C, diode, and BJT etc.

2. Familiarization of Function generator and measuring instruments such as CRO and multimeter.

3. Study the V-I characteristic of PN junction diode and find knee voltage.

4. Study the input and output characteristic of bipolar junction transistor (BJT): Common emitter (CE) configuration

5. Study the transfer and drain characteristic of junction field-effect transistor (JFET), hence determine the drain resistance, transconductance factor, amplification factor.

6. Study the transfer and drain characteristic of MOSFET, hence determine the drain resistance, transconductance factor, amplification factor.

7. Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.).

Text Books/References: N.A

EIC11001 Venture Ideation

Course Code	:	**EIC11001**
Course Title	:	**Venture Ideation**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To help the students understand the way to be an Entrepreneur. To identify the right business opportunity. To empower students to perform a technical feasibility study and thereby developing a prototype. To help students in identifying their customers using primary and secondary research methods. Expose students to various factors of market and competition with the help of market feasibility study, forecasting techniques, business

model canvass and insights about financial statements. To prepare students with finalizing their entrepreneurial Portfolio.

Course Content:

Unit I Introduction: Preview of the Course, Introduction to the Course, Guest Lecture with U.S. Secretary of Commerce Penny Pritzker – Meaning of Innovation, Entrepreneurial opportunities, Factors influencing the feasibility of an innovation, Innovation strategy: technology-push or market- pull, Product-market fit, How to develop a business model, Walkthrough of the business model canvas, Welcome to Innovation for Entrepreneurs: From Idea to Marketplace.

Unit II Customer Discovery and Validation: Customer types, Customer archetypes, Customer segments and business models, Customer segments, value propositions, product features, value mapping, interviewing customer, insights of your customers.

Unit III Product Understanding and Marketing: Customer value, The DNA of customer-centricity, Crossing the chasm, Qualitative and quantitative marketing research, importance and methods of market segmentation, Focusing on the target market, Beyond the chasm, Strategic implications of beyond the chasm, E-commerce: The internet as a selling platform.

Unit IV Prototyping and Testing: Planning for prototyping, Rapid prototyping and development, Lean startup MVPs, Choosing a wire framing/UX prototyping tool, Anatomy of an experience map, What you'll learn from user testing, Analytics and insight, Troubleshooting your customer discovery, Levels of a product/service.

BIT11003 Life Sciences

Course Code	:	**BIT11003**
Course Title	:	**Life Sciences**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	BSC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: Introduction to Basics of Biology which includes cell, the unit of life, Types of cell and classification of living organisms. Understanding biomolecules present in a cell, their structure function and their role in a living organism. Application of certain bio molecules in Industry. Brief introduction to human physiology, which is essential for bioengineering field. Understanding the hereditary units, that is genes and genetic materials (DNA and RNA) present in living organisms. How biology can be applied in our daily life using different technology, for production of medicines to transgenic plants and animals to designing new biotechnological products

Course Content:

Unit I Integration of Biology and Engineering: (Re)connect human nature connection , Bioinspired invention, Biomimicry: History of biomimicry, types of biomimicry, Biomimicry Thinking - Creating, brainstorming,

Explaining biology through Physics and chemistry, expressing biological processes through mathematics, concept of system and systems biology

Unit II Forms of Life: Brief introduction to five kingdoms of classification. Introduction to the basic classification of plant and animal kingdom up to class.

Unit III: Basic structure and Function of a Cell: What is a Cell, Cell theory, structure of a Cell, The Plant Cell and animal Cell, protoplasm, prokaryotic and eukaryotic Cell; Carbohydrates, proteins, Amino acid, nucleic acid (DNA and RNA) and their types, chromosomes, Cell cycle and cancer

Unit IV Physiological processes in living beings: Nutrition (Classes of nutrients or food substances), Digestive systems, Respiratory system (two kinds of respiration – aerobic and anaerobic) Respiratory organs, respiratory cycle. Excretory system

Unit V Microbes and Diseases: Basics of immune system: innate and adaptive immunity, antibodies and T cells, Microbes breaching our immune system, Diseases caused by microbes, treatment of diseases, Vaccine

Text Books/References:

1. Biology for Engineers by Arthur T. Johnson. CRC Press, 1 edition, 2010.

2. Campbell Biology (10th Edition) 10th edition by Reece, Jane B., Urry, Lisa A., Cain, Michael L., Wasserman, (2013)

3. Applied Cell and Molecular Biology for Engineers by Gabi Nindl Waite and Lee R. Waite.

McGraw-Hill Education, 1 edition, 2007.

4. Samson Wright's Applied Physiology.

5. Biomimicry Innovation Inspired by Nature by Janine M Benyus, Herper Collins, 2002

MEE11002 Engineering Mechanics

Course Code	:	**MEE11002**
Course Title	:	**Engineering Mechanics**
Number of Credits	:	3 (L: 3, T: 0, P: 0)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To make the students to know the importance of this subject in the field of engineering particularly Mechanical Engineering. To make them learn the fundamentals of Mechanics, equation of static equilibrium & dynamic equilibrium of particles and rigid bodies. To learn the effect of friction on equilibrium. To learn kinematics, kinetics of particle and rigid body, related principles. To implement the above know how to solve practical problems.

Course Content:

Unit I Basics of Statics and Concurrent Forces: Statics of Particles: Force System: Force, classification & representation, force as a vector, composition and resolution of forces, principle of superposition and

transmissibility of forces. Statics of Rigid bodies: Equilibrium of coplanar force system, free body diagrams, determination of reactions, equilibrium of a body under three forces, Lami's theorem. Moment of a force about a point and an axis, moment of coplanar force system, Varignon's theorem.

Unit II Parallel and Distributed Forces: Parallel forces in a plane, Distributed Parallel forces in a plane, couple, resolution of a force into a force and a couple, moment of a couple. Centroid and Moment of Inertia: Determination of centre of gravity, centre of mass and centroid by direct integration and by the method of composite bodies, area moment of inertia of composite plane figures and mass moment of inertia, radius of gyration, parallel axis theorem, Pappus theorems, polar moment of inertia.

Unit III Friction: Introduction to wet and dry friction, laws of dry friction, cone of friction, block friction, ladder friction, wedge friction, application of friction in machines.

Unit IV Virtual Work: Virtual displacement, principle of virtual work.

Unit V Introduction to Dynamics: Laws of motion, Projectile motion, D'Alembert's Principle, Work and energy, impulse and momentum, impact of bodies.

Text Books/References:

1. Engineering Mechanics [Vol-I & II] by Meriam&Kraige, 5th ed. – Wiley India

2. Engineering Mechanics by S.S. Bhavikatti and K.G. Rajashekarappa – New Age International

3. Mechanics of Solids by Crandall,Dahl and Sivakumar-MC Graw Hill ,5th Edition, 2015, New Delhi

4. Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI

5. Engineering Mechanics by Timoshenko , Young and Rao, Revised 4th ed. – TMH

CEE12001 Engineering Drawing and CAD

Course Code	:	**CEE12001**
Course Title	:	**Engineering Drawing and CAD**
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To comprehend general projection theory, with an emphasis on the use of orthographic projection to represent three-dimensional objects in two-dimensional views. To understand the application of industry standards and techniques applied in engineering drawing. To apply auxiliary or sectional views to most practically represent engineered parts. To Dimension and annotate two-dimensional engineering drawings. To employ freehand 3D pictorial sketching to aid in the visualization process and to efficiently communicate ideas graphically.

Course Content:

Module I: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Module II: Orthographic Projections covering, Principles of Orthographic Projections Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Module III: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary Views.

Module IV: Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

Module V: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions

Text Books/References:

1. Engineering Drawing, N. D. Bhat, Charotar Publishing House (2012).

2. Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education.

3. Engineering Drawing & Graphics using Autocad, T. Jeyapoovan, Vikas Publishing House Pvt. Ltd.-Noida; Third edition (2010).

4. https://nptel.ac.in/courses/112103019/

MEE12001 Engineering Workshop

Course Code	:	**MEE12001**
Course Title	:	**Engineering Workshop**
Number of Credits	:	2 (L: 0, T: 0, P:2)
Course Category	:	ESC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: To develop general machining skills in the students. To develop a skill in dignity of labour, precision, safety at work place, team working and development of right attitude

Course Content:

List of Experiments (Any ten)

14. To make a single piece pattern from the given work piece and dimensions.
15. To make a double piece match pattern from the given dimensions.
16. To make a single piece cylindrical (solid) pattern from the given dimensions.
17. To make a cone from sheet metal as per given dimensions.
18. To make a frustum from sheet metal as per given dimensions.

19. To prepare a sand mould, given the single piece pattern and casting.
20. To prepare a sand mould, given the double piece match pattern and casting with different dimensions and shape
21. To make a square fitting from the given mild steel piece and the dimensions.
22. To make a square fitting from the given mild steel piece and the dimensions.
23. To make a single 'V' butt joint between two metal plates by using ARC welding.
24. To make a square butt joint between metal plates by using gas welding.
25. To perform various types of machining operations (cantering, facing and turning) on a given mild steel rod followed by the given dimensions.
26. To perform various types of machining operations (chamfering, grooving, thread cutting, and knurling) on a given mild steel rod followed by the given dimensions.

Text Books/References:

7. Workshop Technology I,II,III, by S K Hajra, Choudhary and A K Chaoudhary. Media Promoters and Publishers Pvt. Ltd., Bombay
8. Workshop Technology by Manchanda Vol. I,II,III India Publishing House, Jalandhar.
9. Manual on Workshop Practice by K Venkata Reddy, KL Narayana et al; MacMillan India Ltd.
10. Basic Workshop Practice Manual by T Jeyapoovan; Vikas Publishing House (P) Ltd.,New Delhi
11. Workshop Technology by B.S. Raghuwanshi, Dhanpat Rai and Co., New Delhi.
12. Workshop Technology by HS Bawa, Tata McGraw Hill Publishers, New Delhi.

AEC503 French II

Course Code	:	**AEC503**
Course Title	:	**French II**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Educational Objectives (PEO): The French Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Equip students with essential French language skills for basic communication in everyday contexts

PEO2 – Strengthen linguistic competence through a structured progression of vocabulary, grammar and writing skills

PEO3 – Foster an appreciation of Francophone cultures, enhancing intercultural sensitivity and global perspectives

Course Content:

Module 1: French Communication

- Asking questions

- Visualising someone's daily life
- Describing the classroom
- Portraying the house

Module 2: Grammar

- Interrogative adverbs, Near future, Recent past
- Possessive adjectives, Pronominal verbs
- Irregular verbs : Faire, Prendre, Mettre, Lire, Venir, Voir, Boire, Savoir, Connaître, écrire
- Prepositions

Module 3: French Culture and Civilisation

- Markets in France
- French Festivals
- Sports
- French Newspapers and Magazines
- French Television Channels

Module 4: Writing

- Writing an informal e-mail to a friend
- Passage on unseen topic
- Writing a paragraph on: My best friend / Summer vacation / Visiting France

Text Books/References:

N.A

AEC504 German II

Course Code	:	**AEC504**
Course Title	:	**German II**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Educational Objectives (PEO)

The German Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Develop foundational skills in speaking, reading, writing, and listening, enabling effective communication in German

PEO2 – Gain insight into German cultural practices, traditions and social etiquette

PEO3 – Acquire the ability to use German in real-life contexts, such as introducing oneself, in restaurant interactions, in supermarkets, in commuting and in formal writing

PEO4 – Develop competence in German grammar, understanding articles, pronouns, conjunctions, verb conjugations and sentence structures

Course Content:

Module 1: Grammar - Mission: Grammatik Possible

- Everyday Verbs in the Present Tense
  Verbs of type: kaufen / antworten / fahren / essen / geben / lesen / haben / sein and similar verbs
- The Power of German Modal Verbs - From "Ich kann nicht!" to "Ich muss doch!" Modal Verbs: sollen / wollen / können / dürfen / mögen / müssen / möchten
- Coordinate Conjunctions: und / oder / aber / sondern / wenn
- Quizzes and Worksheets

Module 2: Speaking German – Real Life Scenarios in Germany:

- The Art of Introducing Yourself in German - "Ich heiße... und du?" Speaking Topics: Personal / Family / Studies / Food / Hobbies and Spare Time. Activity: Pair Work - Students pair up for casual dialogues and switch partners every 3 minutes
- Essential Ordering Phrases in a German Restaurant " Von Schnitzel bis Erdbeerkuchen mit Sahne". Activity: Restaurant Simulation - Students practice ordering different items using a mock menu
- Lost in the Aisles? Navigating a German Supermarkt Without Panic Shopping Conversations: Prices, Discounts, Preferences. Activity: Simulated Shopping - "Customer and Store Attendant / Cashier" practice
- Asking for Directions and using Public Transport Navigating bus stops and train stations
  Buying tickets and asking about timetables. Activity: Role Play - Students ask for directions to famous places in Germany. Students buy train tickets at a railway station.

Module 3: German Culture

- Mastering German Greetings on Occasions and Holidays: Alles Gute! Gesundheit! Herzlichen Glückwunsch zum Geburtstag! / zur Hochzeit! Alles Gute zum Jahrestag! Viel Glück für die Zukunft! Frohe / Fröhliche Weihnachten! Frohes neues Jahr! / Prosit Neujahr! / Guten Rutsch ins neue Jahr! Frohe Ostern! German Media: Brief Overview
  Newspapers – Die Zeit / Frankfurter Allgemeine / Süddeutsche Zeitung / Bild
  Magazines: Spiegel / Stern / Focus / Kicker Television: Deutsche Welle (DW) / ZDF / ARD / RTL. Popular talk shows (Markus Lanz, Anne Will)
- Tor! German Football: Snapshot
  Bundesliga – The top-tier football league
  German Football Clubs – FC Bayern München, Borussia Dortmund, RB Leipzig, Bayer 04 Leverkusen
- German Car Industry: Brief Overview
  Brands – Mercedes Benz, Audi, BMW, Volkswagen, Porsche

Module 4: Writing Skills

- Writing 20-25 word brief e-mails or messages on instant messaging apps. Formal e-mails - Greetings and Salutations: Sehr geehrte / Sehr geehrter. Valedictory Address: Mit freundlichen Grüßen / Mit freundlichem Gruß. Informal e-mails - Greetings and Salutations: Hallo / Liebe / Lieber
  Valedictory Address: Tschüss / Bis bald!

Activity: Students write a short email / message based on a given scenario like fixing up or cancelling an appointment, then peer-review each other's work

Module 5: Elementary Vocabulary

- Surviving in a German City Without Getting Lost. Urban Vocabulary for Everyday Use: From Bahnhof to Brücke
- Dressing the German Way. Essential Clothing Vocabulary: From Mantel to Mütze
- Talking About the Weather Like a True German. Mastering Weather Terms: Regen oder Schnee?
- Learning about parts of the body without losing your head. Requisite Vocabulary for Anatomy: Von Kopf bis Fuß
- Audio Comprehensions

Text Books/References:

N.A

AEC505 Spanish II

Course Code	:	**AEC505**
Course Title	:	**Spanish II**
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives/ Programme Educational Objectives (PEO)

The Spanish Programme aims to equip students with fundamental linguistic, cultural and communicative competencies for practical applications. The educational objectives are:

PEO1 – Equip students with the ability to communicate effectively in basic spoken and written Spanish in familiar contexts

PEO2 – Provide a strong foundation in Spanish grammar, vocabulary and pronunciation

PEO3 – Develop cross-cultural awareness and appreciation of Hispanic cultures and global diversity

PEO4 – Enable students to engage in real-life situations using Spanish through listening, speaking, reading and writing practice

Course Content:

Module 1: Basic Vocabulary

- Clothes and Shopping
- Body Parts and Health
- Weather and Seasons

Module 2: Elementary Grammar

- Basic sentence structure: affirmative, negative, interrogative
- Prepositions (en, a, de, con, etc.)
- Introduction to important irregular verbs: ser, estar, tener, ir, hacer
- Possessive Adjectives
- Introduction to Reflexive Verbs

Module 3: Reading

- Reading Short Texts, Personal Info, Public Signs

Module 4: Writing

- Writing brief e-mails
- Filling up Forms in Spanish

Module 5: Speaking

- Guided Pronunciation Practice
- Role plays and mini dialogues
  (in markets, at a restaurant, asking for directions)
- Oral presentations (introduce a friend, describe a city)

Module 6: Listening

- Audio and Video Comprehension
- Spanish Songs / Short Spanish Videos

Module 7: Spanish Culture

- Introduction to Spanish-speaking countries & Spanish and
  Latin American Cultural Norms & Customs
- Famous festivals: La Tomatina, Día de los Muertos, Semana Santa
- Brief intro to Hispanic cuisine, music, cinema
  Cultural comparisons: India and the Hispanic World

CLL103 Soft Skills and Aptitude I

Course Code	:	**CLL103**
Course Title	:	**Soft Skills and Aptitude I**
Number of Credits	:	1 (L: 0, T: 0, P: 1)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objectives: The six-semester Soft Skills Programme aims to equip undergraduate students with communication, leadership, emotional intelligence and career readiness skills essential for professional success and personal growth. The Programme Educational Objectives (PEO) focus on long-term competencies that prepare students for dynamic work environments, lifelong learning, and ethical leadership.

PEO1 – Impart skills required for employability and ensure career readiness

PEO2 – Develop leadership skills and ability for effective teamwork

PEO3 – Encourage critical thinking, creativity, and innovation

PEO4 – Develop self-awareness, emotional regulation, adaptability and resilience

PEO5 – Instill professionalism and a sense of ethical work culture

PEO6 – Ensure proficiency in professional communication

PEO7 – Encourage self-reflection, continuous learning and personal growth

Course Content:

Module 1: Introduction to Soft Skills

- Concept of Soft Skills
- Soft Skills vis-à-vis Hard Skills (Subject Knowledge / Technical Skills)
- Importance of Soft Skills in Academia (Presentations and Seminars) and Industry (Internships, Projects, Placements and Workplace Success)
- Overview of the Course

Module 2: Curricula Vitae, Résumés, Crafting Cover Letters

- Understanding the difference between a CV and Résumé and when to use each (Academic / Research, Corporate)
- Key Components of a Professional Résumé
  (Contact Information, Educational Background, Work Experience, Skills and Certifications, Achievements, Internships, Projects)
- Cover Letters
  Purpose and Importance
  Structure and Format: Introduction, Body, Closing
  Tailoring Cover Letters to Job Descriptions / Specific Roles
  Common Mistakes and how to avoid them
  Live Drafting of a Cover Letter based on a real Job Posting with instant Peer Review and Faculty Feedback

Module 3: Interview Skills

- Stages of an Interview:
  Pre-Interview Preparation, Actual Interview Process, Post-Interview Follow-Up
- Pre-Interview Preparation:
  Importance of pre-interview preparation
  Understanding job descriptions and role expectations
  Mapping skills and qualifications to job roles
  Industry and employer research techniques
  Interview Dress

- Post-Interview Follow-Up:
  Thank-you emails: tone, structure, timing, Accepting Job Offers gracefully

  Handling rejections and requesting feedback

  Maintaining professional relationships for future opportunities
- Employer Expectations and Common Evaluation Criteria
- Mock Interview with Feedback

Module 4: Group Discussions

- Why GDs are used in admissions and placements
- Types of GDs
  (Structured / Unstructured / Case-based or Situation-based / Abstract)
- Skills and Strategies for effective participation in a GD
  How to start a GD: The art of Initiation
  Structuring Arguments and speaking with clarity
  Listening actively and interjecting diplomatically
  Building on the points of others vs. contradicting respectfully
  Handling dominance, interruptions and time pressure
- Non-verbal communication - posture, gestures, and eye contact
- Common do's and don'ts in a GD
- Practice GD with Observer Feedback

Module 5: Personal Branding and Online Presence

- Importance of online presence in modern job markets
- How recruiters screen candidates online
- Consistency between Résumé and Digital Profiles
- Creating and optimising LinkedIn Profiles

Module 6: Professional Skills

- Adaptability and resilience in the workplace
  Flexibility and Importance of Relocation
- Practice Professionalism Everyday (Arrive on Time, Dress for Success, Work Smart, Manage and live up to Expectations, Lead by Example, Be Consistent)
- Time management, discipline and organizational skills
- Problem-solving and decision-making skills
- Teamwork and collaboration
- Leadership and interpersonal skills

AU102 Sports and Yoga

Course Code	:	**AU102**
Course Title	:	**Sports and Yoga**

Number of Credits	:	0 (L: 2^, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective: To make the students understand the importance of sound health and fitness principles as they relate to better health. To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness. To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury. To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Contents:

- **Introduction to Physical Education**

o Meaning & definition of Physical Education

o Aims & Objectives of Physical Education

o Changing trends in Physical Education

● Olympic Movement

o Ancient & Modern Olympics (Summer & Winter)

o Olympic Symbols, Ideals, Objectives & Values

o Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

- **Physical Fitness, Wellness & Lifestyle**

o Meaning & Importance of Physical Fitness & Wellness

o Components of Physical fitness

o Components of Health related fitness

o Components of wellness

o Preventing Health Threats through Lifestyle Change

o Concept of Positive Lifestyle

- **Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga**

o Define Anatomy, Physiology & Its Importance

o Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)

- **Kinesiology, Biomechanics & Sports**

- **o** Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
- o Newton's Law of Motion & its application in sports.
- o Friction and its effects in Sports.

- **Postures**

- **o** Meaning and Concept of Postures.
- o Causes of Bad Posture.
- o Advantages & disadvantages of weight training.
- o Concept & advantages of Correct Posture.
- o Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
- o Corrective Measures for Postural Deformities

- **Yoga**

- **o** Meaning & Importance of Yoga
- o Elements of Yoga
- o Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
- o Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
- o Relaxation Techniques for improving concentration - Yog-nidra

- **Yoga & Lifestyle**

- **o** Asanas as preventive measures.
- o Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
- o Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
- o Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
- o Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.
- o Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

- **Training and Planning in Sports**

- **o** Meaning of Training
- o Warming up and limbering down
- o Skill, Technique & Style
- o Meaning and Objectives of Planning.

- Tournament – Knock-Out, League/Round Robin & Combination.

- **Psychology & Sports**

- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development

- Adolescent Problems & Their Management
- Emotion: Concept, Type & Controlling of emotions
- Meaning, Concept & Types of Aggressions in Sports.
- Psychological benefits of exercise.
- Anxiety & Fear and its effects on Sports Performance.
- Motivation, its type & techniques.
- Understanding Stress & Coping Strategies.

- **Doping**

- Meaning and Concept of Doping
- Prohibited Substances & Methods
- Side Effects of Prohibited Substances

- **Sports Medicine**

- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.
- Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

- **Sports / Games**

Following subtopics related to any one Game/Sport of choice of student out of: Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

- History of the Game/Sport.
- Latest General Rules of the Game/Sport.
- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.
- Sports Personalities.
- Proper Sports Gear and its Importance.

Text Books/References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.

2. Light On Yoga By B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

SEMESTER III

SEMESTER – III

MTH11527 Probability, Statistics and Numerical Methods

Course Code	:	MTH11527
Course Title	:	Probability, Statistics and Numerical Methods
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To use the techniques of statistical analysis, which are commonly applied to understand and analyse business problems. To enhance the fundamental knowledge of probability where the true essence of statistics lies. To understand the calculation and interpretation of errors in numerical methods, and numerical solutions of nonlinear equations with one variable. To enable students acquire concept of numerical integration and differentiation, numerical solution of ordinary and partial differential equations.

Course Content:

Unit 1 Correlation and Regression: Introduction to Correlation analysis, Karl Pearson correlation coefficient, Rank Correlation, Regression Analysis, Fitting Straight Lines, Method of least square, regression coefficients, properties of regression coefficients and applications

Unit 2 Probability, Probability Distributions and Test of hypothesis: Introduction, Probability of an event, additive rule & multiplication rule, conditional probability Bayes' rule and applications. Random variable, discrete and continuous probability distribution, Mathematical expectation, Variance of a random variable, Binomial, Hyper-geometric, Geometric, Poisson distribution, Uniform, Normal, Exponential Distribution. Introduction, type I and type II Error, one and two tailed test, test on a single mean when variance is known & variance is unknown. Test on two means, test on a single mean population and test on two populations, one and two sample test for variance, - Test for goodness of fit and test for independence.

Unit 3 Numerical Methods, Numerical differentiation and integration: Introduction, Concept of Errors, Bisection Method, False Position Method, Secant Method, Newton-Raphson Method, Successive Approximation Method, Discussion of Convergence, Interpolation and Extrapolation, Calculus of difference, Newton's Forward Interpolation Formula and Backward Interpolation Formula, Lagrange's method, Newton's divided difference formula, Inverse Interpolation and its applications. Differentiation formulae based on polynomial fit, trapezoidal, Simpson's and Gaussian quadrature formulae.

Unit 4: Solution of simultaneous linear equations and ordinary differential equations: Gauss elimination method, pivoting, ill conditioned equations, Gauss Seidel and Gauss Jacobi iterative methods, Taylor series and Euler methods, Modified Euler method, error analysis, Runge-Kutta method.

Text Books/ Reference Books:

1. S.C. Gupta and V K Kapoor; Fundamentals of Mathematical Statistics, S Chand & Sons

2. T. Veerarajan, T Ramachandran; Numerical Methods.

3. Manish Goyal; Numerical methods and Statistical Techniques using 'C', Laxmi Publications pvt. Ltd

4. S Dey and S Gupta; Numerical Methods ,Tata McGraw-Hill Education, 2013

5. B.S. Grewal; Numerical methods in engineering and science, 42 Edition, Khanna *Publishers* .

XXXXXX: Effective Technical Communication

Course Code	:	XXXXXX
Course Title	:	Effective Technical Communication
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The students will acquire knowledge on various types of listening techniques, barriers and benefits of listening recognize the speech sounds and learn the intonation patterns, learn various vocabulary patterns, develop the ability to structure and punctuate the sentences, learn different reading techniques learn different writing skills.

Course Content:

Unit 1: Information Design and Development: Creation of various technical documents, the information development life cycle, organizational structures, factors affecting information and document design, strategies for organization, and information design and writing for both print and online media.

Unit 2: Technical Writing, Grammar, and Editing: The technical writing process, forms of discourse, writing drafts and revising, collaborative writing, creating indexes, technical writing style and language, basics of grammar and study of advanced grammar, editing strategies to achieve appropriate technical style, introduction to advanced technical communication, usability, human factors, managing technical communication projects, time estimation, single sourcing, and localization.

Unit 3: Self Development and Assessment: Self-assessment, awareness, perception and attitudes, values and belief, personal goal setting, career planning, self-esteem, managing time, personal memory, rapid reading, taking notes, complex problem solving, and creativity.

Unit 4: Communication and Technical Writing: Public speaking, group discussion, oral presentation, interviews, graphic presentation, presentation aids, personality development, writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, and event reports.

Unit 5: Ethics: Business ethics, etiquettes in social and office settings, email etiquettes, telephone etiquettes, engineering ethics, managing time, role and responsibility of engineer, work culture in jobs, personal memory, rapid reading, taking notes, complex problem solving, and creativity.

Text Books/References:

1. Effective Communication Skills. Kulbhushan Kumar. Khanna Publishing House. 2018.

2. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
3. Diane Hacker, Pocket Style Manual, Bedford Publication, New York, 2003. (ISBN 0312406843).
4. Shiv Khera, You Can Win, Macmillan Books, New York, 2003.
5. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
6. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
7. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH. 2002.
8. Xebec, Presentation Book, TMH New Delhi, 2000.

BBT201: Biochemistry

Course Code	:	BBT201
Course Title	:	Biochemistry
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): It is intended to impart basic undergraduate level knowledge in the area of general Biochemistry. Students would be able to understand the basic principles of structural and functional properties of biomolecules in living organisms. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Content:

Unit 1: Basic concepts on Bioenergetics and interactions: Basic concepts of entropy, enthalpy and Gibbs energy. Biochemical equilibria, dissociation and association constants. pH and water, Weak Interactions in Aqueous Systems, Ionization of Water, Weak Acids and Weak Bases, Buffering against pH Changes in Biological Systems.

Unit 2: Enzyme kinetics: Properties and types of enzymes. Kinetics of enzyme action. Enzyme inhibition.

Unit 3: Introduction to Metabolism and Carbohydrates: Introduction to carbohydrates, classification and structure of saccharides. Introduction to metabolism, glucose metabolism – glycolysis, citric acid cycle, the electron transport chain and oxidative phosphorylation. Regulation and integration of metabolic pathways and the biochemical basis of human diseases (e.g. diabetes).

Unit 4: Lipid and its metabolism: The structure and properties of fatty acids. Types of lipids and their significance in biological systems. Fatty acid metabolism

Unit 5: Protein Function and Metabolic Integration: Basics of amino acids, pK and pI values of amino acids, pK values of the ionizable groups of proteins, peptide bond, peptide, protein structures, protein stability and folding. Haemoglobin structure and function. Amino acid metabolism.

Practical Exercise:

1. Buffer preparation and pH measurement
2. Estimate quality and quantity of the carbohydrates
3. Analyse quality and quantity of the lipids
4. Estimate quality and quantity of the proteins
5. Estimate quantity of sugar from given sample
6. Estimation of saponification value of lipids

Text Books/References:

1. Principles of Biochemistry by David L. Nelson and Michael M. Cox
2. Biochemistry by Voet &Voet, Wiley New York
3. Biochemistry. 5th edition. Berg JM, Tymoczko JL, Stryer L. New York: W H Freeman

Course Outcomes: After completion of the course, students will be able to

1. Explain the thermodynamic principles governing biochemical reactions, and analyze the role of buffers in biological systems.
2. Classify enzymes based on their properties and mechanism of actions
3. Describe the structure and metabolism of carbohydrates
4. Relate the structure and properties of fatty acids and lipids to their biological functions
5. Analyze protein structure to stability and function and integrate amino acid metabolism with overall metabolic pathways.

BBT202**: Microbiology**

Course Code	:	BBT202
Course Title	:	Microbiology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50

End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The course provides the students both conceptual and experimental background in the broad discipline of microbiology. The students will be introduced to the major groups of microorganisms and their diversity in structure and functions and microbial interactions. Emphasis has been laid on bacterial growth, nutrition, control, metabolism and genetics. Course also introduces the students to the scope and relevance of microbes in the field of medicine, agriculture and industry.

Unit 1: Fundamentals, History & Evolution of Microbiology: History of microbiology; Microbial taxonomy; Microbial phylogeny & current classification of bacteria. Microbial Diversity - Distribution & characterization Prokaryotic & Eukaryotic cells; Morphology & cell structure of major groups of microorganisms - Bacteria, Algae, Fungi, Protozoa.

Unit 2: Microbial growth, Metabolism and control of Microorganisms: Nutritional categories, Types of growth media, growth phases, culture methods. Aerobic & anaerobic respiration, fermentation, Entner Duodruffs pathway, photosynthesis, nitrogen fixation, Bacterial Reproduction - Transformation, Transduction & Conjugation, Purification & preservation methods. Sterilization and control methods- by physical, chemical & chemotherapeutic agents.

Unit 3: Microbial Ecology and Interactions: Microbial habitat- air, water and soil; microbial adaptation- Extremophiles; Microbial interactions; Quorum sensing and biofilm formation; microbial nutrient cycling- Nitrogen and Carbon cycling; Applications of microbial Ecology: Biodegradation, Biofuel production, Bioleaching and Sewage treatment. Pathogenic microbes and AMR.

Unit 4: The Viruses and microbial genetics: Discovery and general properties of viruses; Differences between viruses & cellular organisms; Structure and Classification of viruses; Replication of viruses: Lytic and Lysogenic cycle; Phage genetics; Concepts of Microbial genetics and operons; Horizontal Gene transfer.

Unit 5: Applications of Microbiology: Water Microbiology - Bacterial pollutants of water, coliforms & non-coliforms; Sewage composition & its disposal; Important microorganism in food Microbiology - Moulds, Yeasts, and bacteria; Major food born infections & intoxications; Fermented Foods. Scope- Role of Microbes in agriculture, public health, medicine and industry.

Practicals:

1. Microbial Good Lab Practices and Biosafety
2. Media preparation, sterilization and disinfection
3. Microscopic examination of different groups of microorganisms
4. Total count and viable count determination
5. Microbial simple and differential staining methods
6. Isolation of pure culture and its preservation
7. Microbial Growth Curve Determination

8. Effect of physical and chemical environment on growth
9. Biochemical tests for microbial identification
10. Antibiotic Sensitivity of Microorganisms

Text Books/References:

1. Prescott's Microbiology by Willey, Sherwood and Woolverton.
2. Brock Biology of Microorganisms by Madigan, Martinko, Stahl and Clark.
3. General Microbiology by Stanier, Ingraham, Wheelis and Painter.
4. Microbiology, M. Pelczar, E. Chan, N. Kreig, 5th ed, MGH.

Course Outcomes: At the end of the course students will be aware about the conspicuous presence of microbes in the environment and their influence in our daily lives as part of food, soil, air environment and disease development. The students will be excited to know the immense diversity in the microbial world, their varied inter or intra community interactions and their contribution in the biotech industry. Many students would be inspired to go for advanced microbial course and pursue basic or applied microbial research.

BBT203**: Genetics**

Course Code	:	BBT203
Course Title	:	Genetics
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide students the knowledge about gene organization, genetic materials, molecular heritance, gene transfer and their regulations.

Course Content:

Unit 1: Introduction to Mendelian Genetics & its extension: Principles of inheritance, Incomplete dominance and co-dominance, Multiple alleles, Lethal alleles, Epistasis,, Sex-linked, sex-influenced and sex-limited characters' inheritance, Pleiotropy gene interaction - epistatic and non-epistatic, interaction between gene(s) and environment. Penetrance and expressivity.

Unit 2: Linkage, Crossing over and Pedigree techniques: Linkage, Crossing Over and Chromosomal Mapping: Linkage and crossing over, Cytological basis of crossing over, Molecular mechanisms of crossing

over including models of recombination, Recombination frequency as a measure of linkage intensity. Pedigree conventions, characteristics of dominant and recessive inheritance. Applications of pedigree analysis

Unit 3: Mutations and Chromosomal Aberrations: Transposable elements in maize and Drosophila, introduction to and types of gene mutations including base substitution and frameshift mutations, physical and chemical mutagens, reverse mutation in bacteria along with the beneficial and harmful effects of mutations. Variations in chromosome number- monosomy and trisomy of sex and autosomes. Variations in chromosome structure - inversions, deletions, duplications and translocations.

Transposable Genetic Elements: Transposons in bacteria, Ac-Ds elements in maize and P elements in Drosophila, Transposons in humans, Extra-chromosomal Inheritance.

Unit 4: Bacterial and population Genetics: Mechanism of genetic exchange - conjugation, transformation and transduction. Gene mapping in bacteria.

Gene pool, Gene and genotype frequencies: Hardy-Weinberg principle, Evolutionary agents: Selection – differential selection, gametic selection, zygotic selection, fitness; Migration; Mutation and genetic drift. Population bottleneck and founder effect.

Unit 5: Practical Applications in Genetics: Evaluate the effectiveness of different genetic technologies and techniques in practical applications

Practicals:

1. Study of various stages of mitosis in onion root tip
2. Study of various stages of meiosis in onion flower buds
3. Mendelian deviations in dihybrid crosses.
4. Karyotype analysis
5. Pedigree Analysis
6. Study of polyploidy in onion root tip by colchicine treatment.
7. Model making and presentation (Experiential learning activity)

Text Books/References:

1. Genetics (2012) 6th ed., Snustad, D.P. and Simmons, M.J., John Wiley & Sons.

(Singapore), ISBN: 978-1-118-09242-2.

2. Genetics - A Conceptual Approach (2012), 4th ed., Pierce, B.A., W.H. Freeman

& Co. (New York), ISBN:13:978-1-4292-7606-1 / ISBN:10:1-4292-7606-1.153

3. 3. An Introduction to Genetic Analysis (2010), 10th ed., Griffiths, A.J.F, Wessler, S.

R, Carroll, S. B. and Doebley, J., W.H. Freeman & Company (New York), ISBN:10: 1-4292-2943-8.

4. Latest/classic research articles and reviews relevant to various topics.

Course Outcomes: After completion of the course, students will be able to understand about gene organization, genetic materials, molecular heritance, gene transfer and their regulations.

BBT204**: Biophysics**

Course Code	:	BBT204
Course Title	:	Biophysics
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): It is intending to impart basic undergraduate level knowledge in the area of general Biophysics. Student would be able to understand the molecular and mechanistic basis of the cellular functions, organism physiology and pathophysiology. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Content:

Unit 1: Thermodynamical Basis of Biophysics: Thermodynamics of Biological Systems, First and Second Law and its significance in biological systems, Concept of Enthalpy, Entropy and Free Energy and Bioenergetics, Concept of standard state, steady state, activation energy, equilibrium constant and absolute entropy. Thermodynamics of energy-rich biological compounds and its importance in biochemical reaction.

Unit 2: Membrane Biophysics: Mechanism of Active and Passive transport, Osmotic pressure and its measurement, Concept of Diffusion coefficient, and Derivation of Vant-Hoff equation. Mechanism of semi-permeable membrane.

Unit 3: Electrical Phenomena in Living Cell: Electrical phenomena in excitable cells and their properties, electrical signals of nerve cells, the ionic hypothesis and rules of ionic electricity, membrane protein structure and function, channels and transporters in biological systems, functional properties of voltage-gated ion channels, and ion pumping and ion channel rhodopsins and their applications.

Unit 4: Molecular Motors and Cellular Mechanics: Cilia and flagella structure and movement, molecular motors including kinesin, dynein, and myosin, intracellular movement mechanisms, microtubule structure and dynamics, and an introduction to mechanobiology and its importance in human health.

Unit 5: Transport Phenomenon: Brownian motion, Viscosity - Hooke's law, Newton's law, Reynolds number, Stokes–Einstein formula; Thermal Conduction - law of heat conduction, conductivity gradient.

Text Books/References:

1. Biophysics: An Introduction by Rodney Cotterill.

2. Basic Neurochemistry: Molecular, Cellular and Medical Aspects. 6th edition. Siegel GJ, Agranoff BW, Albers RW, et al., editors. Philadelphia: Lippincott-Raven; 1999.

3. Molecular Biology of the Cell. 4th edition. Alberts B, Johnson A, Lewis J, et al. New York: Garland Science; 2002.

4. Molecular Cell Biology. 4th edition. Lodish H, Berk A, Zipursky SL, et al. New York: W. H. Freeman; 2000.

5. Neuroscience. 2nd edition.Purves D, Augustine GJ, Fitzpatrick D, et al., editors. Sunderland (MA): Sinauer Associates; 2001.

6. Transport Phenomena. 2nd Edition. R. Byron Bird, Warren E. Stewart, ad Edwin N. Lightfoot

Course Outcomes: After completion of the course, Student would be able to understand the molecular and mechanistic basis of the cellular functions, organism physiology and pathophysiology.

BBT205**: Cell & Molecular Biology**

Course Code	:	BBT205
Course Title	:	Cell & Molecular Biology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide a comprehensive understanding of cellular structure, organization, and communication in plant and animal systems, while developing in-depth knowledge of key molecular processes including DNA replication, transcription, translation, and their regulation in prokaryotic and eukaryotic cells, and imparting fundamental insights into cell cycle control, mechanisms of cell division, apoptosis, and DNA damage and repair pathways.

Course Content:

Unit 1: Cellular Structure and Organization: Microscopy techniques for visualizing cells and tissues, integration of cells into tissues in both animals and plants, detailed structure of cell and cell organelles, and the molecular basis of cell-cell junctions and communication.

Unit 2: Cell cycle and apoptosis: Details of the cell cycle, regulation of cell cycle progression, mitosis and meiosis, and the mechanisms controlling cell division and proliferation. Programmed cell death / Apoptosis; intrinsic and extrinsic pathways of cell death.

UNIT 3: Replication of DNA in prokaryotes and eukaryotes: Semiconservative nature of DNA replication, Bi-directional replication, Rolling circle replication, Unique aspects of eukaryotic replication, DNA damage, mechanism of DNA repair

UNIT 4: Transcription: Prokaryotic and eukaryotic transcription: Eukaryotic RNA polymerases, transcription factors, promoters, RNA splicing and processing: processing of pre-mRNA: 5' cap formation, polyadenylation, splicing

UNIT 5: Prokaryotic and eukaryotic translation: ribosome structure and assembly, Charging of tRNA, aminoacyl tRNA synthetases, Mechanism of initiation, elongation and termination of polypeptides,regulation of gene expression in prokaryotes –operon concept (Lac and Tryp), regulation of gene expression in eukaryotes galactose metabolism in yeast.

Practicals:

1. Understanding components of different kinds of microscopes.
2. Preparation of a temporary mount of onion peel and cheek epithelial cells to study their characteristics
3. Demonstration of plasmolysis and deplasmolysis.
4. Demonstration of the effect of increasing concentration of ethanol and temperature on the permeability of cell membrane
5. Determination of stomatal index from leaf epidermal peel and cast.
6. Molecular weight determination of DNA and Quantification of DNA
7. Total RNA isolation from bacteria
8. DNA isolation from eukaryotes- Saccharomyces cerevisiae
9. Isolation of Plasmid DNA by alkaline lysis method
10. Resolution and visualization of DNA by Agarose Gel Electrophoresis.

Text Books/References:

1. Molecular Biology of the Cell: Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walte; 6th edition New York: Garland Science; 2008.

2. Cell and Molecular Biology-Concepts and Experiments; Gerald Karp et al. John Wiley; 8th edition; 2015.

3.. Molecular Cell Biology. 4th edition. Lodish H, Berk A, Zipursky SL, et al. New York: W.

H. Freeman; 2000.

4. 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

5. Becker WM, Kleinsmith LJ, Hardin J and Bertoni GP (2009) The World of the Cell, 7th edition, Pearson Benjamin Cummings Publishing, San Francisco

6. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.

Course Outcomes: Students will be able to explain cellular structure and organization, and critically analyze fundamental molecular processes such as DNA replication, transcription, translation, and gene regulation in prokaryotic and eukaryotic systems. They will also be able to interpret mechanisms of cell cycle regulation, apoptosis, and DNA repair, and apply this knowledge to understand cellular function, growth, and development.

BBT206**: Animal & Plant Biology**

Course Code	:	BBT206
Course Title	:	Animal & Plant Biology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	BS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To understand basics of metabolism, physiology of animals and plants.

Course Content:

Unit 1: Basic plant anatomy and morphology: Overview of plant structure at the cellular and tissue levels; Root Anatomy; Stem Anatomy; Leaf Anatomy; Flower Anatomy; Fruit and Seed Anatomy.Overview of Plant Tissue Systems: Tissues: Classification - structural characteristics and functions of the following tissues.

Unit 2: Basic plant Physiology: Growth and development: phases of growth, growth curve, Transpiration and significance, Water use efficiency, Carbon and nitrogen metabolism: Photosynthesis- Photosynthesis pigments, concept of two photo systems, photophosphorylation, Calvin cycle, CAM plants, photorespiration, compensation point. Translocation of assimilates, Phloem loading, apoplastic and symplastic transport of assimilates, source and sink concept, Plant growth regulators- occurrence-Biosynthesis-Mode of action of auxins, Gibberellins, Cytokinis, ABA, Ethylene. Photoperiodism and Vernalization; Senescence and abscission

Unit 3: Digestive System: Functions of digestive organs, Modes of mechanical digestion, Chemical digestion (hormones, enzymes, pH), Absorption and elimination, Name parts of GI Tract and accessory organs, Nutrition and metabolism (production of ATP). Excretory System: Functions of urinary system, Kidney, ureter, bladder, urethra, Microanatomy and function of nephron, Formation of urine-steps involved.

Unit 4: Respiratory System: General structure of respiratory system and functions- Lungs and Trachea, Respiratory Pathways, Functional aspects and mechanics of respiration, Mechanics and regulation of breathing, Gas exchange and gas laws, Hypoxia, effect of exercise. Nervous System: Functions of nervous system, Organization of the Nervous System - Structural Classification, Functional Classification, and Nervous Tissue: Structure and Function – Neurons, Supporting Cells, The Blood-Brain Barrier, reflex arc, PNS (autonomic and somatic), Sensory motor nerve functions.

Unit 5: Mushroom Cultivation: Identification - edible and poisonous Mushrooms - external factors for growth; Spawn production; Cultivation of Mushrooms; Economic Importance and Cultivation of Lichen; Industrial and Commercial Plants; Ornamental Plants; Basics of Animal Sciences Applications: Analyse, appraise and discuss the topic with different tools and techniques.

Practicals:

1. Cytochemical test for starch, sugar and protein.
2. Microscopic Examination of Algal Diversity
3. Study of simple & Complex (primary and secondary) tissues (by maceration.)
4. Study of internal structure of Young and old stem of dicotyledons.
5. Observation of stomatal structure and distribution on plant leaves
6. Examination of photosynthetic pigments using leaf extracts and spectrophotometry.
7. Experiments on Osmosis and Respiration in Plants
8. Identification of Different mammalian tissue sections of digestive system, excretory system and respiratory system.

Text Books/References:

1. Plant Biology. Allison Smith et al. Garland Science, 2010.
2. Botany: An Introduction to Plant Biology, James D. Mauseth.
3. Barnes, R.D. (1992). Invertebrate Zoology. Saunders College Pub. USA.
4. Campbell & Reece (2005). Biology, Pearson Education, (Singapore) Pvt. Ltd.
5. Raven, P. H. and Johnson, G. B. (2004). Biology, 6th edition, Tata McGraw Hill Publications. New Delhi.
6. Ruppert, Fox and Barnes (2006) Invertebrate Zoology. A functional Evolutionary Approach 7th Edition, Thomson Books/Cole.
7. Kardong, K. V. (2002). Vertebrates Comparative Anatomy. Function and Evolution. Tata McGraw Hill Publishing Company. New Delhi.

Course Outcomes: After completion of the course, Students will understand about biology of plant development and their interaction with other organisms.

BBT291**: Technical Seminar**

Course Code	:	BBT291
Course Title	:	Technical Seminar
Number of Credits	:	1 (L: 0, T: 0, P: 2)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): Develop an ability to understand and present a seminar on the latest scientific and technological developments in the field of engineering and technology which enhances writing as well as oral communication skills.

Course Content:

Unit 1: Introduction to Technical Seminars: Understanding the significance of technical seminars, the utility of these seminars for professional development, and guidelines for selecting appropriate topics related to latest scientific and technological developments in engineering and technology.

Unit 2: Topic Identification and Planning: Methods for identifying relevant topics in the field of biotechnology, deciding on presentation slots, scheduling presentations, and maintaining proper documentation in seminar registers.

Unit 3: Seminar Preparation and Content Development: Guidelines for preparing seminar reports and presentations, ensuring content includes topic introduction, clear explanations, appropriate diagrams and tables, practical applications, and well-supported conclusions.

Unit 4: Presentation Skills and Delivery: Techniques for effective oral communication during seminar presentations, use of visual aids, time management during presentations, and handling questions and discussions from the audience.

Unit 5: Evaluation and Feedback: Understanding the evaluation criteria for technical seminars, the importance of continuous assessment, review of seminar progress by department heads, and incorporating feedback for improvement in future presentations.

SEMESTER IV

SEMESTER – IV

BBT226**: Bioprocess Engineering**

Course Code	:	BBT226
Course Title	:	Bioprocess Engineering
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The Course Objective is to provide basic concepts of bioprocess engineering to the students. They will learn engineering principles that can be applied to processes involving cell or enzyme catalysts with applications in the industry. The students will learn the basics of bioreactor design and operation control that have been applied to a variety of bioprocess industries and also conduct related experiments for better understanding.

Course Content:

Unit 1: Microbial Growth and Enzyme Kinetics: Microbial growth kinetics, substrate utilization and product formation kinetics, stoichiometry of cellular reactions, principles of enzyme catalysis, enzyme kinetics including Michaelis-Menten kinetics, and immobilized enzymes and their kinetic behavior.

Unit 2: Bioreactor Types and Operation: Types of bioreactors including batch, fed-batch, and continuous bioreactors, immobilized cell systems, solid-state fermentations, and operation and control of bioreactors covering aeration, agitation, heat transfer, mass transfer and instrumentation control and monitoring.

Unit 3: Bioprocess Engineering Principles: Energy balance and stoichiometric analysis in bioprocess systems, scale-up and scale-down strategies, process modelling, sterilization techniques, and an introduction to downstream processing and brief outline of the downstream processing technoligies.

Unit 4: Industrial Bioprocesses: Bioprocesses for the production of antibiotics, therapeutic proteins, polysaccharides, and aroma compounds, fermented food products, dairy products, organic acids, plant and mammalian cell culture reactors, and examples of industrial bioprocesses including production of antibiotics, enzymes, insulin, and bio-ethanol.

Unit 5: Bioprocess Case Studies: Detailed case studies on the production of antibiotics including penicillin production, production of enzymes including industrial enzymes, and production of bio-ethanol from renewable resources.

Practicals:

1. Microbial growth kinetics and estimation of cell mass
2. Growth inhibition kinetics
3. Operation of pH control and dissolved oxygen measurement
4. Enzyme immobilization techniques

5. Bioconversion using immobilized enzyme preparation
6. Aerobic and anaerobic bioconversion process
7. Product formation kinetics in a fermentation process
8. Online analyses of process parameters
9. Effect of mixing and agitation in bioreactors
10. Mass transfer in immobilized cell
11. Estimation of volumetric oxygen transfer coefficient

Text Books/References:

1. Michael Shuler, Fikret Kargi, Matthew DeLisa, Bioprocess Engineering: Basic Concepts, 3rd Edition
2. Pauline Doran, Bioprocess engineering principles
3. Colin Ratledge, Bjorn Kristiansen, Basic Biotechnology, 2nd Edition, Cambridge University Press, 2001.
4. Roger Harrison et al., Bioseparations Science and Engineering, Oxford University Press, 2003.
5. Bioreaction Engineering, Bioprocess Monitoring (Bioreaction Engineering) by Karl Schügerl

Course Outcomes: At the end of this course the students will learn the basics of bioprocess engineering and learn the principle, design, and operation control of various types of bioreactors and their scale-up strategies.

BBT227**: Green Biotechnology and Pollution Abetment**

Course Code	:	BBT227
Course Title	:	Green Biotechnology and Pollution Abetment
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The course content aims to make the student understand how biotechnology can help in monitoring or removing the pollutants and developing an understanding of new trends such as biofuels, renewable energy sources, or development of stress-tolerant plants which can minimize the harmful impact of pollutants thereby making the planet earth a better dwelling place.

Course Content:

Unit 1: Biological Waste Treatment: Biological wastewater treatment covering principles and design aspects of various waste treatment methods with advanced bioreactor configuration, waste

water treatment plant operation, solid waste management including landfills, recycling and processing of organic residues, and minimal national standards for waste disposal.

Unit 2: Biodegradation of Xenobiotic Compounds: Xenobiotic compounds including definition, examples and sources, biodegradation covering introduction, effect of chemical structure on biodegradation, recalcitrance, co-metabolism and biotransformation, factors affecting biodegradation, and microbial degradation of hydrocarbons.

Unit 3: Biotransformations, Biocatalysts, and Bioremediation: Basic organic reaction mechanism, common prejudices against enzymes, advantages and disadvantages of biocatalysts, isolated enzymes versus whole cell systems, biocatalytic application, catalytic antibodies, stoichiometry, introduction and types of bioremediation including in situ and ex-situ technologies, bioremediation of surface soil and sludge, bioremediation of subsurface material, phytoremediation, and biorestoration including reforestation through micropropagation and use of mycorrhizae.

Unit 4: Eco-Friendly Bioproducts from Renewable Sources: Fundamentals of composting process, scientific aspects and prospects of biofuel production including bioethanol, biohydrogen and biodiesel, biohythane, Sustainable aviation Fuel, biofertilizers and biopesticides, valorization of the waste product.

Unit 5: Biotechnology in Environment Protection: Current status of biotechnology in environment protection and its future, release of genetically engineered organisms in the environment, and restoration of coal mines and soils contaminated with heavy metals as case studies, air pollution control using biofilters,

Text Books/References:

1. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications
2. Introduction to Wastewater Treatment- R. S. Ramalho, Academic Press.
3. Elements of Water Pollution Control Engineering – O.P. Gupta, Khannabooks.
4. Energy Technology – O.P. Gupta, Khannabooks, 2018.
5. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.
6. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.
7. Environmental Biotech, Pradipta Krimar, I.K. International Pvt. Ltd., 2006.
8. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.
9. Biodegradation and Bioremediation 1999 (2nd edition). Martin Alexander, Elsevier Science & Technology.
10. Environmental Biotechnology by Bruce Rittmann and Perry McCarty.

Course Outcomes: Students will gain knowledge about how to maintain environment. They will also gain the knowledge to use biotechnology for waste management, bioremediation and green energy.

BBT228**: Immunology & Immuno-technology**

Course Code	:	BBT228
Course Title	:	Immunology & Immuno-technology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course will introduce the students with basic principles of immunology and recent advancements in the field of adaptive immunity.

Course Content:

Unit 1: Cells and Organs of the Immune System: Immune cell types including B and T lymphocytes and NK cells, hematopoiesis, lymphoid organs including primary and secondary lymphoid organs, and features of and introduction to inflammation.

Unit 2: Innate and Adaptive Immunity: Humoral immunity and cell-mediated immunity, pro-inflammatory and anti-inflammatory cytokines, innate immune system, cell polarization and activation including classical and alternative pathways, adaptive immune system, and an introduction to vaccines and memory B and T cell responses.

Unit 3: Antibody Structure and Diversity: Antibody structure, generation of antibody diversity including somatic hypermutation, major histocompatibility complex, antigen presentation and antigen-presenting cells, germinal center and plasma cells, BCR signaling, and B-cell maturation and activation.

Unit 4: T Cell Development and Function: T-cell development including negative and positive selection, TCR rearrangement, co-stimulatory molecules, T cell subtypes including Th1, Th2, Th17, and Tregs, active immunization and passive immunization, and immunity without infection including autoimmunity, hypersensitivity, and host versus graft reaction.

Unit 5: Immunotechnology and Applications: Immune checkpoints including PD1, CTLA4, and TIM3, design of recombinant antibodies, commercial production of polyclonal and monoclonal antibodies, antibodies in diagnostics, immunotherapy in cancer and checkpoint therapy, vaccine production and immunological techniques including immuno-diffusion assay, ELISA, immuno-blotting, immuno-histochemistry, flow cytometry.

Practicals:

1. To perform Blood grouping Test
2. To perform Plasma and Serum separation.
3. To perform total and differential leucocyte count.
4. To perform Latex Agglutination assay.
5. To perform radial immunodiffusion assay

6. To perform double diffusion assay
7. To perform rocket immunoelectrophoresis
8. To perform immunoinformatics

Text Books/References:

1. Kuby Immunology by Thomas J. Kindt, Barbara A. Osborne, Richard Goldsby.
2. Principles of Microbiology and Immunology by Harper and Row.
3. Introduction to Medical Immunology by Gabriel Virella.

Course Outcomes: Students will gain knowledge about the immune system, cell types and its pathway. They will understand the role of immune system in disease conditions. Further they will gain knowledge about the generation of antibodies and use of antibodies in analytics, diagnostics and therapy.

BBT229**: rDNA Technology**

Course Code	:	BBT229
Course Title	:	rDNA Technology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): It is intended to impart basic undergraduate level knowledge in the area of molecular biology and recombinant DNA technology. Student would be able to understand working details of the cloning of a gene. They would also be able to assimilate recent research findings, advancement and development in the relevant subject. The use of virtual lab and computational tools would enable them to perform in silico cloning of the selected DNA.

Course Content:

Unit 1: Introduction to rDNA Technology and Vectors: Introduction to recombinant DNA technology and its uses, vectors including cloning vectors, expression vectors, and promoterless vectors, cloning and expression in bacterial host strains, and an overview of genomic and cDNA libraries.

Unit 2: Enzymes and Tools for Gene Manipulation: Restriction enzymes including types and mechanisms, ligase and its role in DNA joining, other important DNA modifying enzymes including CIAP and their use in recombinant DNA technology, and tools for gene identification and isolation including PCR-based methods.

Unit 3: Gene Cloning Strategies: Amplification of DNA using PCR, selection of restriction sites through restriction digestion analysis of target DNA for cloning into selected vectors, preparation of bacterial competent cells, transformation of ligated recombinant DNA into selected hosts, and screening of recombinant bacterial colonies using colony PCR and restriction digestion analysis.

Unit 4: Gene Expression and Protein Purification: Sequencing of recombinant DNA, expression of recombinant DNA into suitable hosts, purification and selected characterization of purified recombinant proteins using spectroscopic methods, and discussion of possible troubleshooting in cloning and expression experiments.

Unit 5: Advanced Techniques and Applications: Site directed mutagenesis and its applications, RNA isolation and RT-PCR for gene expression analysis, and the use of virtual lab and computational tools for in silico cloning of selected DNA.

Practical Exercise:

Repeat (Experiments: 1-3)

Preparation of competent cells,

Transformation of the selected plasmid (high copy number),

Isolation of the plasmid from bacterial culture (alkali lysis methods),

Restriction digestion of the plasmids and analysis using DNA gel and extraction of plasmid DNA from the gel using glass wool methods.

PCR amplification and ligation

Selection of transformed E. coli and validation of cloning

RNA isolation and RT PCR and their analysis.

Text Books/References:

1. Principles of Gene Manipulation and Genomics, Primrose & Twyman.

2. Winnacker, Ernst L. (1987), From genes to clones: introduction to gene technology [Gene und Klone] (in German), Horst Ibelgaufts (trans.), Weinheim, New York: VCH, ISBN 0-89573-614-4.

3. Modern Genetic Analysis. Griffiths AJF, Gelbart WM, Miller JH, et al. New York: W. H. Freeman; 1999.

4. Molecular Cloning - Sambrook Russel - Vol. 1, 2, 3.

5. Molecular Biology of the Cell. 4th edition. Alberts B, Johnson A, Lewis J, et al. New York: Garland Science; 2002.

Course Outcomes: Students will gain knowledge about the use and applications of recombinant DNA technology in different sectors like health, agriculture and environment. Students will also gain knowledge about safety and ethical use of rDNA technology.

BBT230**: Structural Biology**

Course Code	:	BBT230
Course Title	:	Structural Biology
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	PC

Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course focuses on relating theoretical concepts and experimental approaches to a wide range of potential research problems in the area of structural biology. The course aims to provide a solid foundation of understanding structural biology that will facilitate application to current and future research problems.

Course Content:

Unit 1: Protein Structural Biology Fundamentals: Protein sequences and sequence alignment, basic polypeptide stereochemistry, hierarchy in protein folds including secondary structure, tertiary structure, and quaternary structure, chaperone-assisted protein folding, thermodynamics of protein stability, effect of amino acid composition on protein structure.

Unit 2: Protein Structure Analysis and Databases: Principles of soluble and membrane protein purification, phase diagram and separation, protein crystallization, use of robotics in crystallization, space groups and symmetry in crystals, structure determination methods. Structure validation and best practices for using protein structures from protein data bank, protein fold-function relationships, Protein Data Bank, EM Data Bank, and BioMagResBank.

Unit 3: Atomic-Resolution Structure Determination Methods: X-ray crystallography, solution-state and solid-state NMR spectroscopy, single particle Cryo Electron Microscopy, and X-Ray Free-Electron Laser.

Unit 4: Biophysical and Spectroscopic Techniques: Use of circular dichroism spectroscopy, steady-state and time-resolved fluorescence spectroscopy, FRET, single molecule fluorescence, Electron paramagnetic resonance spectroscopy

Unit 5: Nucleic Acid Structures and Dynamics: DNA and RNA secondary structures including duplex, triplex, quadruplexes and aptamers, RNA secondary structure prediction, structure of sugars and lipids, structural dynamics of protein-RNA complexes, structure and organization of genomes. Protein functional dynamics, protein dynamics studies by MD simulations, and protein dynamics studies by biophysical techniques.

Text Books/References:

1. Biophysical Chemistry vol I, II and III by Charles R. Canter and Paul R. Shimmel.
2. Structure and Mechanism in Protein Science by Alan Fersht.
3. Proteins: Structures and Molecular Properties, by Thomas E. Creighton.
4. Introduction to Protein Structure by Branden and Tooze, Garland Science; 2nd edition 1999.
5. Principles of nucleic acid structure, by Stephen Neidle.
6. RNA Sequence, Structure, and Function: Computational and Bioinformatic Methods by Walter L. Ruzzo, Jan Gorodkin, Springer 2014.
7. Crystallography made crystal clear by Gale Rhodes.

8. NMR of Proteins and Nucleic Acids by Kurt Wüthrich.

9. The Art of Molecular Dynamics Simulation by D. C. Rapaport Cambridge University Press; 2nd edition 2004.

Course Outcomes: After the course, the students will be able to

1. Analyze protein sequences, stereochemistry, folding hierarchy, chaperone function, thermodynamic stability, and amino acid composition effects on protein structure.
2. Compare soluble and membrane protein purification, crystallization, symmetry, structure determination methods, and effectively use PDB, EMDB, and BMRB for structure validation and fold-function analysis.
3. Differentiate and evaluate atomic-resolution structure determination methods including X-ray crystallography, NMR, cryo-EM, and XFEL.
4. Apply CD spectroscopy, steady-state/time-resolved fluorescence, FRET, single-molecule fluorescence, and EPR to study protein structure and dynamics.
5. Explain DNA/RNA secondary structures, predict RNA folding, describe sugar/lipid structures, analyze protein-RNA complexes, genome organization, and protein dynamics via MD simulations and biophysical techniques.

BBT231**: Bioinformatics & Computational Biology**

Course Code	:	BBT231
Course Title	:	Bioinformatics & Computational Biology
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course is beneficial for students to understand the principles of analyzing biological data, building models and testing hypotheses using computer science algorithms. This course is a survey of algorithms and tools in biological sequence analysis, genome-wide disease association, and precision medicine. Basic concept machine learning and its application in analysis of biological data are also included in this course. It will also introduce information technology practices in the field of biotechnology.

Course Content:

Unit 1: Introduction and Biological Databases: General introduction to bioinformatics and its applications, biological databases including nucleotide sequence databases, protein sequence, structural and functional databases, patent databases, in silico tools for rDNA technology, database searching using BLAST and its types, Entrez, and Ensembl-Biomart.

Unit 2: Sequence Alignment and Phylogenetics: Pairwise sequence alignment including pairwise alignment, dynamic programming, scoring matrices, and gaps, multiple sequence alignment including dynamic and heuristic

methods and relevance to inferences about evolution, introduction to molecular phylogeny, phylogenetic analysis including types of phylogenetic trees, methods and applications, and bootstrap validation.

Unit 3: Genome Informatics and Variations: Genome sequencing technologies and analysis methods, transcription factor regulation and motif finding, computational epigenetics and its role in transcription regulation, development, and diseases, genomic variations and their associations, linking genes, variations and diseases, and introduction to biomarkers and personalized medicine.

Unit 4: Network Biology and Machine Learning: Network biology and human diseases, genome-wide association studies of human diseases, genome editing tools and applications to human diseases, and machine learning including classification, regression, SVM, decision trees, artificial neural networks, and big data in biology.

Unit 5: Molecular Modeling and Simulations: Molecular modeling including homology and ab initio approaches, structure validation using Procheck and verify 3D, molecular docking, molecular dynamics simulations, energy calculations, and classical and quantum mechanical approaches to molecular modeling.

Practicals:

1. Finding patterns in genomes.
2. Implementation of motif finding algorithms.
3. Identifying various regions around genes using Genome browsers
4. Browsing genetic variation databases such as dbSNP, ClinVar.
5. Finding disease variation association using GWAS Catalog.
6. Basic machine learning using WEKA tool.
7. Accessing databases from NCBI.
8. Extracting protein and nucleotide sequences from NCBI.
9. Database Search Tools.
10. Similarity search using BLAST.
11. Pairwise sequence alignment.
12. Multiple sequence alignment.
13. Conserved domain analysis.
14. Construction of Phylogenetic trees.

Text Books/References:

1. Jonathan Pevsner. Bioinformatics and Functional Genomics, 2nd Edition. ISBN: 978-0- 470-08585-1.
2. Greg Gibson and Spencer V. Muse. A Primer of Genome Science, Third Edition. ISBN: 978-0-87893-309-9.
3. Essential Bioinformatics, Jin Xiong, Cambridge University Press; 1st edition 2006.
4. Bioinformatics: methods and applications, S. C. Rastogi, PHI learning; 4th edition, 2013.
5. The Dictionary of Genomics, Transcriptomics and Proteomics, Günter Kahl, Willey VCH, 2015.

Course Outcomes: After completing this course, students will perform computational analyses of biological sequences, genome-wide studies and relate the results to core principles of biology; use computational methods to help execute a biological research plan; analyze biological problems and data using the latest machine learning and deep learning techniques. By the end of this course students can browse or retrieve gene, protein sequences and related information from biological databases; learn to align sequences using dot matrices, dynamic programming and heuristic approach; understand the notion of similarity, identity and gaps in the context of sequence alignment and deduce evolutionary relationships among sequences; analyze microarray and RNA-seq gene expression data.

EVS11112**: Environmental Science**

Course Code	:	EVS11112
Course Title	:	Environmental Science
Number of Credits	:	0 (L: 2^, T: 0, P: 0)
Course Category	:	AU
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): People working in industries or elsewhere essentially require the knowledge of environmental science so as to enable them to work and produce the most efficient, economical and eco-friendly finished products.

Course Content:

Unit 1: Ecosystem: Structure of ecosystem including biotic and abiotic components, food chain and food web, aquatic and terrestrial ecosystem, biogeochemical cycles including carbon, nitrogen, sulphur, and phosphorus cycles, and global warming including causes, effects, process, greenhouse effect, and ozone depletion.

Unit 2: Air and Noise Pollution: Definition of pollution and pollutant, natural and man-made sources of air pollution including refrigerants, IC engines, and boilers, air pollutants types including particulate pollutants effects and control using bag filter, cyclone separator, and electrostatic precipitator, gaseous pollution control using absorber and catalytic converter, effects of air pollution due to refrigerants, IC engines, and boilers, noise pollution including sources, measurement, effects, and Noise Pollution Rules 2000.

Unit 3: Water and Soil Pollution: Sources of water pollution, types of water pollutants, characteristics of water pollutants including turbidity, pH, total suspended solids, total solids, BOD and COD with definition and calculation, wastewater treatment including primary methods like sedimentation and froth flotation, secondary methods like activated sludge treatment and trickling filter, tertiary methods like membrane separation technology and reverse osmosis, causes, effects and preventive measures of soil pollution including excessive use of fertilizers, pesticides and insecticides, irrigation, and e-waste.

Unit 4: Renewable Sources of Energy: Solar energy including basics, flat plate collector, theory of flat plate collector, importance of coating, advanced collector, solar pond, solar water heater, solar dryer, and solar stills, biomass including overview as energy source, thermal characteristics, anaerobic digestion, biogas production mechanism, utilization and storage, wind energy including current status and future prospects in India, environmental benefits and problems, new energy sources including hydrogen energy, ocean energy resources, tidal energy conversion, and geothermal energy.

Unit 5: Solid Waste Management, ISO 14000 and Environmental Management: Solid waste generation including sources and characteristics of municipal solid waste, e-waste, and biomedical waste, metallic wastes and non-metallic wastes from industries, collection and disposal including MSW principles, energy recovery, sanitary landfill, and hazardous waste management, air quality act 2004, air pollution control act 1981 and water pollution control act 1996, structure and role of central and state pollution control board, concept of carbon credit and carbon footprint, environmental management in fabrication industry, and ISO 14000 implementation in industries and benefits.

Text Books/References:

1. S.C. Sharma & M.P. Poonia, Environmental Studies, Khanna Publishing House, New Delhi.
2. C.N. R. Rao, Understanding Chemistry, Universities Press (India) Pvt. Ltd., 2011.
3. Arceivala, Soli Asolekar, Shyam, Waste Water Treatment for Pollution Control and
4. Reuse, Mc-Graw Hill Education India Pvt. Ltd., New York, 2007, ISBN:978-07-062099-
5. Nazaroff, William, Cohen, Lisa, Environmental Engineering Science, Willy, New York, 2000, ISBN 10: 0471144940.
6. O.P. Gupta, Elements of Environmental Pollution Control, Khanna Publishing House, New Delhi
7. Rao, C. S., Environmental Pollution Control and Engineering, New Age International Publication, 2007, ISBN: 81-224-1835-X.
8. Rao, M. N.Rao, H.V.N, Air Pollution, Tata Mc-Graw Hill Publication, New delhi, 1988, ISBN: 0-07- 451871-8.
9. Frank Kreith, Jan F. Kreider, Principles of Solar Engineering, McGraw-Hill, New York; 1978, ISBN: 9780070354760.
10. Aldo Vieira, Da Rosa, Fundamentals of renewable energy processes, Academic Press Oxford, UK; 2013. ISBN: 9780123978257.
11. Patvardhan, A.D, Industrial Solid Waste, Teri Press, New Delhi, 2013, ISBN:978-81- 7993-502-6
12. Metcalf & Eddy, Waste Water Engineering, Mc-Graw Hill, New York, 2013, ISBN: 077441206.
13. Keshav Kant & Rajni Kant, Air Pollution & Control, Khanna Publishing House, New Delhi (Edition 2018)

Open source software and website address:

1. www.eco-prayer.org
2. www.teriin.org
3. www.cpcp.nic.in
4. www.cpcp.gov.in
5. www.indiaenvironmentportal.org.in
6. www.whatis.techtarget.com
7. www.sustainabledevelopment.un.org
8. www.conserve-energy-future.com

Teachers should use the following strategies to achieve the various outcomes of the course.

- Different methods of teaching and media to be used to attain classroom attention.
- Massive open online courses (MOOCs) may be used to teach various topics/subtopics.
- 15-20% of the topics which are relatively simpler of descriptive in nature should be given to the students for self-learning and assess the development of competency through classroom presentations.
- Micro-projects may be given to a group of students for hands-on experiences.
- Encouraging students to visit sites such as Railway station and research establishment around the institution.

Course Outcomes: At the end of the course student will be able to

1. Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco – friendly products.
2. Understand the suitable air, extent of noise pollution, and control measures and acts.
3. Understand the water and soil pollution, and control measures and acts.
4. Understand different renewable energy resources and efficient process of harvesting.
5. Understand solid Waste Management, ISO 14000 & Environmental Management.

ECO11505**:** Economics for Engineers

Course Code	:	ECO11505
Course Title	:	Economics for Engineers
Number of Credits	:	2 (L: 2, T: 0, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course aims at providing the student with advanced concepts of engineering economic analysis and its role in engineering decision making. Additionally, the course also covers topics such as depreciation, after tax analysis, replacement analysis, uncertainty, inflation, deflation, and estimation of future events.

Course Content:

Unit 1: Introduction and Demand Analysis: Definition, nature, scope and significance of economics for engineers, demand including types, determinants, law of demand, elasticity of demand, types and significance, supply and market price determination, and case study in demand forecasting including meaning, methods, consumer survey, trend projections, and moving average.

Unit 2: Cost, Revenue and Market Structure: Cost and revenue including concepts, classifications, short run and long run cost curves, revenue concepts and measurement of profit, market structure including perfect competition

characteristics, price and output determination in short run and long run, monopoly and price discrimination, monopolistic competition and product differentiation, and oligopoly and duopoly.

Unit 3: Market Failure and Money: Market failure including causes, types of goods including rivalrous and non-rivalrous goods, excludable and non-excludable goods, and solutions through government intervention, money including functions and quantity theory of money, banking including commercial banks functions, central bank functions, and role of banks in economic development.

Unit 4: Foreign Exchange and Business Cycles: Foreign exchange including balance of payments, exchange rate determination, methods of foreign payments, international institutions including IMF and IBRD, business cycle and national income including meaning and phases of business cycle, inflation causes and control measures, deflation, national income concepts, methods of calculating national income, and problems in calculating national income.

Unit 5: Engineering Economic Analysis: Advanced concepts of engineering economic analysis and its role in engineering decision making including depreciation methods, after tax analysis, replacement analysis, handling uncertainty in economic evaluations, and estimation of future events including inflation and deflation impacts on project viability.

Text Books:

1. Premvir Kapoor, "Sociology & Economics for Engineers", Khanna Publishing House, 2018.

2. Dewett. K.K., Navalur M. H., "Modern Economic Theory", S. Chand and Company Ltd, New Delhi, 24thEdn., 2014.

3. Lipsey& Chrystal, "Economics", Oxford University Press, 2010.

References:

1. Paul A Samuelson & William, "Economics", Tata McGraw Hill, New Delhi, 2012.

2. Francis Cherinullem "International Economics", McGraw Hill Education, 2011.

3. William A McEachern and Simrit Kaur, "Micro ECON", Cengage Learning, 2013.

4. William A McEachern and Indira A., "Macro ECON", Cengage Learning, 2014.

Course Outcome(s):

1. Describe the role of economics in the decision making process and perform calculations in regard to interest formulas.

2. Estimate the Present, annual and future worth comparisons for cash flows.

3. Calculate the rate of return, depreciation charges and income taxes.

4. Enumerate different cost entities in estimation and costing.

5. Explain the importance of finance functions, financial ratios and solve related problems.

6. Explain the elements of budgeting and benchmarking.

SEMESTER V

SEMESTER – V

XXXXXX: Entrepreneurship & Startups

Course Code	:	**XXXXXX**
Course Title	:	Entrepreneurship & Startups
Number of Credits	:	2 (L: 1, T: 1, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): Acquiring Entrepreneurial spirit and resourcefulness; familiarization with various uses of human resource for earning dignified means of living; understanding the concept and process of entrepreneurship and its contribution and role in the growth and development of individuals and the nation; acquiring entrepreneurial quality, competency, and motivation; and learning the process and skills of creation and management of entrepreneurial venture.

Course Content:

Unit 1: Introduction to Entrepreneurship and Startups: Definitions of entrepreneurship and entrepreneur, traits of an entrepreneur, intrapreneurship, motivation for entrepreneurship, types of business structures, and similarities and differences between entrepreneurs and managers.

Unit 2: Business Ideas and Their Implementation: Discovering business ideas and visualizing the business concept, creating an activity map for business operations, and developing a comprehensive business plan covering all aspects of the proposed venture.

Unit 3: Idea to Startup: Market analysis including identifying the target market, competition evaluation and strategy development, marketing and accounting fundamentals, and risk analysis for new business ventures.

Unit 4: Management of the Venture: Company's organization structure development, recruitment and management of talent, and financial organization and management including budgeting and financial controls.

Unit 5: Financing, Protection, and Exit Strategies: Financing methods available for startups in India, communication of ideas to potential investors through investor pitch development, patenting and licenses for idea protection, and exit strategies for entrepreneurs including bankruptcy, succession, and harvesting strategy.

Text Books/References:

1. The Startup Owner's Manual: The Step- by-Step Guide for Building a Great Company by Steve Blank and Bob Dorf K & S Ranch ISBN–978-0984999392.
2. TheLean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries Penguin UK ISBN–978-0670921607.
3. Demand: Creating What People Love Before They Know They Want It by Adrian J. Slywotzky with Karl Weber Headline Book Publishing ISBN–978-0755388974.
4. The Innovator's Dilemma: The Revolutionary Book That Will Change the Way You Do Business by Clayton M. Christensen Harvard business ISBN:978-142219602.

Websites:

1. https://www.fundable.com/learn/resources/guides/startup
2. https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
3. https://www.finder.com/small-business-finance-tips
4. https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your- business/

Course Outcomes: Upon completion of the course, the student will be able to demonstrate knowledge of the following topics:

1. Understanding the dynamic role of entrepreneurship and small businesses
2. Organizing and Managing a Small Business
3. Financial Planning and Control
4. Forms of Ownership for Small Business
5. Strategic Marketing Planning
6. New Product or Service Development
7. Business Plan Creation

BBT326**: Metabolic Engineering**

Course Code	:	BBT326
Course Title	:	Metabolic Engineering
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The course will provide an overview of the basic concepts and experimental techniques used in metabolic engineering and its applications in production of useful compounds of industrial importance. The students will also learn that how complex regulatory mechanisms at multiple levels control the dynamics of the cellular metabolism. The course will also cover examples of successful engineering strategies used for the production of commercially important primary and secondary metabolites or recombinant proteins.

Course Content:

Unit 1: Introduction to Metabolism and Its Regulation: Introduction to metabolism including catabolism and anabolism, key differences between metabolic controls of prokaryotes and eukaryotes, stoichiometry of cellular reactions, enzyme kinetics, reaction rates, dynamic mass balance, yield coefficients and linear rate equations, the black box model, elementary balance, heat balance, different models for cellular reactions including Induction-Jacob Monod Model and its regulation, differential regulation by isoenzymes, concerted or cumulative feedback regulation, regulation in branched pathways, and permeability and transport of metabolites.

Unit 2: Metabolic Flux Analysis: Building stoichiometric matrices for metabolic networks, steady state and pseudo steady state assumptions in flux analysis, using different optimizing functions to solve linear programming problems, understanding flux cone and constraints in metabolic systems, and introducing additional constraints from thermodynamics to refine flux predictions.

Unit 3: Experimental Determination of Metabolic Fluxes: C13 labeling techniques for tracking carbon atoms through metabolic pathways, NMR-based methods for flux determination, and GC-MS based methods for quantifying metabolite labeling patterns and calculating intracellular fluxes.

Unit 4: Computational Modeling of Biological Networks: Introduction to MATLAB for biological modeling, synthetic circuit design principles, metabolic flux analysis using computational tools, advanced flux analysis methods including MOMA, iFBA, and dFBA, and strategies for enhancement of product yield and productivity through metabolic engineering.

Unit 5: Industrial Applications of Metabolic Engineering: Pathway engineering strategies for overproduction of commercially important primary metabolites including amino acids and organic acids, production of secondary metabolites including therapeutic compounds, production of industrially relevant enzymes and recombinant proteins, bioconversion applications and factors affecting bioconversion, mixed or sequential bioconversions, regulation of enzyme production, strain selection and improvement, and modification of existing or introduction of entirely new metabolic pathways.

Practicals:

1. Develop engineering strategies to boost production of industrially relevant compound in E. coli.
2. Strain engineering (deletion or overexpression of genes) to boost production of target compound followed by metabolite extraction and quantification.
3. Demonstration of feed-back regulation and product inhibition
4. Development of a flux model and correlation of the model with experimental data.

Text Books/References:

1. Metabolic Engineering: Principles and Methodologies by Gregory N. Stephanopoulus, Aristos A. Aristidou, and Jens Nielsen.

2. Pathway Analysis and Optimization in Metabolic Engineering by Néstor V. Torres and Eberhard O. Voit.

3. The Metabolic Pathway Engineering Handbook by Christina D. Smolke.

4. Biochemical Engineering by Harvey W. Blanch and Douglas S. Clark.

Course Outcomes: At the end of this course the students will learn and systematically analyze the complexities defining regulation of various metabolic pathways. They will be able to design and learn strain-engineering strategies to alter cellular behavior, metabolic flux, and product formation. They will also appreciate the vast industrial applications of metabolic engineering in the field of medicine, energy and environment.

BBT327**: Analytical Techniques**

Course Code	:	BBT327
Course Title	:	Analytical Techniques

Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To learn different modern analytical techniques used in biotechnology.

Course Content:

Unit 1: Microscopy and its Application: Basic principle of optics, Magnification, Resolution, Contrast, Numerical Aperture and Aberration. Principle, mechanism of action and application of different types of microscopies: bright-field microscopy, dark-field microscopy, phase-contrast, fluorescence and confocal microscopy. Outline concept of electron microscopy and sample preparation.

Unit 2: Centrifugation and Electrophoresis: Principle of centrifugation, preparatory and analytical centrifugation, types of rotors, RPM vs RCF, sedimentation coefficient, differential and density gradient centrifugation, Basic principle and application of Ultracentrifugation technique

Basic principle of Electrophoresis: Agarose gel electrophoresis, PFGE, Native PAGE, SDS-PAGE, 2-D PAGE and their applications in molecular biology research.

Unit 3: Chromatographic Techniques: Principles of chromatography including ion-exchange, affinity, hydrophobic interaction, and size exclusion chromatography, fast protein liquid chromatography, high-performance liquid chromatography, and gas chromatography for separation and analysis of biomolecules.

Unit 4: Spectroscopy: Absorption spectroscopy principles and applications, infrared spectroscopy for molecular identification, scattering techniques, fluorescence spectroscopy.

Unit 5: Advanced Spectroscopic and Structural Methods: Solution-state and solid-state NMR spectroscopy for biomolecular structure determination, mass spectroscopy techniques including MALDI, LC-MS, GC-MS, MS-MS, and MALDI-mass imaging for proteomics and metabolomics applications.

Practical:

1. Measurement of UV-Visible spectra of DNA, RNA, proteins and coloured compounds

2. Measurement of excitation and emission spectra of a fluorophore and their wavelengths for maximum excitation and emission

3. Measurement and analysis of IR spectra of small molecules

4. Purification of a compound from a mixture using HPLC

5. Protein purification using affinity, ion-exchange and gel filtration chromatography

6. Analysis of NMR spectra and structure determination of a bio-active compound like cyclosporine.

7. Demonstration of analysis of proteomics data

Text Books/References:

1. Biophysical Chemistry, Vol II by Charles R. Canter and Paul R. Shimmel.
2. Protein Purification: Principles and Practice by Robert K. Scopes (Narosa).
3. Principles of Fluorescence Spectroscopy by Joseph R. Lakowicz.
4. Infrared Spectroscopy Fundamentals and Applications by Barbar Stuart.
5. NMR spectroscopy by Harald Gunther (John Wiley).
6. Mass Spectrometry Basics by Christopher G. Herbert and Robert W. Johnstone.
7. Chromatographic methods by A Braithwaite and F. J. Smith (Kluwer Academic Publishers).
8. Fundamentals of Melecular Spectroscopy by C.N Banwell and E.M McCash

Course Outcomes: At the end of the course, student would be able to understand and apply modern analytical techniques used in biotechnology.

BBT328: **Cheminformatics & Medicinal Chemistry**

Course Code	:	BBT328
Course Title	:	Cheminformatics & Medicinal Chemistry
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course for biotechnology students introduces the small-molecule-ligand-oriented *in silico* physico-chemical aspects of rational drug design. Topics include in silico representation of chemical information, chemical databases and data mining, molecular drawing and interactive visualization, computer-aided drug design, building a ligand ab initio or from similar ligands, with and without known macromolecules, assessing activity and toxicity and drugability.

Course Content:

Unit 1: Chemistry and Information Technology in Drug Design: Overview of rational drug design, ligands and targets in drug discovery, in silico representation of chemical information, and the integration of chemistry and information technology for pharmaceutical research.

Unit 2: Chemical Databases and Data Mining: Chemical databases for drug discovery, data mining techniques for chemical and biochemical data, data collation, retrieval, analysis and interpretation, and molecular drawing and interactive visualization including building molecules on computer and molecular modeling.

Unit 3: Computer-Aided Drug Design: Overview of computer-aided drug design approaches, structural homology modeling tools for protein structure prediction, docking tools for studying ligand-target interactions, and screening tools for virtual high-throughput screening.

Unit 4: Chemical Data Science and Medicinal Chemistry Fundamentals: Artificial intelligence in chemistry for drug discovery, simulation methods for molecules and materials, stereochemistry and mechanism in drug action, coordination chemistry for drug design, in silico tools for medicinal chemistry including docking, MD simulations, and de novo drug design, organic reaction mechanisms, and logic in organic synthesis.

Unit 5: QSAR, Drug Metabolism, and Preformulation: Quantitative structure-activity relationships for predicting biological activity, pharmacological screening methods, chemistry of drug action, pharmaceutical preformulation studies, solid-state pharmaceutics, drug metabolism and pharmacokinetics, and pharmacodynamics of drug candidates.

Practicals:

1. In silico selection of compound from an NCI library against a target protein.
2. Molecular Docking between protein and ligand
3. Energy minimization and MD simulation protein-ligand complex
4. Structure based drug design against a target protein such HIV-1 protease using crystal structure from Protein Data Bank
5. Analysis of PK and PD data of a drug candidate

Text Books/References:

1. Muthukumarasamy Karthikeyan and Renu Vyas. Practical chemoinformatics. Springer, soft-cover ISBN 9788132234913, 2014.
2. Silverman, Richard B., and Mark W. Holladay. The organic chemistry of drug design and drug action. Academic Press, 2014.
3. Bajorath, Jurgen. Chemoinformatics for Drug Discovery. John Wiley & Sons, 2013.
4. Cramer, C.J., Essentials of Computational Chemistry, 2nd Ed., John Wiley & Sons Ltd., 2004.
5. Essentials of Foye's Principles of Medicinal Chemistry – 2016.
6. An Introduction to Medicinal Chemistry, by Graham L. Patrick.
7. Medicinal Chemistry by Ashutosh Kar.

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

1. Explain the principles of rational drug design, ligand-target interactions, in silico chemical representation, and the integration of chemistry with information technology in pharmaceutical research.
2. Utilize chemical databases, apply data mining techniques for biochemical data analysis, and perform molecular drawing, visualization, and modeling on computers.
3. Apply computer-aided drug design approaches including homology modeling, molecular docking, and virtual high-throughput screening for ligand-target interaction studies.

4. Implement AI and simulation methods in drug discovery, analyze stereochemistry and coordination chemistry in drug action, and apply in silico tools like docking, MD simulations, and de novo design with organic synthesis logic.
5. Apply QSAR for biological activity prediction, evaluate pharmacological screening methods, and analyze drug metabolism, pharmacokinetics, pharmacodynamics, and preformulation studies.

BBT329**: Good Manufacturing and Laboratory Practice**

Course Code	:	BBT329
Course Title	:	Good Manufacturing and Laboratory Practice
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): Basic understanding of the regulatory requirement of cGMP and GLP.

Course Content:

Unit 1: Introduction to GMP and GLP: Introduction to Good Manufacturing and Laboratory Practice, requirement of GLP and GMP compliance for regulatory approval, ethics in manufacturing and control, and the importance of these practices for drug regulation.

Unit 2: Quality by Design Principles: Principles of quality by design in pharmaceutical development, introduction to the concept of design of experiments, application of QBD principles in biotech product development, and case studies demonstrating QBD and DOE in process development and analytical development.

Unit 3: ICH Guidelines and Regulatory Authorities: Introduction to ICH guidelines and their usage in pharmaceutical development, national and international regulatory authorities and their functions, and pharmaceutical jurisprudence and laws related to product design and drug development.

Unit 4: Drug Development and Approval Process: Drug development and approval process including regulation of clinical and preclinical studies, good manufacturing practices in drug production, formulation production management, and authorization and marketing of drugs.

Unit 5: Computer Simulations and Practical Applications: Computer simulation on process design for pharmaceutical manufacturing, understanding that GLP covers personnel, testing facilities, equipment, records, and protocols for non-clinical labs, and understanding that GMP covers facilities, equipment, production, process control, packaging, labeling, and laboratory controls.

Text Books/References:

1. cGMP starter guide: Principles in Good Manufacturing Practices for Beginners, Emmet P. Tobin, Createspace Independent Publishing Platform, April 2016.

2. Good Manufacturing Practices for Pharmaceuticals: GMP in Practice, B Cooper, Createspace Independent Publishing Platform, July 2017.

3. Sarwar Beg and Md Saquib Hasnain, Pharmaceutical Quality by design: Principles and application, Academic press, March 2019.

4. Ron S. Kenett, Shelemyahu Zacks, Daniele Amberti, Modern Industrial Statistics: with applications in R, MINITAB and JMP, 2nd Edition, Wiley, January 2014.

5. N Politis S, Colombo P, Colombo G, M Rekkas D.Design of experiments (DoE) in pharmaceutical development, Drug Dev Ind Pharm. 2017 Jun;43(6):889-901. doi: 10.1080/03639045.2017.1291672.

6. Andrew Teasdale, David Elder, Raymond W. Nims, ICH quality guidelines- An implementation guide, Dec 2017.

7. Gajendra Singh, Gaurav Agarwal an Vipul Gupta, Drug regulatory affairs, CBS publication, 2005.

8. Marc P. Mathieu, New Drug Development: A regulatory overview, Nov 2000.

9. ICH guidelines available in the official website "https://www.ich.org".

Course Outcomes: Understand that the areas that come under the Good Laboratory Practices are: personnel and organizational, testing facilities, equipment, testing and controls, records, reports, and protocol for and conduct of non-clinical labs., Understand that the areas that come under GMP are: facilities and buildings, equipment, production, process control, packaging and labeling, laboratory controls, and returned/salvaged drug products., Importance of GMP and GLP for drug regulation.

BBT351-38**: Professional Elective – I**

Course Code	:	BBT351-380
Course Title	:	Professional Elective – I
Number of Credits	:	5 (L: 3, T: 1, P: 1)
Course Category	:	PE
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide specialized knowledge in an area of biotechnology chosen by the student.

Refer Appendix I for details regarding Professional Elective – I.

OSXXX: Open Subject – I

Course Code	:	OSXXX
Course Title	:	Open Subject - I
Number of Credits	:	5 (L: 3, T: 1, P: 1)
Course Category	:	OS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide interdisciplinary knowledge in an area outside the core biotechnology curriculum.

Refer Appendix II for details regarding Open Subject – I.

AU301: Indian Constitution

Course Code	:	AU301
Course Title	:	Indian Constitution
Number of Credits	:	0 (L: 2^, T: 0, P: 0)
Course Category	:	AU
Continuous Assessment (C.A.)	:	--
End Semester Assessment (E.S.A.)	:	--

Course Objective(s): To provide students with knowledge of the Indian Constitution, its structure, and the functioning of various government bodies.

Course Content:

Unit 1: The Constitution - Introduction: The history of the making of the Indian Constitution, preamble and the basic structure and its interpretation, fundamental rights and duties and their interpretation, and state policy principles.

Unit 2: Union Government: Structure of the Indian Union, the role and power of the President, the Prime Minister and Council of Ministers, and the functions of Lok Sabha and Rajya Sabha.

Unit 3: State Government: The role and power of the Governor, the Chief Minister and Council of Ministers, and the functions of the State Secretariat in state administration.

Unit 4: Local Administration: District administration structure and functions, municipal corporation organization and responsibilities, and Zila Panchayat role in local governance.

Unit 5: Election Commission: The role and functioning of the Election Commission, the position and powers of the Chief Election Commissioner, and the functions of the State Election Commission.

Suggested Learning Resources:

1 Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008

2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)

3 Introduction to the Constitution of India DD Basu Lexis Nexis;Twenty-Third 2018 edition

Suggested Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html

2. http://www.legislative.gov.in/constitution-of-india

3. https://www.sci.gov.in/constitution

4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of- india/

BBT391**: Summer Internship – I**

Course Code	:	BBT391
Course Title	:	Summer Internship - I
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): Minimum of six weeks in an Industry preferably in the area of Biotechnology. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Outcome: This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Guidance/Remarks: Note: Internship needs to be done in Summer Break after Semester - IV and will be considered for evaluation in Semester - V.

SEMESTER VI

SEMESTER – VI

BBT330**: Bioseparation Engineering**

Course Code	:	BBT330
Course Title	:	Bioseparation Engineering
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): It is intended to impart basic undergraduate level knowledge in the area of separation technologies for the biomolecules. Students would be able to understand workflow for the separation of DNA, RNA, proteins, secondary metabolites etc. They would also be able to assimilate recent research findings, advancement and development in the relevant subject.

Course Content:

Unit 1: Introduction and Centrifugation Methods: Introduction to separation of biomolecules and its importance in biotechnology, working principles of centrifugation, centrifugation-based methods for separation of cell organelles and biomolecules including DNA, RNA, proteins, and secondary metabolites, and separation of different types of DNA and RNA from biological samples.

Unit 2: Chromatographic Separation Techniques: Basics of chromatography and its use in separation of biomolecules, principles and applications of thin layer chromatography, high-performance liquid chromatography, and gas chromatography for biomolecule separation and analysis.

Unit 3: Protein Separation Methods: Methods for separation of proteins based on size, charge, and chemical nature of proteins, principles of ion-exchange, affinity, and size exclusion chromatography for protein purification, and techniques for isolating and separating biolipids.

Unit 4: Membrane-Based and Advanced Separation Technologies: Membrane and rotating membrane systems in bioseparation, ultrafiltration methods for separation of biomolecules, polymer beads for immobilization of biomolecules, magnetic beads for bio-separation applications, and cell sorting technologies including fluorescence-activated cell sorting.

Unit 5: Microfluidics and Practical Applications: Microfluidics-based separation techniques for biomolecules, isolation of photosynthetic pigments using centrifugation methods, and integration of multiple separation technologies for comprehensive biomolecule purification workflows.

Practicals:

1. Isolation of the plant cell organelles using centrifugation methods.
2. Isolation and separation of the DNA, RNA and proteins using centrifugation and biochemical methods.
3. Separation of the proteins with suitable chromatography methods.
4. Apply filtration and ultrafiltration method for separation of proteins.
5. Use TLC for separation of the biolipids.

6. Isolation of the photosynthetic pigments using centrifugation methods.

Text Books/References:

1. Molecular Cloning - Sambrook Russel - Vol. 1, 2, 3.

2. Fat Detection: Taste, Texture, and Post Ingestive Effects. Montmayeur JP, le Coutre J, editors. Boca Raton (FL): CRC Press/Taylor & Francis; 2010.

3. Biochemistry. 5th edition. Berg JM, Tymoczko JL, StryerL. New York: W H Freeman; 2002.

Course Outcomes: The students will learn how to separate and purify to homogeneity molecules and biological macromolecules of interest using different technologies. The course will also introduce how to scale up the separation in a cost effective manner.

BBT331**: Synthetic & Systems Biology**

Course Code	:	BBT331
Course Title	:	Synthetic & Systems Biology
Number of Credits	:	4 (L: 3, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): This course introduces students to the rapidly evolving field of Systems & synthetic biology. Successful examples illustrating tremendous application potentials of synthetic biology in the fields of biofuels, biomedicine, and other areas will also be discussed. Emphasis has also been laid on the use of online bio-design software and computer labs to design new circuits and assemblies followed by experiments to evaluate their functionality.

Course Content:

Unit 1: Introduction to Synthetic Biology and Systems Biology: Introduction to synthetic biology, background of gene regulatory mechanisms including gene parts, promoters, terminators, enhancers, inducers, repressors, transcription factors, and co-factors, transcriptional and post-transcriptional regulation, post-translational modifications, genetic engineering and genome editing, various omics technologies and their role in systems biology including genomics, proteomics, transcriptomics, and metabolomics.

Unit 2: Elements of Synthetic Biology: Gene shuffling for large scale pathway assembly and engineering, choices for microbial hosts for industrial applications including bacteria, yeast, and insect cells, gene editing methods including CRISPR-Cas systems, gene sequencing technologies including pyrosequencing and nanopore sequencing, bacterial circuits including feed-back, feed-forward, toggle switch, signal propagators, band filters, and synchronized oscillators, introduction to BioBricks and their applications, and microarrays and systems biology.

Unit 3: Mathematical Modelling and Simulation: Noise in gene expression and its implications, mathematical modeling and simulation of biological systems, biosensor design and applications, application of software tools for modeling gene expression, various markup languages used in systems biology, and introduction to various metabolic pathway databases.

Unit 4: Commercial Applications of Synthetic Biology: Applications in biomedicine, biomaterials, biofuels, and bioremediation, production of artemisinin as a case study, building the new bio-economy, introduction to biofoundries and automation in biofactories, green chemistry using plants for engineering biologics and small molecules, biosurfactants as an example of microbial cell factory based production, and global events and competitions including iGEM and synbiobeta.

Unit 5: Regulations, Ethics, and Future Directions: Safety and bioethics in synthetic biology research, legal and IP elements involved in synthetic biology applications for human, animal, and plant systems, standards for plant synthetic biology, and future directions and emerging trends in the field.

Practicals:

1. Introduction to various bio-design software.
2. Design and construction of a biosensor.
3. Gene circuit design and engineering.
4. Crispr-Cas9 based genome editing.

Text Books/References:

1. Uri Alon, An Introduction to Systems Biology: Design Principles of Biological Circuits, Chapman & Hall/CRC (2006).
2. Eric Davidson, The Regulatory Genome: Gene Regulatory Networks In Development And Evolution, Academic Press (2006).
3. Hamid Bolouri, Computational Modeling of Gene Regulatory Networks - A Primer, Imperial College Press (1st edition) (2008).
4. Freemont, P.S and Kitney, R.I. (2012). Synthetic Biology – a Primer. World Scientific Publishing Co pte Ltd
5. Singh, V and P.K. Dhar. (2015). Systems and Synthetic Biology. Springer publishing, Netherlands
6. Fu, P and Panke, S (2009). Systems Biology and Synthetic Biology. Wiley Publishing.
7. Covert, M.W. (2014). Fundamentals of Systems Biology: from Synthetic Circuits to Whole Cell Models. CRC Press
8. Konopka, A. K. (2006). Systems Biology: Principles, Methods, and Concepts. CRC Press.
9. Church, G and Regis, E. (2012). Regenesis: How Synthetic Biology will Reinvent Nature and Ourselves. Basic Books.
10. Standards for Plant Synthetic Biology - http://onlinelibrary.wiley.com/doi/10.1111/nph.13532/full
11. Synthetic and Systems Biology for Microbial production of Commodity Chemicals -
12. http://www.nature.com/articles/npjsba20169.
13. Biotechnology and Synthetic Biology Approaches for Metabolic Engineering of Bioenergy Crops - https://www.ncbi.nlm.nih.gov/pubmed/27030440.
14. Microarray Data Analysis: Gene Expression Data Analysis. A Beginner's Guide by: Helen Causton (Imperial College), J Quackenbush and AlvisBrazma (The European Bioinformatics Institute).

15. A Practical Approach to Microarray Data Analysis (Hardcover) by Daniel P. Berrar (Editor), Werner Dubitzky (Editor), Martin Granzow (Editor).

Course Outcomes: The students will learn the concept of synthetic biology and its widespread applications in research and industry. They will be able to assemble DNA and genes into biological circuits to make a biosensor or even engineer organisms. The students will also appreciate that biological systems are highly dynamic and not static and can be manipulated by various design strategies.

BBT332**: Animal & Plant Biotechnology**

Course Code	:	BBT332
Course Title	:	Animal & Plant Biotechnology
Number of Credits	:	4 (L: 2, T: 0, P: 2)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): At the end of this course the students will learn and systematically analyze the complexities defining regulation of various metabolic pathways. They will be able to design and learn strain-engineering strategies to alter cellular behavior, metabolic flux, and product formation. They will also appreciate the vast industrial applications of metabolic engineering in the field of medicine, energy and environment. The course intends to teach students about the traditional and new approaches used in crop improvement. This includes the conventional and marker assisted breeding approaches, plant tissue culture and its importance in generation of transgenic plants, methods to express large quantities of important proteins and modern tools for site directed mutagenesis in plants.

Course Content:

Unit 1: Animal Cell Culture Fundamentals: History of animal cell culture, characteristics of animal cell metabolism, regulation and nutritional requirements, culture media and growth conditions, development of primary culture and cell lines, suspension culture, characterization and maintenance of cell lines, cryopreservation techniques, common cell culture contaminants, marker gene characterization, and transfection and transformation of cells.

Unit 2: Scale-Up and Animal Biotechnology Applications: Need for scaling-up cells for vaccine, antigen, or pharmaceutical protein production, hybridoma technology for monoclonal antibody production, cell culture reactors, scale-up in suspension and monolayer cultures, factors affecting cell growth, growth monitoring, mass transfer considerations, concept of transgenic animals, methods of transgene delivery including microinjection of recombinant DNA into fertilized eggs and stem cells, animal pharming, organ culture, regenerative medicine, and human embryonic stem cell research with ethical concerns and biosafety.

Unit 3: Crop Improvement and Plant Tissue Culture: The need for crop improvement, conventional methods including selection, mutation, polyploidy, and clonal selection, the green revolution in India, introduction to marker assisted breeding and selection, history of plant tissue culture, plasticity and totipotency, laboratory setup for plant tissue culture, sterilization methods, types of nutrient media and plant growth regulators, pathways for in vitro regeneration including organogenesis, somatic and gametic embryogenesis, protoplast isolation and culture,

somatic hybridization, haploid and triploid production, applications of micropropagation, meristem culture, embryo rescue, and somaclonal variations.

Unit 4: Genetic Transformation of Plants: Introduction to Agrobacterium biology and biotechnology, mechanism of T-DNA transfer to plants, Agrobacterium rhizogenes and its applications, transplastomics and its utility, methods for direct gene transfer, marker and reporter genes, promoters used in plant vectors, plant viral vectors, molecular techniques for analysis of transgenics including copy number, transgene stability, silencing, and segregation, marker-free transgenics, and environmental, social, and legal issues associated with transgenic plants with case studies for genetic engineering in plants for agronomic traits, biotic and abiotic stress tolerance, and herbicide resistance.

Unit 5: Molecular Farming and Genome Editing in Plants: Transgenic crops for production of antibodies, viral antigens, and peptide hormones in plants, edible vaccines and nutraceuticals, plant biotechnology for biofuels, the history of targeted mutations in plants, use of ZFNs and TALENs as early tools for genome editing, discovery of CRISPR-Cas system and its applications, recent innovations in genome editing technology, and case studies where CRISPR-Cas has been used for plant improvement.

Practicals:

1. Animal Cell Culture Biosafety and Ethical Concerns
2. Preparation of reagents and media for cell culture
3. Cell counting and plating
4. Maintenance of Adherent (Monolayer) and Suspension Cell culture
5. Cryopreservation of cell lines
6. Determination of common cell culture contaminants
7. Cell Viability Assay (MTT reagent)
8. Cell Cytotoxicity Assay (Trypan Blue Assay)
9. Transfection in mammalian Cell Lines
10. Preparation and sterilization of standard tissue culture media.
11. Sterilization of explants and generation of undifferentiated mass of cells. Regeneration of plants from undifferentiated cells.
12. Preparation of competent cells, transformation and colony PCR for confirmation of transformation in Agrobacterium tumefaciens.
13. Agrobacterium mediated transformation of plants.
14. Selection and screening of transgenic plants.
15. Evaluation of a transgenic phenotype (viz., Herbicide resistance) under contained conditions.
16. Analysis of crude extracts from medicinal plants using HPLC.
17. Use of microsatellite markers for DNA fingerprinting.

Text Books/References:

1. Culture of Animal Cells by R.I. Freshney.

2. Animal Cell Biotechnology 2007, Humana Press by Portner R.

3. Basic Cell Culture Second Edition, Oxford University Press by Davis, J.M.

4. Principles of Plant Genetics and Breeding by George Acquaah 2007. Blackwell Publishing.

5. An introduction to Plant Tissue culture by MK Razdan. M.K. 2003. Oxford & IBH Publishing Co, New Delhi, 2003.

6. Plant Biotechnology: An Introduction to Genetic Engineering by Adrian Slater, Nigel

W. Scott, Mark R. Fowler. Oxford University Press, 2008.

7. Biochemistry & Molecular Biology of Plants. Bob Buchanan, Wilhelm Gruissem, Russell Jones. John Wiley & Sons, 2002.

BBT351-380**: Professional Elective – II**

Course Code	:	BBT351-380
Course Title	:	Professional Elective – II
Number of Credits	:	5 (L: 3, T: 1, P: 1)
Course Category	:	PE
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide specialized knowledge in an area of biotechnology chosen by the student.

Kindly Refer Appendix I on Professional Electives.

OSXXX: Open Subject – II

Course Code	:	OSXXX
Course Title	:	Open Subject – II
Number of Credits	:	5 (L: 3, T: 1, P: 1)
Course Category	:	OS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide interdisciplinary knowledge in an area outside the core biotechnology curriculum.

Kindly Refer Appendix II on Open Subjects.

PSG11021:**Universal Human Values 2: Understanding Harmony**

Course Code	:	PSG11021
Course Title	:	Universal Human Values 2: Understanding Harmony
Number of Credits	:	3 (L: 2; T: 1; P: 0)
Course Category	:	MT
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): The objective of the course is four fold: development of a holistic perspective based on self-exploration about themselves, family, society and nature; understanding of the harmony in the human being, family, society and nature; strengthening of self-reflection; and development of commitment and courage to act.

Course Content:

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education: Purpose and motivation for the course including recapitulation from Universal Human Values-I, self-exploration as a process involving natural acceptance and experiential validation, understanding continuous happiness and prosperity as basic human aspirations, right understanding, relationship and physical facility as basic requirements for fulfilment of aspirations with correct priority, a critical appraisal of the current scenario regarding happiness and prosperity, and the method to fulfil human aspirations through understanding and living in harmony at various levels.

Unit 2: Understanding Harmony in the Human Being - Harmony in Myself: Understanding human being as a co-existence of the sentient I and the material body, understanding the needs of self and body as happiness and physical facility, understanding the body as an instrument of I with I being the doer, seer and enjoyer, understanding the characteristics and activities of I and harmony in I, understanding the harmony of I with the body through Sanyam and health, correct appraisal of physical needs and the meaning of prosperity in detail, and programs to ensure Sanyam and health.

Unit 3: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship: Understanding values in human-human relationship, the meaning of justice including nine universal values in relationships and programs for its fulfilment to ensure mutual happiness, trust and respect as the foundational values of relationship, understanding the meaning of trust and the difference between intention and competence, understanding the meaning of respect and the difference between respect and differentiation along with the other salient values in relationship, understanding the harmony in the society as an extension of family including resolution, prosperity, fearlessness and co-existence as comprehensive human goals, and visualizing a universal harmonious order in society from undivided society to universal order from family to world family.

Unit 4: Understanding Harmony in the Nature and Existence - Whole Existence as Coexistence: Understanding the harmony in nature, interconnectedness and mutual fulfilment among the four orders of nature including recyclability and self-regulation in nature, understanding existence as co-existence of mutually interacting units in all-pervasive space, and holistic perception of harmony at all levels of existence.

Unit 5: Implications of Holistic Understanding on Professional Ethics: Natural acceptance of human values, definitiveness of ethical human conduct, the basis for humanistic education, humanistic constitution and humanistic universal order, competence in professional ethics including the ability to utilize professional competence for augmenting universal human order, ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, ability to identify and develop appropriate technologies and management patterns for above production systems, case studies of typical holistic technologies, management models and production systems, and strategy for transition from the present state to universal human order at the level of individual and society.

Text Books/References:

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4. The Story of Stuff (Book).
5. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
6. Small is Beautiful - E. F Schumacher.
7. Slow is Beautiful - Cecile Andrews
8. Economy of Permanence - J C Kumarappa
9. Bharat Mein Angreji Raj - PanditSunderlal
10. Rediscovering India - by Dharampal
11. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
12. India Wins Freedom - Maulana Abdul Kalam Azad
13. Vivekananda - Romain Rolland (English)
14. Gandhi - Romain Rolland (English)

BBT392**: Comprehensive viva voce**

Course Code	:	BBT392
Course Title	:	Comprehensive *viva voice*
Number of Credits	:	1 (L: 0, T: 0, P: 1)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): To assess the student's overall understanding of the subjects covered in the curriculum through an integrated oral examination.

Guidance/Remarks:

- There shall be comprehensive viva voce as stated above which will be evaluated for 100 marks. This will be evaluated during the end term examination.
- The evaluation of comprehensive viva-voce has to be carried out by two teachers independently and average be taken.
- The recommendations of the Committee are final and binding.

SEMESTER VII

SEMESTER – VII

XXXXXX: Intellectual Property Rights (IPR) & Regulatory

Course Code	:	XXXXXX
Course Title	:	Intellectual Property Rights (IPR) & Regulatory
Number of Credits	:	2 (L: 1, T: 1, P: 0)
Course Category	:	HS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To disseminate knowledge on patents, patent regime in India and abroad and registration aspects; to make students aware about current trends in IPR and Govt. supports in promoting IPR; to classify the role of regulatory committees in controlling the risk.

Course Content:

Unit 1: Intellectual Property Rights: Introduction and the need for intellectual property rights, kinds of intellectual property rights including patent, copyright, trade mark, design, geographical indication, plant varieties and layout design, genetic resources and traditional knowledge, trade secret, IPR in India including genesis and development, IPR in abroad, major international instruments concerning intellectual property rights including Paris Convention, Berne Convention, Universal Copyright Convention, WIPO Convention, Patent Co-operation Treaty, TRIPS Agreement, India's New National IP Policy 2016, government of India steps towards promoting IPR, government schemes in IPR, career opportunities in IP, and IPR in current scenario with case studies.

Unit 2: Biosafety-Regulatory Framework for GMOs: Regulatory framework in India governing GMOs including Recombinant DNA Advisory Committee, Institutional Biosafety Committee, Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee, Recombinant DNA Guidelines, Revised Guidelines for Research in Transgenic Plants, Seed Policy, Prevention Food Adulteration Act, The Food Safety and Standards Bill, Plant Quarantine Order, Regulation for Import of GM Products Under Foreign Trade Policy, National Environment Policy, rules for the manufacture, use, import, export and storage of hazardous microorganisms and genetically engineered organisms, Convention of Biological Diversity, Cartagena Protocol on Biosafety including objectives and salient features, understanding the legal steps involved in progressing a new drug to market, and grasping the current regulatory acts and safety norms of modern pharmaceutical industries.

Unit 3: Bioethics: Patenting live microorganisms, human genome project and ethical issues, animal cloning and human cloning and their ethical issues, experimenting on animals, public education on producing transgenic organisms, legal and socioeconomic impacts of biotechnology, testing drugs on human volunteers, and hazardous materials used in biotechnology including their handling and disposal.

Unit 4: Regulatory Affairs in Pharmaceuticals: Detailed understanding of the drug development process and regulatory requirements for market approval, roles and responsibilities of various regulatory bodies in pharmaceutical approval, and current regulatory acts and safety norms in the pharmaceutical industry.

Unit 5: IPR in Biotechnology: Specific considerations for intellectual property protection in biotechnology including patenting of biological materials, navigating the intersection of IPR with biosafety and bioethics, and case studies of IPR issues in biotechnology research and development.

Text Books/References:

1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.

3. V Sreekrishna, 2017. Bioethics and Biosafety in Biotechnology by New Age International publishers.

E-resources:

1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf

2. World Intellectual Property Organization. (2004). WIPO Intellectual Property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf

Course Outcomes:

- The students shall get an adequate knowledge on patent and copyright. This provide further way for developing their idea or innovations.
- Identify the role of regulatory committees in controlling the risk.
- Students should get enough information on ethical issues linked to research on animal models, transgenics, clinical trials.
- Students to consider Intellectual Property (IP) as a career option as IP Counsel/Patent Examiner/Patent agent.

BBT426**: Data Analysis and Simulations**

Course Code	:	BBT426
Course Title	:	Data Analysis and Simulations
Number of Credits	:	3 (L: 2, T: 0, P: 1)
Course Category	:	PC
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective: In this course, the students will learn the principles and methods of statistical analysis, but will also put them into practice using a range of real-world data sets. The objective of the course is to provide a basic understanding of data analysis using statistics and to use computational tools on problems of applied nature. Applications of data science techniques such as machine learning, deep learning and their applications in biological data.

Course Content:

Unit 1: Data Preprocessing and Visualization: Types of data in biological research, methods for dealing with missing data, data visualization techniques including scatter plots, histograms, group plots, and box plots, and dimensionality reduction methods for high-dimensional biological data.

Unit 2: Statistical Data Analysis: Fundamentals of statistical analysis for biological data, hypothesis testing and interpretation of p-value significance, chi-square tests for categorical data analysis, T-tests for comparing group means, ANOVA for multi-group comparisons, and introduction to Bayesian probability and its applications in biology.

Unit 3: Mining Frequent Patterns and Machine Learning Fundamentals: Mining frequent patterns in biological data, associations and correlations between variables, classification methods, introduction to machine learning including supervised and unsupervised learning approaches, logistic regression, support vector machines, decision trees, clustering algorithms, and model evaluation techniques.

Unit 4: Artificial Neural Networks and Deep Learning: Types of artificial neural networks and their architectures, introduction to deep learning concepts, and case studies demonstrating the application of deep learning in biology and healthcare research.

Unit 5: Practical Applications in Biology: Implementation of data analysis workflows using computational tools, plotting graphs using MS Excel for data visualization, statistical data analysis using PSPP or similar software, implementing machine learning algorithms for biological data analysis, and deep learning applications using platforms like Deep Learning Studio Desktop.

Practicals:

1. Plotting graphs using MS Excel.
2. Statistical data analysis using PSPP.
3. Implementing machine learning algorithms.
4. Deep learning using Deep Learning Studio Desktop.

Text Books/References:

1. Introduction to Machine Learning using Python, Jeeva Jose, Khanna Publishing House, 2019.
2. Data Mining: Concepts and Techniques by Jiawei Han, Jian Pei, Micheline Kamber, Elsevier; Third edition 2007.
3. Deep Learning by Ian Goodfellow, Yoshua Bengio, MIT Press 2017.
4. Data Visualization – A Practical Introduction by Kieran Healy, Princeton University Press 2019.
5. Deep Learning – Rajiv Chopra, Khanna Publishing House, 2019.

Course Outcomes: On completion of this course, students will be able to gain insights such as correlation and basic analysis using data visualization. Students can present their research results in probabilistic terms using statistical significance. Students can build and train machine learning models and evaluate them; get accustomed with deep learning techniques and their applications in biological and healthcare data.

BBT451-480**: Professional Elective – III**

Course Code	:	BBT451-480
Course Title	:	Professional Elective – III
Number of Credits	:	5 (L: 3, T: 1, P: 1)

Course Category	:	PE
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide specialized knowledge in an area of biotechnology chosen by the student.

Kindly Refer Appendix I on Professional Electives.

BBT451-480**: Professional Elective – IV**

Course Code	:	BBT451-480
Course Title	:	Professional Elective – IV
Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	PE
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide specialized knowledge in an area of biotechnology chosen by the student.

Kindly Refer Appendix I on Professional Electives.

OSXXX: Open Subject – III

Course Code	:	OSXXX
Course Title	:	Open Subject – III
Number of Credits	:	5 (L: 3, T: 1, P: 1)
Course Category	:	OS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide interdisciplinary knowledge in an area outside the core biotechnology curriculum.

Kindly Refer Appendix II on Open Subjects.

OSXXX: Open Subject – IV

Course Code	:	OSXXX
Course Title	:	Open Subject – IV

Number of Credits	:	3 (L: 2, T: 1, P: 0)
Course Category	:	OS
Continuous Assessment (C.A.)	:	50
End Semester Assessment (E.S.A.)	:	50

Course Objective(s): To provide interdisciplinary knowledge in an area outside the core biotechnology curriculum.

Kindly Refer Appendix II on Open Subjects.

BBT498**: Project-I**

Course Code	:	BBT498
Course Title	:	Project-I
Number of Credits	:	2 (L: 0, T: 0, P: 2)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): To synthesize and apply the knowledge gained over the engineering programme to solve real world problems.

Guidance/Remarks: Project-I can be done either during the Summer Break between Semester VI and Semester VII or during the Semester VII. It will be evaluated as part of Semester VII. It may either be a complete project related to the field of Biotechnology or it may be an initiation (Phase I) of Project-II present in Semester VIII, provided the "Project Work II" is expected to extend beyond the duration of 6 months.

BBT491**: Summer Internship - II**

Course Code	:	BBT491
Course Title	:	Summer Internship – II
Number of Credits	:	3 (L: 0, T: 0, P: 3)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): Minimum of six weeks in an Industry preferably in the area of Biotechnology. The summer internship should give exposure to the practical aspects of the discipline. In addition, the student may also work on a specified task or project which may be assigned to him/her. The outcome of the internship should be presented in the form of a report.

Course Objective: This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

AICTE Internship Policy available on AICTE's website may be referred for more information regarding Internship.

Remarks: Internship needs to be done in Summer Break after Semester - VI and will be considered for evaluation in Semester - VII.

SEMESTER VIII

SEMESTER – VIII

BBT499: Project-II (Biotech Industrial or Biotech In-house Project or Bio-Entrepreneurship/ startups)

Course Code	:	BBT499
Course Title	:	Project-II (Biotech Industrial or Biotech In- house Project or Bio-Entrepreneurship/ startups)
Number of Credits	:	9 (L: 0, T: 0, P: 9)
Course Category	:	PS
Continuous Assessment (C.A.)	:	---
End Semester Assessment (E.S.A.)	:	100

Course Objective(s): To synthesize and apply the knowledge gained over the engineering programme to solve real world problems. Project-II may be a complete project related to the field of Biotechnology or an extension of Project-I, or a startup in the field related to Biotechnology.

Guidance/Remarks: Project-II have to be done during the Semester VIII. It may be initiated in the break between Semester VII & VIII although it is not mandatory to initiate in the break. It will be evaluated as part of Semester VIII. It may either be a complete project related to the field of Biotechnology or it may be an extension (Phase II) of Project- I present in Semester VII, provided the Project in charge agrees that "Project Work I" is worthy enough to extend across two semesters (i.e. VII & VIII). It may also be a startup in the field related to Biotechnology. In case of startups, substantial evidence has to be produced for evaluation of the work carried out as part of Project-II.