तार : विश्वविद्यालय
Gram : UNIVERSITY

टेलीफोन : कार्या0 : 2320496
कुलसचिव : निवास : 2321214
फैक्स : 0510 : 2321667
मेल नं.: registrar.bujhansi@gmail.com

बुन्देलखण्ड विश्वविद्यालय, झाँसी
BUNDELKHAND UNIVERSITY, JHANSI (U.P.)

झाँसी (उ.प्र.) 284128

संदर्भ..BT/IET/05/1122

दिनाँक..07/11/2022

The Minutes of Meeting of BOS

In reference to the BOS of Department of Biotechnology, Institute of Engineering and Technology held on 07th November 2022 regarding the revision of syllabus in tune with CBCS/NEP 2020 and the subsequent approval from academic council. This is to certify that syllabus is revised accordingly.

Dr. DINESH DWIVEDI
Coordinator
Deptt. of Biotechnology
Institute of Engg. & Technology
Bundelkhand University, Jhansi

Coordinator
Department of Biotechnology,
Institute of Engineering & Technology
BU, Jhansi

बुन्देलखण्ड विश्वविद्यालय, झाँसी

सूचना

एदत् द्वारा सूचित किया जाता है कि के स्ववित्त पोषित योजना के अन्तर्गत **अभियांत्रिकी संकाय** के **बायोटेक्नोलॉजी इंजीनियरिंग** पाठ्यक्रम समिति की बैठक दिनांक 07/11/2022 को अपरान्ह 11.00 बजे विश्वविद्यालय के सभागार में ऑनलाइन/ऑफलाइन के माध्यम से आहूत की गयी है। अतः आपसे अनुरोध है कि बैठक में निर्धारित तिथि एवं समय पर उपस्थित होने का कष्ट करें।

कार्यसूची :–

1. सत्र 2022–2023 की परीक्षा हेतु प्राशिनकों/ परीक्षकों की सूची तैयार करने सम्बन्धी कार्य।
2. अन्य मद अध्यक्ष की अनुमति से।

सेवा में,

1	प्रो0 एम.एम.सिंह, संकायाध्यक्ष–अभियांत्रिकी, बुन्देलखण्ड विश्वविद्यालय,झाँसी	संकयाध्यक्ष/संयोजक
2	श्री मुकुल सक्सेना, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
3	श्री बृजेन्द्र शुक्ल, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
4	श्री दिनेश द्विवेदी, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
5	श्री महेन्द्र प्रताप सिंह, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
6	श्री बृजेन्द्र कुमार कश्यप, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
7	डॉ0 आनन्द कुमार पाण्डेय, सहा0 आचार्य, बुन्देलखण्ड विश्वविद्यालय, झाँसी	सदस्य
8	प्रो0 बी0एन0मिश्रा, डिपार्टमेन्ट ऑफ बायोटेक्नोलोजी इन्स्टीटयूट ऑफ इंजी0 एण्ड टैक्नोलोजी, सीतापुर रोड़, लखनऊ, उ0प्र0	वाह्य विशेषज्ञ
9	ई0 प्रियेश शिवम सिंह, एसो0 सांइटिस्ट, एम.एस.ए.टी. सिन्जेन इन्टरनेशनल लिमि. (बायोकोन ग्रुप ऑफ कम्पनीज) बेंगलौर	वाह्य विशेषज्ञ

(विनय कुमार सिंह)
कुलसचिव

बुन्देलखण्ड विश्वविद्यालय, झाँसी

पत्रांकः– बु0वि0/एके0/2022/7721-7729 दिनांकः– 7-11-22

प्रतिलिपि – निम्नलिखित को सूचनार्थ एवं आवश्यक कार्यवाही हेतु प्रेषित।

1. उपर्युक्त समस्त सदस्यगण
2. संकायाध्यक्ष– अभियांत्रिकी को सूचनार्थ।
4. वित्त अधिकारी।
5. सहायक कुलसचिव (अतिगोपनीय)।
6. कुलपति जी के निजी सचिव।
7. कुलसचिव के आशुलिपिक।

कुलसचिव

Department of Biotechnology
Institute of Engineering & Technology
Bundelkhand University, Jhansi
Minutes of the meeting of board of studies
(Academic session 2022-2023)

A meeting of the board of studies held on 07th November, 2022 at 2.00 P.M to discuss the agenda provided vide letter no. BU/Acad /2022/7721-7729 dated 7/11/22

Agenda:

1. To approve the panel of external & internal examiners for B.Tech. Biotechnology Engg. program at Institute of Engineering and Technology, Bundelkhand University, Jhansi.
2. To revise the syllabus.

The following members were present:

External Members:

1. Prof. B.N. Mishra, Head Department of Biotechnology, Institute of Engineering and Technology, Sitapur Road , Lucknow. **(Attended the meeting online)**
2. Er. Priyesh Shivam Singh, Senior Associate Scientist, MSAT, Syngene International Ltd.,(Biocon Group of Companies) **(Industry Expert as well as Alumnus)**

Internal Members:

1. Prof. M M Singh (Convenor), Dean, Institute of Engineering, Bundelkhand University, Jhansi
2. Er. Brajendra Shukla (Member), Academic Coordinator, Institute of Engineering& Technology, Bundelkhand University, Jhansi
3. Er. Mukul Saxena, (Member) Assistant Professor, Deptt. of Biotechnology Engg. Institute of Engineering & Technology, Bundelkhand University, Jhansi
4. Er. Dinesh Diwedi, Coordinator Deptt. of Biotechnology Engg. Institute of Engineering & Technology, Bundelkhand University, Jhansi
5. Er. Mahendra Pratap Singh, (Member) Assistant Professor , Deptt. of Biotechnology Engg. Institute of Engineering, Bundelkhand University, Jhansi
6. Dr.Anand Kumar Pandey, (Member) Assistant Professor, Deptt. of Biotechnology Engg. Institute of Engineering& Technology, Bundelkhand University, Jhansi
7. Mr. Brijendra Kumar Kashyap, Assistant Professor, Deptt. of Biotechnology Engg. Institute of Engineering & Technology, Bundelkhand University, Jhansi

Proceedings:

1. In compliance of agenda point no. 1-the panel for external and internal examiners for the Odd & Even semesters theory and practical examinations was put up for 2022-23 and has been approved.
2. In compliance of agenda point no. 2-

i. It has been proposed to shift the course 'Bioprocess engineering II' which was in course structure of VIII semester to course structure of 6th semester. The rationale for this change has been proposed in purview of importance of course content in competitive examinations like GATE, GATE-B, CSIR, DBT-JRF etc. and the pre-final year student will also be able to prepare for such competitive examination.

The proposed change has been discussed thoroughly in length and approved.

ii. It has been proposed to merge the syllabi of course 'Heat transfer operations' and 'Mass Transfer Operation' which were taught in 4th and 6th semester respectively to form a single course as 'Heat and Mass transfer operation which shall be taught in 4th semester with effect of this change.

The proposed change has been discussed thoroughly in length and approved.

iii. Keeping in view of the importance of research activities and entrepreneurial skill development, the contact hours and credit of major project of VIII semester has been proposed to increase as –

a. Contact hours 12hrs. to 18hrs.
b. Credits from 7 to 10.

The proposed change has been discussed thoroughly in length and approved.

iv. It has been proposed to increase the credit allotted for Biochemistry Lab i.e. 2 credits to 3 credits and subsequently decrease the credit allotted for theory paper of Biochemistry i.e. 4 credits to 3 credits keeping in purview the importance of Laboratory courses of Biochemistry.

The **proposed change has been discussed thoroughly in length and approved.**

3. In purview of additional skill development to enhance employability, it has been proposed to include value added courses in the course curriculum of B. tech (Biotechnology Engg.)

The proposal has been discussed thoroughly in length and it has been approved to include the value added courses in I, II, III, IV, V and VI semester. The students have to choose any one value added course in each semester from the list (attached). The course will be of non-evacuative and non-credit in nature. Each value added course shall be of 30 hrs. The course structure and syllabus of session 2022-23 is attached (copy attached).

The meeting ends with thanks to the chair.

07.11.22
(Prof. M M Singh)

07/11/2022
(Er. Brajendra Shukla)

07/11/2022
(Er. Dinesh Diwedi)

(Er.Mukul Saxena)

(Er. Mahendra Pratap Singh)

(Dr. Anand Kumar Pandey)

(Er.Priyesh Shivam Singh)

(Mr. Brijendra Kumar Kashyap)

(Prof. B. N. Mishra) Approval is attached.
(Present on-line)

BRAJENDRA SHUKLA <er.brajendrashukla007@bujhansi.a

MoM of BOS held today i.e on 07/11/2022

2 messages

BRAJENDRA SHUKLA <er.brajendrashukla007@bujhansi.ac.in>
To: "bnmishra@ietlucknow.ac.in" <bnmishra@ietlucknow.ac.in> Mon, Nov 7, 2022 at 5

Dear Sir,
As discussed the MoM of BOS held today i.e on 07/11/2022 is be' ng sent to you for your approval.
Regards
--
Er. Brajendra Shukla
Department of Biotechnology
Academic Coordinator,
Institute of Engineering & Technology
Bundelkhand University, Jhansi

MoM BoS 22 23.docx
22K

B N Mishra <bnmishra@ietlucknow.ac.in> Thu, Nov 10, 2022 at 12:1
To: BRAJENDRA SHUKLA <er.brajendrashukla007@bujhansi.ac.in>

Dear Dr Shukla,

As I have attended the meeting, I hereby find the BOS minutes okay from my side.

Best wishes
Regards
Prof BN Mishra
IET, Lucknow

Sent from my iPhone

On 07-Nov-2022, at 6:57 PM, BRAJENDRA SHUKLA <er.brajendrashukla007@bujhansi.ac.in> wrote:

[Quoted text hidden]

BUNDELKHAND
UNIVERSITY JHANSI

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22K

INSTITUTE OF ENGINEERING AND TECHNOLOGY

(DEPARTMENT OF BIOTECHNOLOGY)

Course Structure & Syllabus
For
B.Tech. Biotechnology Program

W.E.F

2022-23

BUNDELKHAND UNIVERSITY, JHANSI
Kanpur Road, Jhansi, Uttar Pradesh, India
Pin Code- 284128
Visit us at: www.bujhansi.ac.in

Department of Biotechnology
Institute of Engineering and Technology

I. Vision

- Be an international standard organization leading technological and socioeconomic development of the region and country-
  1. By ensuring high quality technical education in the field of Biotechnology to all sections of the society.
  2. By enhancing the goal competitiveness of technical manpower.

- To remain a leading centre in education, research, entrepreneurship in biotechnology guided by sound technical and ethical principles

II. Mission

M1	To develop high quality engineering professional by offering B.Tech. Biotechnology program and to develop a premier Biotechnology teaching and research department to cater the needs and challenges of the region and country.
M2	To provide globally acceptable technical education in Biotechnology.
M3	To promote collaboration with academia, industries and research organizations.
M4	To contribute to socio-economics development through education and bio-entrepreneurship.
M5	To contribute to the all-round development of students through various activities and program and enrich their capacities and potentials.

III. Program Outcomes (POs)

Graduate Students of B. Tech. (Biotechnology) program will be able to:

Program Outcomes (POs)		Graduate Attributes (GAs)
PO1	Apply the knowledge of physical sciences, biological sciences, mathematics, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.	**Engineering knowledge**
PO2	Review research literature, formulates identify and analysis complex engineering problems using principles of mathematics, science, natural science and bioengineering.	**Problem analysis**

PO3	Select and apply appropriate technique, resources and IT tools including production and modelling to complex engineering activities.	**Modern tool usage**
PO4	Function effectively as a member or leader in diverse team and in multidisciplinary settings.	**Team work**
PO5	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	**The engineer and society**
PO6	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	**Environment and sustainability**
PO7	Apply ethical principle and commit to professional ethics and responsibilities and norms of the engineering practice.	**Ethics**
PO8	Communication effectively on complex engineering activities with the engineering community.	**Communication**
PO9	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	**Life-long learning**

IV. Program Educational objectives (PEOs)

The educational objectives are:

PEO1	Graduates will be able to implement the engineering principles to biological systems for the development of industrial applications as well as Entrepreneurship skills to start biotech industries.
PEO2	Graduates will think critically and creatively about the use of biotechnology to address local and global problems with ethical values with holistic approach.
PEO3	Graduate of the program will be able to serve the nation as academician, government professional, entrepreneur by implication of their work as it affects the health, safety and environment of human population.

V. Program specific outcomes (PSOs)

Graduate students of B. Tech. Biotechnology program will be able:

PSO1	To implement technical knowledge practically in the field of strain improvement, fermentation, recovery of the product, Treatment of waste materials and commercial production of primary and secondary metabolites specially in application areas of engineering and technology in biotech industries.
PSO2	To take up career in biotech industries, pharma industries, food industries, IT sector and national and international research institutes to pursue higher studies.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 1st, Semester-I

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	MA-1841/ MA*-1842/ BT*-1852/ FT-1842/1852	Maths I/ Elementary Mathematics-I/Remedial Elementary Mathematics/ Remedial Biology-I (for FT)	3	0	0	30	20	50	100	150	3
2.	ME-1850/ HU-1851	Manufacturing Process/ Environment and Ecology (No credit)**	2	0	0	10	10	20	30	50	2
3.	PH-1843	Engineering Physics-I	2	0	0	15	10	25	50	75	2
4.	CY-1844/ ME-1845	Engineering Chemistry/ Engineering Mechanics	3	0	0	30	20	50	100	150	3
5.	EC-1846/ CS-1847	Electrical Engineering/ Computer concepts & programming in C	3	0	0	30	20	50	100	150	3
6.	EC-1848/ HU-1849	Electronic Engineering/ Professional Communication	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
7.	PH-10859/ HU-10860	Physics Lab/ Professional Communication Lab	0	0	2	15	10	25	50	75	1
8.	CY-10853/ ME-10854	Engineering Chemistry/ Engineering Mechanics Lab	0	0	2	15	10	25	50	75	1
9.	WS-10857/ ME-10858	Workshop Practice/ Computer Aided Engg. Graphics Lab	0	0	2	15	10	25	50	75	1
10.	EE-10855/ CS-10856	Electrical Engineering Lab/ Computer Programming Lab	0	0	2	15	10	25	50	75	1
11.	10861/GP-101	General Proficiency**	-	-	-	-	-	50	-	50	-
		Total	**16**	**0**	**8**	**-**	**-**	**-**	**-**	**1025/975**	**20/18**

Note:-

***Elementary Mathematics is for the students who passed 10+2 examination with Biology and Remedial Biology/Elementary Biology (for FT) is for the students who passed 10+2 with Mathematics.**

****No credit: General proficiency marks will not be added in the total marks as it is non-credited subject.**

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 1st, Semester-II

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	MA*-1855/ MA*-1856/ BT-1866	MathsII/ Elementary Mathematics-II/ Remedial Biology-II / Engineering Mathematics-I (for FT)	3	1	0	30	20	50	100	150	3
2.	ME-1859/ HU-1858	Engineering Mechanics/ Engineering Chemistry	3	0	0	30	20	50	100	150	3
3.	PH-1857	Engineering Physics-II	2	0	0	15	10	25	50	75	2
4.	EE-18/ HU-1863	Electronic Engineering/ Professional Communication	3	0	0	30	20	50	100	150	3
5.	CS-1861/ EE-1860	Computer concepts & programming in C/Electrical Engineering	3	0	0	30	20	50	100	150	3
6.	CE-1865/ ME-1864	Environment and Ecology (No credit)** / Manufacturing Process	2	0	0	10	10	20	30	50	-
PRACTICAL/TRAINING/PROJECT											
7.	PH-10873/ HU-10874	Physics Lab/ Professional Communication Lab	0	0	2	15	10	25	50	75	1
8.	CS-10870/ EE-10869	Computer Programming Lab/ Electrical Engineering Lab	0	0	2	15	10	25	50	75	1
9.	CE-10872/ WS-10871	Computer Aided Engg. Graphics Lab/Workshop Practice	0	0	2	15	10	25	50	75	1
10.	ME-10868/ CY-10867	Engineering Mechanics Lab/Engineering Chemistry	0	0	2	15	10	25	50	75	1
11.	10875/GP-201	General Proficiency**	-	-	-	-	-	50	-	50	-
		Total	**16**	**1**	**8**	**-**	**-**	**-**	**-**	**975/1025**	**18/20**

Note:-

***Elementary Mathematics/Engineering Mathematics-I (Food Tech.)/ Maths-II is for the students who passed 10+2 examination with Biology and Remedial Biology is for the students who passed 10+2 with Mathematics.**

****No credit: General proficiency marks will not be added in the total marks as it is non-credited subject.**

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 2nd, Semester-III

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	BT 301/2461	Biochemistry	3	0	0	30	20	50	100	150	3
2.	BT-302 /2462	Applied Microbiology	3	0	0	30	20	50	100	150	3
3.	CH-301 /2463	Fluid Flow and Solid Handling	3	0	0	30	20	50	100	150	3
4.	MA-302 /2464	Statistical Techniques	3	0	0	30	20	50	100	150	3
5.	CS-306 /2465	Data structure & Algorithms using C	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6.	BT 351 / 20466	Biochemistry Lab	0	0	4	20	20	40	60	100	3
7.	BT-352 /20467	Applied Microbiology Lab	0	0	3	20	20	40	60	100	2
8.	CH-351 /20468	Fluid Mechanics Lab	0	0	2	10	10	20	30	50	1
9.	GP-301/20469	General Proficiency*	-	-	-	-	-	50	-	50	0
		Total	**15**	**1**	**9**	**-**	**-**	**-**	**-**	**1050**	**21**

*Note: General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 2nd, Semester-IV

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	BT-401 / 2466	Immunology	3	0	0	30	20	50	100	150	3
2.	BT-402 / 2471	Protein and Enzyme Engineering	3	0	0	30	20	50	100	150	3
3.	BT-403 / 2468	Genetics & Molecular Biology	3	0	0	30	20	50	100	150	3
4.	CH-401 / 2469 (New)	Heat and Mass Transfer Operations	3	0	0	30	20	50	100	150	3
5.	CH - 402 / 2472	Chemical Engineering Thermodynamics	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6.	BT-451 / 20471	Immunology Lab	0	0	3	15	10	25	50	75	2
7.	BT-452 / 20472	Genetics & Molecular Biology Lab	0	0	3	15	10	25	50	75	2
8.	CH-451 / 20475	Chemical Engineering Operations Lab	0	0	3	20	20	40	60	100	2
9.	GP-401 / 20474	General Proficiency*	-	-	-	-	-	50	-	50	0
		Total	**15**	**0**	**9**	**-**	**-**	**-**	**-**	**1050**	**21**

*Note: General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 3rd, Semester-V

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	BT 501 / 3461	Analytical Methods in Biotechnology	3	0	0	30	20	50	100	150	3
2.	BT-502 / 3462	Bioprocess Engineering-I	3	0	0	30	20	50	100	150	3
3.	HU-501 / 3463	Industrial Economics & Principles of Management	3	0	0	30	20	50	100	150	3
4.	CH-501 / 3464	Chemical Reaction Engineering	3	0	0	30	20	50	100	150	3
5.	CS-506 / 3465	Design & Analysis of Algorithms	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6.	BT-552 / 30466	Bioprocess Engineering Lab	0	0	4	30	20	50	75	125	3
7.	CS-551 / 30467	Design & Analysis of Algorithms Lab	0	0	4	30	20	50	75	125	3
8.	GP-501 /30468	General Proficiency*	-	-	-	-	-	50	-	50	0
		Total	**15**	**2**	**8**	**-**	**-**	**-**	**-**	**1050**	**21**

*Note: General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 3rd, Semester-VI

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	BT-601/ 3466	Bioinformatics	3	0	0	30	20	50	100	150	3
2.	BT-602 / 3467	Plant Biotechnology	3	0	0	30	20	50	100	150	3
3.	BT-603 / 3468	Fermentation Biotechnology	3	0	0	30	20	50	100	150	3
4.	BT-604 / 3469	Genetic Engineering	3	0	0	30	20	50	100	150	3
5.	BT-605 / 3470 (New)	Bioprocess Engineering-II	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6.	BT-651 / 30471	Bioinformatics Lab	0	0	3	20	20	40	60	100	2
7.	BT-653 / 30472	Fermentation Lab	0	0	3	20	20	40	60	100	2
8.	BT-654 / 30473	Genetic Engineering Lab	0	0	3	10	10	20	30	50	2
9.	GP-601 /30474	General Proficiency*	-	-	-	-	-	50	-	50	0
		Total	**15**	**0**	**9**	**-**	**-**	**-**	**-**	**1050**	**21**

*Note: General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 4th, Semester-VII

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	OE - 01/4462	Non Conventional Energy Resources	3	0	0	30	20	50	100	150	3
2.	BT - 704/ 4461	Nano-biotechnology	3	0	0	30	20	50	100	150	3
3.	BT-701 / 4463	Environmental Biotechnology	3	0	0	30	20	50	100	150	3
4.	BT-702 / 4464	Animal Cell Culture & Tissue Engineering	3	0	0	30	20	50	100	150	3
5.	BT-703 / 4465	Food Biotechnology	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
6.	BT-751 / 40466	Environmental Biotechnology Lab	0	0	2	10	10	20	30	50	1
7.	BT-752 / 40467	Seminar	0	0	2	0	0	0	50	50	1
8.	BT-753 / 40468	Summer Training	0	0	2	0	0	0	50	50	1
9.	BT-754 / 40469	Mini Project	0	0	2	0	0	0	100	100	1
10.	GP- 701 / 40470	General Proficiency*	-	-	-	-	-	50	-	50	0
		Total	**15**	**0**	**8**	**-**	**-**	**-**	**-**	**1050***	**19**

*Note: General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering & Technology Bundelkhand University Jhansi
STUDY & EVALUATION SCHEME
B. Tech (Biotechnology)

Year 4th, Semester-VIII

S. No	Course Code	Course Title/Subjects	Periods			Evaluation Scheme				Total	Credit
						Sessional			ESE		
		Theory	**L**	**T**	**P**	**CA**	**TA**	**Total**			
1.	BT-802 / 4467	Bioseperation & Down Stream Processing	3	0	0	30	20	50	100	150	3
2.	BT-803 / 4468	IPR, Biosafety & Bioethics	3	0	0	30	20	50	100	150	3
3.	BT-804 / 4469	Industrial Biotechnology	3	0	0	30	20	50	100	150	3
PRACTICAL/TRAINING/PROJECT											
4.	BT-851 / 40471	*Project & Seminar	0	0	18	-	200	200	350	550	10
5.	GP-801 /40472	General Proficiency**	-	-	-	-	-	50	-	50	0
		Total	**9**	**0**	**18**	**-**	**-**	**-**	**-**	**1050**	**19**

*Out of 18 periods, 4 periods per week should be allotted for a group and 14 periods per week should be allotted for self studies & project work.

**General Proficiency marks will not be added in total marks as it is non-credited subject.

Institute of Engineering and Technology

List of value added courses-

SEM -I	**SEM-II**
Photography	Cyber security & ethical hacking
Google Ads	Digital marketing
Goal Setting	Bio-CNG (Green Fuel)
SEM-III	**SEM-IV**
IELTS | IID	E- waste recycling business
Mushroom Cultivation Business	Advance Excel
Introduction to MATLAB	Mobile App Developmnet
SEM-V	**SEM-VI**
Internet of things (IOT)	Marketing Content Writer
Bakery Technology	Milk Processing Business
Drone technology	Organic Waste Management

Note-

- ✓ The Students have to choose any one value added course in each semester from the list.
- ✓ The course will be of no - evaluative and non – credit in nature
- ✓ Each value-added course shall be of 30 hrs.

SYLLABUS

I

SEMESTER

ELEMENTARY MATHEMATICS-I (MA-102/1842)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic differential calculus
2. Understand the use of Integral Calculus
3. Solve differential equations
4. Understand basics of Trignometry
5. Solve the numericals related with Statics problem

Unit I:

Differential Calculus: Function, Limit of Function, Differentiation of function, Product of Function, Product rule, Quotient Rule of Differentiation, Differentiation of Function of a Function, Inverse of Trigonometric Function, Differentiation of Logarithmic Form, Parametric Form, Differentiation by substation, Tangents and Normal, Maxima & minima of one variable.

Unit: II:

Integral Calculus: Integration as inverse process of differentiation, Infinite integrals of standard form, Integration of functions by substitution, by partial fraction parts, Basic properties of definite integrals & evaluation of definite integrals.

Unit III:

Differential Equations: Definition, order & degree, General & particular solutions of a differential equation, Differential equations of first order & first degree, Solutions of differential equations by method of separation of variables, Homogenous differential equations, Linear differential equation, Exact differential equation.

Unit IV:

Trigonometry: System of Measurement of angles, Trigonometric ratios or functions, Fundamental trigonometric identities, Addition, subtraction & transformation formulae, Signs of the values of Trigonometric functions in different quadrants, Ratios of Multiple, Trigonometric ratios of allied & compound angles, Transformation Formulae, Trigonometric ratios of submultiple angles, allied & certain angles.

Unit V:

Statics: Measures of central values, Frequency distribution, Graphical representation, Characteristics of a frequency distribution, Arithmetic mean, median, mode, Relation between AM, GM, HM. Definition of probability, Laws of probability.

Reference books:

1. Dass, H. K. (2011). S Chand Higher Engineering Mathematics. S Chand.
2. Pundir, S. K. (2020). Engineering Mathematics with Applications. Macmillan Publishers.
3. Grewal, B. S. (2015). Higher Engineering Mathematics. 43rd Edition. Khanna Publishers
4. Sharma, R.D. (2020) Objective Mathematics. Dhanpat Rai Publications.
5. Cristina, S. (2021). Differential and Integral Calculus – Differentiate with Respect to Anything. (https://machinelearningmastery.com/differential-and-integral-calculus-differentiate-with-respect-to-anything/).
6. An introduction solving differential equations numerically. (2022, May 27). ML Fundamentals. https://ataspinar.com/2022/04/05/an-introduction-solving-differential-equations-numerically/

ENGINEERING PHYSICS-I (PH-101/1843)

L T P
2 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Relativistic Mechanics
2. Understand the Interference and Diffraction
3. Understand the polarization
4. Understand basics of Fiber Optics and Holography

Unit I:

Relativistic Mechanics: Inertial & non-inertial frames, Michelson-Morley experiment, Einsteins postulates, Lorentz transformation equations, Length contraction & Time dilation, Addition of velocities, Variation of mass with velocity Mass energy equivalence.

Unit II:

Optics: Interference: Interference of light, Biprism experiment, Displacement of fringes, Interference in thin films- wedge shaped film, Newton's rings

Diffraction: Single, Double & N-Slit diffraction grating, Grating spectra, Rayleigh's criterion and resolving power of grating.

Unit III:

Polarization: Phenomena of double refraction, Nicol prism, Production and analysis of plane, Circular and elliptical polarized light, Fresnel's theory of optical activity, Polarimeters.

Laser: Spontaneous and stimulated emission of radiation, Einstein's Coefficients, construction and working of Ruby, He-Ne lasers and laser applications.

Unit IV:

Fiber Optics and Holography: Fundamental ideas about optical fiber, Types of fibers, Acceptance angle and cone, Numerical aperture, Propagation mechanism and communication in optical fiber, Attenuation, Signal loss in optical fibre and dispersion.

Basic Principle of Holography, Construction and reconstruction of Image on hologram and Applications of holography.

Reference books:

1. Beiser, A. (1987). Concepts of Modern Physics. McGraw-Hill Education.
2. Resnick, R. (2022). Introduction to Special Relativity, An Indian Adaptation (1st ed.). WILEY INDIA.
3. Ghatak, A. K. (2017). Optics. McGraw-Hill Education.
4. De, A. (2022). Optical Fibre and Laser. New Age International Publisher.
5. Wiley Editorial. (2020). Halliday/Resnick/Walker Physics for JEE Main, Vol – I, Wiley Publisher
6. Serway, R. A., & Jewett, J. W. (2015). Physics for Scientists and Engineers, Vol-1, Technology Update (9th ed.). Brooks/Cole Pub Co.
7. Prasad, S., NptelIitm. https://nptel.ac.in/courses/115101011

PHYSICS LAB (PH-151/10859)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand the use and application of monochromatic light
2. Understand the polarisation and reflection and diffration

List of Experiments

Any ten experiments, at least four from each group.

Group A

1. To determine the wavelength of monochromatic light by Newton's ring.
2. To determine the wavelength of monochromatic light with the help of Fresnel's biprism.
3. To determine the focal length of two lenses by nodal slide and locate the position of cardinal points.
4. To determine the specific rotation of cane sugar solution using polarimeter.
5. To determine the wavelength of spectral lines using plane transmission grating.
6. To study the polarization of light by simple reflection using laser.
7. Measurement of Wavelength of a laser (He- Ne) light using single slit diffraction.

Group B

1. To determine the specific resistance of a given wire using Carey Foster's bridge.
2. To study the variation of magnetic field along the axis of current carrying Circular coil and then to estimate the radius of the coil.
3. To verify Stefan's Law by electrical method.
4. To calibrate the given ammeter and voltmeter by potentiometer.
5. To study the Hall Effect and determine Hall coefficient, carrier density and - mobility of
1. a given semiconductor using Hall Effect set up.
6. To determine the energy band gap of a given semiconductor material.
7. To determine E.C.E. of copper using Tangent or Helmholtz galvanometer.
8. To draw hysteresis curve of a given sample of ferromagnetic material and from - this to determine magnetic susceptibility and permeability of the given specimen.
9. To determine the ballistic constant of a ballistic galvanometer.
10. To determine the coefficient of viscosity of a liquid.
11. Measurement of fiber attenuation and aperture of fiber.
12. High resistance by leakage method.
13. Magnetic Susceptibility of paramagnetic solution.

Reference books:

1. Gupta, S.L., & Kumar, V. (2020). Physics Practical-II (Thermal Properties of Matter & Electronics Circuits. Pragati Prakashan.
2. Arora, C. L. (2010). B.Sc. Practical Physics. S Chand & Co Ltd.
3. Gupta, S.K. (2015). Engineering Physics Practical. Krishna Prakashan Media
4. To determine wavelength of sodium light using Newton’s Rings. (2015, February 1). E-manuals. https://emanualz.wordpress.com/to-determine-wavelength-of-sodium-light-using-newtons-rings/
5. Das, A.K. NPTEL :: Physics - NOC:Experimental Physics I. https://archive.nptel.ac.in/courses/115/105/115105110/

ENGINEERING CHEMISTRY(CY-102/1844)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Chemical bonding and states of matter
2. Understand the Reaction kinetics, phase rule and electrochemistry
3. Understand the Structural and mechanistic concepts of organics
4. Understand basics of Polymers and organometallics
5. Understand the Analytical methods and fuels

UNIT I:

Chemical bonding and states of matter: M.O. theory and its applications in diatonic molecules. Hydrogen bond, metallic bond and their applications. Various states of matter including liquid crystallite state, classification and applications of liquid crystals. Types of unit cell, space lattice (only cubes, Bragg's Law.) Calculation and density of the unit cell, one and two dimensional solids such as graphite and its conduction properties. Fullerenes and their applications.

UNIT II:

Reaction kinetics, phase rule and electrochemistry: Order and molecularity of reactions, Zero order, first order and second order reactions. Integrated rate equations. Theories of reaction rates. Phase rule and its applications to one component system (water). Equilibrium potential, electrochemical cells, galvanic and concentration cells, electrochemical theory of corrosion and protection of corrosion. Fuel cells.

UNIT III:

Structural and mechanistic concepts of organics: Inductive, electromericmesomeric and hyperconjugative effects. Stability of reaction intermediates e.g. carbocation and free radicals. Mechanism of nucleophilic substitutions. Mechanism of the following reactions:

1. Aldol condensation 2. Cannizaro reaction 3. Beckman rearrangement 4. Hoffmann rearrangement and 5. Diels-Alder reaction.

E-Z nomenclature, R.S. configuration, optical isomerism, chirality and its implications, conformations of butene.

UNIT IV:

Polymers and organometallics: Polymerization and its classification. Thermoplastic and Thermosetting resins. Eleastomers and synthetic fibres. Ion exchange resins. Organic conducting and biodegradable polymers. Classification and general methods of synthesis of organics and their applications in polymerizations and catalysis.

UNIT V:

Analytical methods and fuels: Titrimetric analysis with reference to acid-base, redox, precipitations and complexometric titrations. Elementary ideas and simple applications of u.v., visible, infra-red and HNMR spectral techniques. Water treatment methods for boiler feed water by calgon process, zeolites and ion-exchange Classification of fuels. Analysis of coal, determination of colorific values.Biomass and biogas.

Reference books:

1. Cotton, F. A., Wilkinson, G., Murrillo, C. A., & Bochmann, M. (2007). Advanced Inorganic Chemistry (6th ed.). Wiley.
2. Smith, M. B. (2015). Marchs Advanced Organic Chemistry: Reactions, Mechanisms And Structure, (7th ed.). Wiley.
3. Atkins, P., & Paula, J. (2017). Elements Physical Chemistry (7th ed.). Oxford India.
4. Finar, I. L. (2022). Organic Chemistry, Vol 11, (5th ed.). Pearson India.
5. Gray, G. W., & Winsor, P. A. (1974). Liquid Crystals & Plastic Crystals (Analytical Chemistry of the Elements). Ellis Horwood, Ltd.
6. Samuelson, A.G. Introduction to Organometallic Chemistry, IISc Bangalore, NptelIitm. https://nptel.ac.in/courses/104108062

ENGINEERING CHEMISTRY LAB (CY -151/10853)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand and determine different solute present in given water sample by different menhod
2. Understand the pH-metric titration
3. Signifricance of viscocity and use of viscometer

List of Experiments

1. Determination of alkalinity in the given water sample.
2. Determination of temporary and permanent hardness in water sample using EDTA as standard solution.
3. Determination of available chlorine in bleaching powder.
4. Determination of chloride content in bleaching powder.
5. Determination of iron content in the given water sample by Mohr's methods.
6. PH-metric titration.
7. Determination of Equivalent weight of iron by the chemical displacement method. The equivalent weight of copper is 63.5.
8. Viscosity of an addition polymer like polyester by Viscometer.
9. Determination of iron concentration in sample of water by colorimetric method. The method involves the use of KSCN as a color developing agent and the measurements are carried out at 2 max 480nm.
10. Element detection and functional group identification in organic compounds.
11. Preparation of Bakelite resin.

Reference books:

1. Kum, M. R. (2022). Engineering Chemistry With Laboratory Experiments (1st ed.). PRENTICE HALL.
2. Determination of Available Chlorine in Bleaching Powder, Environmental Science and Engineering Laboratory Methodology, Biocyclopedia.com. (2022). https://biocyclopedia.com/index/enivronmental_science_engineering_laboratory_methodology/determination_of_available_chlorine_in_bleaching_powder.php
3. Chemistry, A. A. (2021, June 27). Detection of Functional Groups in Organic Compounds. All About Chemistry. https://www.allaboutchemistry.net/detection-of-functional-groups-in-organic-compounds/
4. Selvaraj, S. (2016). Practical Engineering Chemistry: Laboratory Manual. LAP LAMBERT Academic Publishing.
5. Jaspal, D., & Malviya, A. (2015). Engineering Chemistry: Practical Book. Alpha Science International

ELECTRICAL ENGINEERING (EE-101/1848)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of D C Circuit Analysis and Network Theorems
2. Understand the Steady-State Analysis of Single-Phase AC Circuits
3. Understand the Three Phase AC Circuits
4. Understand basics of Power System
5. Understand the Electrical Machines

UNIT I:

D C Circuit Analysis and Network Theorems: Circuit Concepts: Concepts of network, Active and passive elements, voltage and current sources, concept of linearity and linear network, unilateral and bilateral elements, R, L and C as linear elements, source transformation. Kirchhoff's laws; loop and nodal methods of analysis; star-delta transformation; Network Theorems: Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer Theorem (simple numerical problems).

UNIT II:

Steady-State Analysis of Single-Phase AC Circuits: AC Fundamentals: Sinusoidal, square and triangular waveforms - average and effective values, form and peak factors, concept of phasors, phasor representation of sinusoidally varying voltage and current. Analysis of series, parallel and series-parallel RLC Circuits: apparent, active & reactive powers, power factor, causes and problems of low power factor, power factor improvement; resonance in series and parallel circuits, bandwidth and quality factor (simple numerical problems).

UNIT III:

Three Phase AC Circuits: Three phase system-its necessity and advantages, meaning of phase sequence, star and delta connections, balanced supply and balanced load, line and phase voltage/current relations, three-phase power and its measurement (simple numerical problems). **Measuring Instruments:** Types of instruments, construction and working principles of PMMC and moving iron type voltmeters & ammeters, single phase dynamometer wattmeter and induction type energy meter, use of shunts and multipliers (simple numerical problems on energy meter, shunts and multipliers).

UNIT IV:

Introduction to Power System: General layout of electrical power system and functions of its elements, standard transmission and distribution voltages, concept of grid (elementary treatment only). **Magnetic Circuit**: Magnetic circuit concepts, analogy between electric & magnetic circuits, magnetic circuits with DC and AC excitations, magnetic leakage, B-H curve, hysteresis and eddy current losses, magnetic circuit calculations, mutual coupling.**Single Phase Transformer:** Principle of operation, construction, e.m. equation, equivalent circuit, power losses, efficiency (simple numerical problems), introduction to auto transformer.

UNIT-V:

Electrical Machines: Principles of electro mechanical energy conversion, DC machines: types, e.m.f. equation of generator and torque equation of motor, characteristics and applications of dc motors (simple numerical problems).**Three Phase Induction Motor:** types, Principle of operation, slip-torque characteristics, applications (numerical problems related to slip only).**Single Phase Induction motor:** Principle of operation and introduction to methods of starting, applications.**Three Phase Synchronous Machines:** Principle of operation of alternator and synchronous motor and their applications.

Reference books:

1. Toro, D. (2022). Electrical Engineering Fundamental (2nd ed.). PEARSON INDIA.
2. Nagrath, I.J., & Kothari, D.P. (2022). Basic Electrical Engineering. MC GRAW HILL INDIA.
3. Fitzgerald, A. E., Higginbotham, D. E., & Grabel, A. (2017). Basic Electrical Engineering (5th ed.). McGraw-Hill Education.
4. Hughes, E. (1969). Electrical technology (A Longman text) (4th ed.). Longman.
5. Bhattacharya, T. K., Electrical Machines-II, IIT Kharagpur, NptelIitkgp (https://nptel.ac.in/courses/108105131).

ELECTRICAL ENGINEERING LAB (EE-151/10855)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Kirchhoff's laws
2. Understand the transistor as a switch.
3. Understand the Three Phase AC Circuits
4. Understand basics of Power System
5. Understand the Electrical Machines

List of Experiments:

Note: A minimum of 10 experiments from the following should be performed

1. Verification of Kirchhoff's laws

2. Verification of (i) Superposition theorem (ii) The venin's Theorem (iii) Maximum Power Transfer Theorem.

3. Measurement of power and power factor in a single-phase ac series inductive circuit and study improvement of power factor using capacitor

4. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.

5. Measurement of power in 3- phases circuit by two wattmeter method and determination of its power factor.

6. Determination of parameters of ac single phase series RLC circuit

7. Determination of (i) Voltage ratio (ii) polarity and (iii) efficiency by load test of a single phase transformer

8. To study speed control of dc shunt motor using (i) armature voltage control (ii) field flux control.

9. Determination of efficiency of a dc shunt motor by load test

10. To study running and speed reversal of a three-phase induction motor and record speed in both directions.

11. To measure energy by a single-phase energy meter and determine error.

12. To study P-N diode characteristics

13. To study full wave and half wave rectifier circuits with and without capacitor and determine ripple factors.

14. To study various logic gates (TTL)

15. To study Operational Amplifier as Adder and Sub tractor

16. To study transistor as a switch.

Reference books:

1. Dhogal, K. S. & Dhogal, D.S. (2004). Basic Practical In Electrical Engineering. Macmillan Publishers.
2. Bhatia, S. L. (2022). Handbook of Electrical Engineering. Khanna Publisher.
3. Series RLC Circuit Analysis. (2020, February 16). Electronics-Lab.com. https://www.electronics-lab.com/article/series-rlc-circuit-analysis/
4. NPTEL :: Electrical Engineering - Electrical Machines -I. https://archive.nptel.ac.in/courses/108/105/108105017/
5. Verification of Maximum Power Transfer Theorem. (2022, June 15). Electronics for You. https://electronicsforyou.in/verification-of-maximum-power-transfer-theorem/

ELECTRONICS ENGINEERING (EC-101/1848)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Semiconductor Diodes and Applications
2. Understand the Bipolar Junction Transistor (BJT)
3. Understand the Field Effect Transistor (FET)
4. Understand basics of Switching Theory and Logic Design (STLD)
5. Understand the Electronics Instruments

Unit I:

Semiconductor Diodes and Applications: P-n junction, depletion layer, v-i characteristics, ideal and practical, diode resistance, capacitance, diode ratings (average current, repetitive peak current, peak-inverse voltage), p-n junction as rectifiers (half wave and full wave), filter (Shunt capacitor filter), calculation of ripple factor and load regulation, clippling circuits, clamping circuits, voltage multipliers

Breakdown diodes: Breakdown mechanism (zener and avalanche), kdown characteristics, zener resistance, zener diode ratings, zener diode application as shunt regulator

Unit II:

Bipolar Junction Transistor (BJT): Basic construction, transistor action, CB, CE and CC configurations, input/ output characteristics, biasing of transistors, fixed bias, emitter bias, potential divider bias, comparison of biasing circuits, graphical analysis of CE amplifier, concept of voltage gain, current gain, h-parameter model (low freq), computation of Ai, Av, Ri, Ro of single transistorCE amplifier configuration

Unit III:

Field Effect Transistor (FET): JFET: Basic construction, principle of working, concept of pinch-off, maximum drain saturation current, input and transfer characteristics, characteristic equation, CG, CS and CD configurations, fixed and self-biasing of JFET amplifier

MOSFET: depletion and enhancement type MOSFET- construction, operation and characteristics Operational Amplifier (Op-Amp): concept of ideal operational amplifier, ideal and practical Op-Amp parameters, inverting, non-inverting and unity gain configurations, applications of Op-Amp as adders, difference amplifiers, integrators and differentiator.

Unit IV:

Switching Theory and Logic Design (STLD): Number system, conversion of bases (decimal, binary, octal and hexadecimal numbers) addition and subtraction, fractional numbers, BCD numbers, Boolean algebra, logic gates, concept of universal gates, canonical forms, minimization using K-map (don't care conditions)

Unit V:

Electronics Instruments: Working principle of digital voltmeter, digital multimeter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO

Reference books:

1. Boylestad, R., & Nashelsky, L. (2007). Electronic Devices And Circuit Theory (9th ed.). Pearson Education.
2. Bell, D. A. (2009). Fundamentals of Electronic Devices and Circuits (5th ed.). Oxford University Press.
3. Millman, J., & Halkias, C. C. (1985). Electronic Devices and Circuits. McGraw-Hill Education.
4. Pejović, M., & Pejovic, M. M. (2017). Different Types of Field-Effect Transistors: Theory and Applications. IntechOpen.
5. Kumar, A. (2022). Switching Theory and Logic Design (3rd ed.). PHI LEARNING PVT. LTD.
6. Cathode Ray Oscilloscope (CRO) : Block Diagram & Its Applications. (2022, June 20). WatElectronics.com. https://www.watelectronics.com/cathode-ray-oscilloscope/

REMEDIAL BIOLOGY-1 (BT-101/1852)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Diversity in living World
2. Understand the classification of animal and plant
3. Understand the Structural Organization of animals and plants
4. Understand basics of plant and animal cell structure
5. Understand the Plant Physiology

UNIT I:

Diversity in living World. Diversity of living organism. Classification of the living organisms (five kingdom classification, major groups and principles of classification within each kingdom) Systematic and binomial System of nomenclature.

UNIT II:

Salient features of animal and plant classification, viruses, viroid. lichens, Botanical gardens, herbaria, zoological parks and museums.

UNIT III:

Structural Organization. Tissues in animals and plants. Morphology, anatomy and functions of different parts of flowering plants. Root, stem, leaf, inflorescence, flower, fruit and seed.

UNIT IV:

Cell: Structure and Function Cell: Cell theory, Prokaryotic and Eukaryotic cell, cell wall. cell membrane, Nucleus and nuclear organization, Mitosis, Meiosis, Cell Cycle (elementary idea) Basic chemical constituents of living bodies.

UNIT V:

Plant Physiology. Movement of water, food, nutrients and gases, Respiration, Photosynthesis, Plant growth and development.

Reference books:

1. Aggarwal, S. A Textbook of CBSE Biology For Class XI. Van Haren Publishing.
2. Aggarwal, S. A Textbook of CBSE Biology For Class XII (Revised Edition). Van Haren Publishing.
3. Raven, P., Johnson, G., Mason, K., Losos, J., & Singer, S. (2013). EBOOK: Biology. McGraw-Hill Education.
4. Khan Y.S., Farhana A. Histology, Cell. [Updated 2022 May 8]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK554382/
5. MacDougal, D. T. (2016). Practical Text-book of Plant Physiology. Palala Press.

MANUFACTURING PROCESSES (ME-102/1850)

L T P
2 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of metals & alloys
2. Understand the metal forming & casting process
3. Understand the machining & welding
4. Understand basics of Manufacturing

Unit I:

Basic metals & alloys: properties and applications:

Properties of Materials: Strength, elasticity, stiffness, malleability, ductility, brittleness, toughness and hardness. Elementary ideas of fracture, fatigue & creep. **Ferrous Materials**: Carbon steels, its classification based on % carbon as low, mild, medium & high carbon steel, its properties & applications. Wrought iron. Cast iron. Alloy steels: stainless steel, tool steel. Elementary introduction to Heat treatment of carbon steels: annealing, normalizing, quenching & tempering and case-hardening. **Non-Ferrous metals & alloys**: Common uses of various non-ferrous metals & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys such as Duralumin.

Unit II:

Introduction to metal forming & casting process and its applications:

Metal Forming: Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube drawing/making and Extrusion, and its products/applications. Press-work, & die & punch assembly, cutting and forming, its applications. Hot-working versus cold-working. **Casting:** Pattern & allowances. Molding sands and its desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Die-casting and its uses.

Unit III:

Introduction to machining & welding and its applications:

Machining: Basic principles of Lathe-machine and operations performed on it.Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding. **Welding:** Importance & basic concepts of welding, classification of welding processes. Gas-welding, types of flames. Electric-Arc welding. Resistance welding. Soldering & Brazing and its uses.

Unit IV:

Misc. Topics: Manufacturing: Importance of Materials & Manufacturing towards Technological & Socio-Economic developments. Plant location. Plant layout - its types. Types of Production. production versus Productivity. Non-Metallic Materials: Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and composite-materials Misc. Processes: Powder-metallurgy process & its applications, Plastic-products manufacturing, Galvanizing and Electroplating.

Text books:

1. Schmid, K. (2018). Manufacturing Engineering & Technology (7th ed.). Pearson India.
2. Sharma, S. K., & Sharma, S. (2010). Manufacturing Processes. I K International Publishing House.
3. Dave, H. K., & Nedelcu, D. (2020). Advances in Manufacturing Processes: Select Proceedings of RAM 2020 (Lecture Notes in Mechanical Engineering) (1st ed. 2021). Springer.
4. Form, D. R. (2022, October 31). Metal Forming Processes: Techniques, Industries, & Uses. https://blog.dahlstromrollform.com/metal-forming-processes-guide
5. What is Welding? - Definition, Processes and Types of Welds. TWI. https://www.twi-global.com/technical-knowledge/faqs/what-is-welding

WORKSHOP PRACTICE (WS-151/10857)

L T P
0 0 2

1. **Carpentry shop:**
   a. Study of tools & operations and carpentry joints.
   b. Simple exercise using jack plane.
   c. To prepare half-lap corner joint, mortise & tendon joints.
   d. Simple exercise on woodworking lathe.
2. **Fitting bench working shop:**
   a. Study of tools & operations.
   b. Simple exercises involving fitting work.
   c. Make perfect male-female joint.
   d. Simple exercises involving drilling/tapping/dieing.
3. **Black smithy shop:**
   a. Study of tools & operations.
   b. Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.
4. **Welding shop:**
   a. Study of tools & operations of Gas welding & Arc welding
   b. Simple butt and Lap welded joints.
   c. Oxy-acetylene flame cutting.
5. **Sheet-metal shop:**
   a. Study of tools & operations.
   b. Making Funnel complete with 'soldering'.
   c. Fabrication of tool-box, tray, electric panel box etc.
6. **Machine shop:**
   a. Study of machine tools and operations.
   b. Plane turning
   c. Step turning
   d. Taper turning
   e. Threading
   f. Single point cutting tool grinding
7. **Foundry shop:**
   a. Study of tools & operations
   b. Pattern making
   c. Mould making with the use of a core
   d. Casting

Text Book:

1. Garg, S. K. (2022). Workshop Technology (Manufacturing Process) (3rd Revised edition). Laxmi Publications.
2. John, K. C. (2010). Mechanical Workshop Practice. PHI Learning.
3. Bridigum, T. (2008). How To Weld (Motorbooks Workshop) (1st ed.). Motorbooks.
4. Bowman, M. (2015). Sheet Metal Work (Crowood Metalworking Guides) (Illustrated). The Crowood Press.
5. Schwarz, C., & Woodworking, P. (2017). The Practical Workshop: A Woodworker's Guide to Workbenches, Layout & Tools (Illustrated). Popular Woodworking Books.

II

SEMESTER

REMEDIAL BIOLOGY –II (BT-202/1866)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Digestion and absorption
2. Understand the Neural control and coordination
3. Understand the Structural Organization of Reproductive system
4. Understand basics of plant and animal cell structure
5. Understand the Origin of life

UNIT I:

Human Physiology I: Digestion and absorption. Breathing and respiration. Body fluids and circulation.

UNIT II:

Human Physiology II: Neural control and coordination, chemical coordination and regulation

UNIT III:

Reproduction: Reproductive system in male and female, menstrual cycle, production of gametes, fertilization, embryo development.

UNIT IV:

Reproductive health& human welfare: Population and birth control, sexually transmitted diseases, infertility. Cancer and AIDS. Adolescence and drug / alcohol abuse. Basic concepts of immunology, vaccines.

UNIT V:

Evolution: Evolution: Origin of life, theories and evidences, adaptive radiation, mechanism of Evolution, origin and evolution of man

Reference books.

1. Aggarwal, S. A Textbook of CBSE Biology For Class XI. Van Haren Publishing.
2. Aggarwal, S. A Textbook of CBSE Biology For Class XII (Revised Edition). Van Haren Publishing.
3. Raven, P., Johnson, G., Mason, K., Losos, J., & Singer, S. (2013). EBOOK: Biology. McGraw-Hill Education.
4. Pocock, G., Richards, C. D., & Daly, B. D. M. (2004). Human Physiology: The Basis of Medicine (Oxford Core Texts) (2nd ed.). Oxford University Press.
5. A Textbook of Human Physiology. (2004). Dreamtech Press.
6. Marieb, E. N., & Hoehn, K. (2019). Human Anatomy & Physiology. Pearson Education, Incorporated.
7. Biology XI Part-II - Course. https://onlinecourses.swayam2.ac.in/nce21_sc05/preview

ELEMENTARY MATHEMATICS- II (MA-202/1856)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Sequence and sereis
2. Understand the Matrix
3. Understand the Coordinate geometery
4. Understand basics of Vectors and Scalars
5. Understand the Differential calculus

UNIT I:

Sequence and sereis: Sequence and Series, Arithmetic progression(A.P),Arithmetic Mean (A.M), geometric mean (G.M), Geometric progression(G.P),general term of an A.P. and G.P., sum of n terms of an A.P and G.P, sum of an infinite , Harmonic progression (H.P), Properties of A.M., G.M., permutations and combinations , Partial Fractions.

UNIT II:

Matrix: Types of matrices, addition, substraction, multiplication and transpose of matrix, Adjoint and inverse of matrix, application of matrix in solving equations , Determinants and its properties, application of determinants of insolutions of linear equations , elementary row and column transformation, rank of matrix, eigen values and eigen vector, Cayley Hamilton theorem (without proof).

UNIT III:

Coordinate geometery: Distance between two points, area of triangle, section formula, equation of a straight line, Slope of a line and angle between two lines, Equations of a line parallel to axis, different forms of the equation of a straight line, Standard equation of a circle, ellipse, parabola and hyperbola .

UNIT IV:

Vectors: Vectors and Scalars, magnitude and direction of a vector, equality of vectors, Types of vectors(equal, unit, zero, parallel and collinear vectors),Addition of vectors, scalar (dot product of vectors), Scalar product in term of components, Scalar triple product, scalar triple products in terms of components, vector differentiation, vector differential operator, gradient, divergence and curl .

UNIT V:

Differential calculus II: Successive differentiation, lebinitiz theorem (without proof), partial differentiation, Euler's theorem on homogenous functions, Expansion of several variables, Taylor's series of two variables (without proof), jacobians.

References:

1. Dass, H. K. (2011). S Chand Higher Engineering Mathematics. S Chand.
2. Sharma, R.D. (2020) Objective Mathematics. Dhanpat Rai Publications.
3. Cristina, S. (2021). Differential and Integral Calculus – Differentiate with Respect to Anything. (https://machinelearningmastery.com/differential-and-integral-calculus-differentiate-with-respect-to-anything/).
4. Ramana, B. V. (2022). Higher Engineering Mathematics (1st ed.). MC GRAW HILL INDIA.
5. Chandra, P., Lal, A.K., Raghavendra, V., Santhanam, G. Mathematics II, IIT Kanpur, https://nptel.ac.in/courses/122104018

ENGINEERING PHYSICS-II (PH-201/1857)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Wave mechanics and x-ray diffraction
2. Understand the Dielectric and magnetic properties of materials
3. Understand the Electromagnetics:
4. Understand basics of Superconductivity and science and technology of nanomaterials

Unit I:

Wave mechanics and x-ray diffraction: Wave- particle duality, de-Broglie matter waves, Phase and Group velocities, Davisson-Germer experiment, Heisenberg uncertainty principle and its applications, Wave function and its significance, Schrödinger's wave equation - particle in one dimensional box. Diffraction of X-rays by crystal planes, Bragg's spectrometer, Compton's effect.

Unit II:

Dielectric and magnetic properties of materials: Dielectric constant and Polarization of dielectric materials, Types of Polarization (Polarizability). Equation of internal fields in liquid and solid (One-Dimensional), Claussius Mussoti-Equation, Ferro and Piezo electricity (Qualitative), Frequency dependence of dielectric constant, Dielectric Losses, Important applications of dielectric material, Langevin's theory for dia and paramagnetic material, Phenomena of hysteresis and its applications.
Ultrasonic: Generation, detection and application of ultrasonics

Unit III:

Electromagnetics: Displacement Current, Maxwell's Equations (Integral and Differential Forms). Equation of continuity, EM-Wave equation and its propagation characteristics in free space and in conducting media, Poynting theorem and Poynting vectors.

Unit IV:

Superconductivity and science and technology of nanomaterials: Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, Temperature dependence of critical field, BCS theory (Qualitative), High temperature superconductors. Characteristics of superconductors in superconducting state, Applications of Super-conductors. Introduction to Nanomaterials- Basic principle of nanoscience and technology, creation and use of buckyballs, structure, properties and uses of Carbon nanotubes, Applications of nanotechnology.

Reference books:

1. Beiser, A., Mahajan, S., & Choudhury, S. R. (2003). Concepts of Modern Physics. McGraw-Hill Education.
2. Kittel, C., McEuen, P., & John Wiley & Sons. (2019). Introduction to Solid State Physics. Wiley.
3. Raghavan, V. (2022). Materials Science & Engineering (2nd ed.). Prentice Hall of India.
4. Pillai, S. O. (2006). Modern Physics And Solid State Physics (problems And Solutions). New Age International.
5. Booker, R. D., & Boysen, E. (2011). Nanotechnology For Dummies. Wiley.
6. Griffiths, D. J. (2013). Introduction to Electrodynamics. Pearson India Education Services.
7. Fowler, M., Maxwell Eqns, EM Waves. http://galileo.phys.virginia.edu/classes/109N/more_stuff/Maxwell_Eq.html

ENGINEERING MECHANICS (ME- 201/1859)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Two dimensional force systems
2. Understand the Beam
3. Understand the Centroid and moment of inertia:
4. Understand basics of Kinematics of rigid body
5. Understand basics of Simple stress and strain

UNIT I:

Two dimensional force systems: Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent and Non-concurrent Force systems, Distributed force system, Free body diagrams, Equilibrium and Equations Equilibrium, Applications.

Friction: Introduction, Laws Coulomb Friction, Equilibrium of Bodies involving Dry-friction, Belt friction, Application.

UNIT II:

Beam: Introduction, Shear force and Bending Moment, Differential Equations for Equilibrium, Shear force and Bending Moment Diagrams for Statically Determinate Beams. **Trusses:** Introduction, Simple Truss and Solution of Simple truss, Method of Joints and Method of Sections.

UNIT III:

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area, Parallel Axes Theorem, Perpendicular axes theorems, Principal Moment Inertia, Mass Moment of Inertia of Circular Ring, Disc, Cylinder, Sphere and Cone about their Axis of Symmetry.

UNIT IV:

Kinematics of rigid body: Introduction, Plane Motion of Rigid Body, Velocity and Acceleration under Translation and Rotational Motion, Relative Velocity.

Kinetics of rigid body: Introduction, Force, Mass and Acceleration, Work and Energy, Impulse and Momentum, D'Alembert's Principles and Dynamic Equilibrium.

UNIT V:

Simple stress and strain: Introduction, Normal and Shear stresses, Stress Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy.

Pure bending of beams: Introduction, Simple Bending Theory, Stress in beams of different cross sections.

Torsion: Introduction, Torsion of shafts of circular section, torque and twist, shear Stress due to torque.

Text Books:

1. Shames, I. H. (1959). Engineering Mechanics. Prentice Hall, Upper Saddle River, New Jersey.
2. Mubeen, A. (2022). Mechanics of Solids (2nd ed.). PEARSON INDIA.
3. Popov, E. P. (1976). Mechanics of Materials (Facsimile). Prentice Hall.
4. Harbola, M.K., Engineering Mechanics, IIT Kanpur, https://nptel.ac.in/courses/122104014
5. Singh, D.K. (2021). Centroid and Moment of Inertia. In: Strength of Materials. Springer, Cham. https://doi.org/10.1007/978-3-030-59667-5_3

ENGINEERING MECHANICS LAB (ME- 251/10868)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand the concept of the reactions at the support of a simply supported beam.
2. Understand the law of machine of single purchase crab, double purchase crab, and differential axle and wheel.
3. Check the stability of Various force systems.
4. To understand the moment of inertia concept.
5. Apply the principles of friction in various conditions.

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.
2. To determine the compression test and determine the ultimate compressive strength for a specimen
3. To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the toughness.
4. To determine the hardness of the given specimen using Vickers/Brinell/Rockwell hardness testing machine.
5. To study the slider-crank mechanism etc. of 2-stroke & 4-stroke I.C. Engine models.
6. Friction experiment(s) on inclined plane and/or on screw-jack.
7. Simple & compound gear-train experiment.
8. Worm & worm-wheel experiment for load lifting.
9. Belt-Pulley experiment.
10. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
11. Torsion of rod/wire experiment.
12. Experiment on Trusses.
13. Statics experiment on equilibrium
14. Dynamics experiment on momentum conservation
15. Dynamics experiment on collision for determining coefficient of restitution.
16. Experiment on Moment of Inertia.

(Any ten experiments from the above list or institute may suitably design experiments)

Reference books:

1. Gupta, A. K. (2015). Engineering Mechanics Lab Manual. SENTIFIC.
2. Ramesh, K. Engineering Mechanics, IIT Madras, https://nptel.ac.in/courses/112106286
3. Obianyo, Ifeyinwa. (2019). Laboratory Manual For Hardness Test.
4. Curtis, P. T. (2000). Durability Testing of Polymer Composites. In: Comprehensive Composite Materials, 163–182. https://doi.org/10.1016/b0-08-042993-9/00038-3
5. Kelly, A. (2000). Comprehensive Composite Materials (1st ed.). Pergamon.

COMPUTER CONCEPTS AND PROGRAMMING IN C (CS-201/1861)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Operating System
2. Understand the Standard I/O in "C"
3. Understand the Conditional program execution
4. Understand basics of Arrays
5. Understand basics of Sequential search

UNIT I:

Introduction to any Operating System [Unix, Linux, Windows], Programming Environment, Write and Execute the first program, Introduction to the Digital Computer; Concept of an algorithm; termination and correctness. Algorithms to programs: specification, top-down development and stepwise refinement. Introduction to Programming, Use of high level programming language for the systematic development of programs. Introduction to the design and implementation of correct, efficient and maintainable programs, Structured Programming, Trace an algorithm to depict the logic, Number Systems and conversion methods.

UNIT II:

Standard I/O in "C", Fundamental Data Types and Storage Classes: Character types, Integer, short, long, unsigned, single and double-precision floating point, storage classes, automatic, register, static and external, Operators and Expressions: Using numeric and relational operators, mixed operands and type conversion, Logical operators, Bit operations, Operator precedence and associativity.

UNIT III:

Conditional program execution: Applying if and switch statements, nesting if and else, restrictions on switch values, use of break and default with switch, Program Loops and Iteration: Uses of while, do and for loops, multiple loop variables, assignment operators, using break and continue, Modular Programming: Passing arguments by value, scope rules and global variables, separate compilation, and linkage, building your own modules.

UNIT IV:

Arrays: Array notation and representation, manipulating array elements,using multidimensional arrays, arrays of unknown or varying size, **Structures:** Purpose and usage of structures, declaring structures, assigning of structures, **Pointers to Objects:** Pointer and address arithmetic, pointer operations and declarations, using pointers as function arguments, Dynamic memory allocation, defining and using stacks and linked lists.

UNIT V:

Sequential search, Sorting arrays, Strings, Text files, **The Standard C Pre-processor:** Defining and calling macros, utilizing conditional compilation, passing values to the compiler, **The Standard C Library:** Input/output: open, read, etc, string handling functions, Math functions: log, sin, alike Other Standard C functions.

Text books:

1. Koffman, E. B., & Hanly, J. R. (2022). Problem Solving And Program Design in C (5th ed.). Addison-Wesley.
2. Forouzan, B. A., & Gilberg, R. F. (2007). Computer Science: A Structured Programming Approach Using C (3rd ed.). Cengage India.
3. Kanetkar, Y. (2017). Computer System and Programming in C. BPB Publications.
4. Kernighan, B. W., & Ritchie, D. M. (2022). The C Programming Language (2nd ed.). PEARSON INDIA.
5. Perry, G., & Miller, D. (2013). C Programming Absolute Beginner's Guide (3rd ed.). Que Publishing.

COMPUTER PROGRAMMING LAB (CS-251/10870)

L T P
0 0 3

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of computer and the environment and execution of sample programs
2. Understand the Conditional program execution
3. Understand basics of Arrays
4. Understand basics of Sequential search and data structure

Suggested Assignments to be conducted on a 3-hour slot. It will be conducted in tandem with the theory course so the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course should appropriately be sequenced for synchronization with the laboratory. A sample sequence of topics and lab classes for the topic are given below:

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Linked lists
10. Data structures

It is suggested that some problems related to continuous domain problems in engineering and their numerical solutions are given as laboratory assignments. It may be noted that some of basic numerical methods are taught in the Mathematics course.

Text Books:

1. Kanetkar, Y. (2017). Computer System and Programming in C. BPB Publications.
2. Learn C Programming. https://www.programiz.com/c-programming
3. Schildt, H. (2000). C: The Complete Reference. McGraw-Hill Education.
4. Rajaraman, V. (1994). *Computer Programming in C* (1st ed.). Prentice Hall India Learning Private Limited.
5. Dixit, J. B. (2022). *Computer Fundamentals And Programming In C*. Laxmi Publications-New Delhi.
6. GeeksforGeeks. C Programming Language. https://www.geeksforgeeks.org/c-programming-language/

PROFESSIONAL COMMUNICATION (HU-201/1863)

L T P
3 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of Basics of technical communication
2. Understand the Constituents of technical written communication
3. Understand the Forms of technical communication:
4. Understand basics of Presentation strategies
5. Understand basics of Value-based text readings

Unit I:

Basics of technical communication: Technical Communication: features; Distinction between General and Technical communication; Language as a tool of communication; Levels of communication: Interpersonal, Organizational, Mass communication; The flow of Communication: Downward, Upward, Lateral or Horizontal (Peer group); Importance of technical communication; Barriers to Communication.

Unit II:

Constituents of technical written communication: Words and Phrases: Word formation. Synonyms and Antonyms; Homophones; Select vocabulary of about 500-1000 New words; Requisites of Sentence Construction: Paragraph Development: Techniques and Methods -Inductive, Deductive, Spatial, Linear, Chronological etc; The Art of Condensation- various steps.

Unit III:

Forms of technical communication: Business Letters: Sales and Credit letters; Letter of Enquiry; Letter of Quotation, Order, Claim and Adjustment Letters; Job application and Resumes. Official Letters: D.O. Letters; Govt. Letters, Letters to Authorities etc. Reports: Types; Significance; Structure, Style & Writing of Reports. Technical Proposal ; Parts; Types; Writing of Proposal; Significance. Technical Paper, Project. Dissertation and Thesis Writing: Features, Methods & Writing.

Unit IV:

Presentation strategies: Defining Purpose; Audience & Locale; Organizing Contents; Preparing Outline; Audio-visual Aids; Nuances of Delivery; Body Language; Space; Setting Nuances of Voice Dynamics; Time-Dimension.

Unit V:

Value-based text readings: Following essays form the suggested text book with emphasis on mechanics of writing: (i)The Aims of Science and the Humanities by M.E. Prior, (ii)The Language of Literature and Science by A.Huxley, (iii)Man and Nature by J.Bronowski, (iv) The Mother of the Sciences by A.J.Bahm, (v) Science and Survival by Barry Commoner, (vi) Humanistic and Scientific Approaches to Human Activity by Moody E. Prior, (vii) The Effect of Scientific Temper on Man by Bertrand Russell.

Text Books:

1. Arora, V.N., & L. Chandra (2022). IMPROVE YOUR WRITING (REV 1E). Oxford University Press.
2. Raman, M., & Sharma, S. (2015). Technical Communication: Principles and Practice. Oxford University Press.
3. Mitra, B. K. (2006). Effective Technical Communication: Guide for Scientists & Engineers (Oxford Higher Education). Oxford University Press.
4. Sharma, R. C., & Mohan, K. (2017). Business Correspondence And Report Writing, (5th ed.). Mc Graw Hill India.
5. Nurnberg, M., & Rosenblum, M. (1989). How to Build a Better Vocabulary. Grand Central Publishing.
6. Science and the Humanities « On the Human. https://nationalhumanitiescenter.org/on-the-human/2010/01/science-and-the-humanities/
7. Shakil, R. (2020, January 12). Man And Nature by J. Bronowski, The Identity of Man (1967). https://openlearningforall.blogspot.com/2020/01/man-and-nature-by-j-bronowski-identity.html

PROFESSIONL COMMUNICATION LABORATORY (HU-251/10874)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Improve group discussion and Conversational Skills for Interviews
2. Understand the Constituents of technical written communication
3. Understand basics of Presentation strategies
4. Understand basics of Value-based text readings

Interactive and Communicative Practical with emphasis on Oral Presentation/Spoken Communication based on International Phonetic Alphabets (I.P.A.)

LIST OF PRACTICALS

1. Group Discussion: Practical based on Accurate and Current Grammatical Paterns.
2. Conversational Skills for Interviews under suitable Professional Communication Lab conditions with emphasis on Kinesics.
3. Communication Skills for Seminars/Conferences/Workshops with emphasis on Paralinguistic's/Kinesics.
4. Presentation Skills for Technical Paper/Project Reports/ Professional Reports based on proper Stress and Intonation Mechanics.
5. Official/Public Speaking based on suitable Rhythmic Patterns.
6. Theme Presentation/ Key-Note Presentation based on correct argumentation methodologies.
7. Individual Speech Delivery/Conferences with skills to defend Interjections/Quizzes.
8. Argumentative Skills/Role Play Presentation with Stress and Intonation.
9. Comprehension Skills based on Reading and Listening Practicals on a model Audio-Visual Usage.

Reference Books:

1. Bansal, R.K., & Harrison, J.B. (2013). Spoken English With Cd. Orient BlackSwan.
2. Sethi, J and P V Dhamija: (1999). A Course in Phonetics and Spoken English. Second Edition. New Delhi: Prentice-Hall of India 1999.
3. Jones, D., Roach, P., Setter, J., & Esling, J. (2011). Cambridge English Pronouncing Dictionary (18th ed.). Cambridge University Press.
4. Group Discussion Tips, Topics And Rules: How To Crack A GD, 2022, https://www.softwaretestinghelp.com/how-to-crack-the-gd/
5. Presentation Skills and Techniques. (2018). https://www.businessballs.com/communication-skills/presentation-skills-and-techniques/.
6. Theobald, T. (2011). Develop Your Presentation Skills. Kogan Page.
7. Ledden, E. (2017). Presentation Book, The: How to Create it, Shape it and Deliver it! Improve Your Presentation Skills Now (2nd ed.). Pearson Business.

ENVIRONMENT & ECOLOGY (CE- 201/1865)

L T P
2 0 0

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand Scope & Importance of Environment & Ecology
2. Understand the Importance of Natural Resources
3. Understand the Environmental Pollution and their effects:
4. Understand basics of Environmental Protection

UNIT I:

Definition, Scope & Importance, Need For Public Awareness- Environment definition, Eco system-Balanced ecosystem, Human activities- Food, Shelter, Economic and social Security.

Effects of human activities on environment-Agriculture, Housing, Industry, Mining and Transportation activities, Basics of Environmental Impact Assessment. Sustainable Development.

UNIT II:

Natural Resources Water Resources- Availability and Quality aspects. Water borne diseases, Water induced diseases, Fluoride problem in drinking water. Mineral Resources, Forest Wealth, Material cycles- C, N and S Cycles.

Energy - Different types of energy, Électro-magnetic radiation. Conventional and Non- Conventional sources - hydro Electric, Fossil Fuel based, Nuclear, Solar, Biomass and Bio-gas. Hydrogen as an alternative source of Energy.

UNIT III:

Environmental Pollution and their effects. Water pollution, Land pollution. Noise pollution, Public Health aspects, Air Pollution, Solid waste management.

Current Environmental Issues of Importance: Population Growth, Climate Change and Global warming- Effects, Urbanization, Automobile pollution.

Acid Rain, Ozone Layer depletion, Animal Husbandry.

UNIT IV:

Environmental Protection-Role of Government, Legal aspects, Initiatives by Non-governmental Organizations (NGO), Environmental Education, Women Education.

Text books:

1. Joseph, B. (2005). Environmental Sc And Engg (As). McGraw-Hill Education.
2. Reddy, M. A. (2014). Textbook of Environmental Science and Technology. BS Publications.
3. Rao, V. P. (2006). Principles Of Enviournmental Scince And Engineering (1st ed.). Prentice-Hall of India Pvt.Ltd.
4. Rajagopalan, R. (2016). Environmental Studies: from Crisis to Cure. Oxford University Press.
5. Masters, G. M., & Ela, W. P. (2020). Introduction to Environmental Engineering and Science. Pearson.
6. Clean Hydrogen: A long-awaited solution for hard-to-abate sectors. (2022, October 3). https://www.seas.harvard.edu/news/2022/10/clean-hydrogen-long-awaited-solution-hard-abate-sectors
7. University of Barcelona. (2022, November 7). Microplastic pollution threats the world's coastal lagoons: Protected, but also polluted coastal lagoons. ScienceDaily. Retrieved November 8, 2022 from www.sciencedaily.com/releases/2022/11/221107103200.htm

COMPUTER AIDED ENGINEERING GRAPHICS (CE -251/10872)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand basic of computer aided sketching
2. Understand the Orthographic projections
3. Understand the Orthographic projections of plane surfaces
4. Understand basics of Projections of solids
5. Understand basics of Isometric projection

1. Introduction to computer aided sketching: Introduction, Drawing Instruments and their uses, BIS conventions, lettering Dimensioning and free hand practicing.Computer screen, layout of the software, standard tool bar/menus and description of most commonly used tool bars, navigational tools. Coordinate system and reference planes. Definitions of HP, VP, RPP & LPP. Creation of 2D/3D environment. Selection of drawing size and scale. Commands and creation of Lines, Co-ordinate points, axes, poly-lines, square, rectangle, polygons, splines, circles, ellipse, text, move, copy, off-set, mirror, rotate, trim, extend, break, chamfer, fillet, curves, constraints viz. tangency, parallelism, inclination and perpendicularity. Dimensioning, line convention, material conventions and lettering.

2. Orthographic projections: Introduction, Definitions-Planes of projection, reference line and conventions employed, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only), True and apparent lengths, True and apparent inclinations to reference planes (No application problems).

3. Orthographic projections of plane surfaces (First angle projection only): Introduction, Definitions-projections of plane surfaces-triangle, square rectangle, rhombus, pentagon, hexagon and circle, planes in different positions by change of position method only (No problems on punched plates and composite plates.) 1-Sheet

4. Projections of solids (First angle projection only): Introduction, Definitions- Projections of right regular- tetrahedron, hexahedron(cube), prisms, pyramids, cylinders and cones in different positions. (No problems on octahedrons and combination solid) 2-Sheet

5. Sections and development of lateral surfaces of solids: Introduction, Section planes, Sections, section views, Sectional views, apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. (No problems on section of solids) 1- Sheet Development of lateral surface of above solids, their frustums and truncations. (No problems on lateral surfaces of trays, Tetrahedrons spheres and transition pieces).

6. Isometric projection (Using isometric scale only): Introduction, Isometric scale, Isometric Projection of simple plane figures, Isometric Projection of tetrahedron, hexahedron (cube), right regular prisms, pyramids, cylinders, cones, spheres, cut spheres and combination of solids (Maximum of three Solids). 1-Sheet

Note: At least 3 drawing assignments must be on AUTOCAD.

Text Books:

1. Bhatt, N. D., Panchal, V. M., & Ingle, P. R. (2019). Engineering Drawing: Plane and Solid Geometry. Penguin Random House.
2. Luzadder, W. J., & Duff, J. M. (1993). Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production. Prentice Hall.
3. Simmons, C., Maguire, D., & Phelps, N. (2020). Manual of Engineering Drawing: British and International Standards (5th ed.). Butterworth-Heinemann.
4. Tornincasa, S. (2020). Technical Drawing for Product Design: Mastering ISO GPS and ASME GD&T (Springer Tracts in Mechanical Engineering) (1st ed. 2021). Springer.
5. Mechanical Engineering Drawing helpful to Engineering projects. (2021, December 27). The Technical Drawing Company. https://thetechnicaldrawingcompany.com/mechanical-engineering-drawing/
6. How to draw an office chair in 2D using AutoCAD? (2022, January 13). The Technical Drawing Company. https://thetechnicaldrawingcompany.com/draw-office-chair-2d-using-autocad/

List of Elective Papers

Elective-I

- Nanobiotechnology
- Agriculture Biotechnology

Elective -II

- Food Biotechnology
- Immunodiagnostics

Elective-III

- IPE, Biosafety & Bioethics
- Immunoinformatic

Elective -IV

- Biomedical Instrumentation
- Industrial Biotechnology

III
SEMESTER

BIOCHEMISTRY (BT–301/ 2461)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the chemistry of biomolecules and role of water in mediating the biomolecular reactions
2. Understand the structural and physiochemical aspects of biomolecules
3. Know about thermodynamics, bioenergetics and metabolism of biomolecules
4. Obtain the knowledge of metabolic engineering and systems biology
5. Explain the applications of biochemistry, metabolic engineering and systems biology to develop industrially relevant products

Unit I:

Stabilizing interactions in Biomolecules (Non covalent interaction: Vander Waals, Electrostatic, Hydrogen bonding, Hydrophobic interaction, etc.), Role of water in biological processes.

Unit II:

Introduction to biomolecules (Carbohydrates, Amino acids, Fatty Acids, Vitamin and Hormones); Conformation of proteins (Ramachandran Plot, Secondary, Tertiary and Quaternary structure, domains, motif and folds), Stability of proteins structure.

Unit III:

Thermodynamics Principles, Bioenergetics and Metabolism of Glucose, Lipid (glycolysis, TCA Cycle, ETS etc..)

Unit IV:

Conformation of Nucleic Acid: DNA (A, B, Z- DNA), RNA (r-RNA, m-RNA, t-RNA). Metabolism of nucleic acid and amino acid.

Unit V:

Basic concepts and applications of Metabolic Engineering: Overview of Cellular metabolism, Metabolic Engineering & Synthetic Biology, Metabolic Engineering: Prokaryotes vs Eukaryotes. Metabolic Engineering in Practice: Actual examples from research and industrial biotechnology.

Books and references:

1. David L., N. D., Lehninger, A. L., Nelson, I. M. G. D. L., Cox, U. M. M., Institute for Molecular Genetics David L Nelson, & University Michael M Cox. (2005). Lehninger Principles of Biochemistry. W. H. Freeman.
2. Berg, J. M., Tymoczko, J. L., Jr., G. G. J., & Stryer, L. (2015). Biochemistry (Eighth). W. H. Freeman.
3. Voet, D., Voet, J.G. (1990). Biochemistry. New York: J Wiley.
4. Cortassa, S., Aon, M. A., Iglesias, A. A., & Lloyd, D. (2002). An Introduction to Metabolic and Cellular Engineering. World Scientific Publishing Co Pte Ltd.
5. The Korea Advanced Institute of Science and Technology (KAIST). (2022, August 4). Metabolically engineered bacterium produces lutein?. ScienceDaily. Retrieved November 8, 2022 from www.sciencedaily.com/releases/2022/08/220804130643.htm
6. Kobe University. (2020, February 25). New metabolic engineering strategy for effective sugar utilization by microbes improves bioproduction of polymer raw materials. ScienceDaily. Retrieved November 7, 2022 from www.sciencedaily.com/releases/2020/02/200225104956.htm

BIOCHEMISTRY LAB (BT-351/ 20466)

L T P
0 0 4

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Estimate biomolecules like carbohydrate, proteins, Nucleic acids etc.
2. Assess enzyme activity and specific activity
3. Seperation and extraction of biomolecules
4. Cell fractionation analysis

1. Estimation of carbohydrates.

2. Estimation of proteins.

3. Estimation of nucleic acids.

4. Isoelectric precipitation.

5. Separation of amino acids by paper chromatography.

6. Extraction of lipids.

7. Thin layer chromatography.

8. Gel electrophoresis.

9. Assay of enzyme activity and enzyme kinetics.

10. Cell fractionation.

Reference books

1. Hofmann, A., & Clokie, S. (2018). Wilson And Walkers Principles And Techniques Of Biochemistry And Molecular Biology 8Ed (Sae) (Pb 2018) (8th edition). Cambridge India.
2. Ghalaut, V. S., & Dahiya, K. (2014). Practical Skills in Biochemistry (2nd ed.).
3. Jayaraman, J. (2022). Laboratory Manual in Biochemistry. New Age International Publisher.
4. Gupta, H. (2016, February 2). Separation of Amino Acids by Paper Chromatography (With Diagram). Biology Discussion. https://www.biologydiscussion.com/amino-acids/separation-of-amino-acids-by-paper-chromatography-with-diagram/18003
5. Biotechnology 101 Protocol: Gel Electrophoresis. (2022, April 9). Bento Lab. https://bento.bio/protocol/biotechnology-101/gel-electrophoresis/

APPLIED MICROBIOLOGY (BT-302/2462)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the composition and importance of desirable and undesirable constituents of microorganisms.
2. To Understand how to isolate and characterize microbes.
3. To assess the microbial growth in nature and study its kinetics.
4. To study and implements basic culture techniques, and how to prepare media.
5. To study economic and industrial importance of microbes.

Unit I:

Introduction and Classification of "Microbes, isolation and identification of: Microorganism, culture techniques and their maintenance, cell counting methods.

Unit ll:

Microbial growth. Kinetics, cell cultivation system. Screening. Physical and Chemical. methods for control of microorganisms. Strain development.

Unit lll:

Effect of environment on cell growth, growth limitation by environmental factors. Microbial nutrition, common nutrients requirements - requirement for carbon, hydrogen and oxygen. Culture media. Formulation of media, Nutritional types of microorganisms. Uptake of nutrients by cell.

Unit lV:

Mechanism of gene transfer in bacteria- conjugation, Transformation and transduction, Impact of microbial.

Unit V:

Industrial scope of Microbiology. Fermentation, microorganisms as food amendments, Biofuels, Microarray, Biosensors.

Text book and references:

1. Willey, J. M., Prescott, L. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. McGraw-Hill Education.
2. Tauro, P., Kapoor, K. K., & Yadav, K. S. (1986). An Introduction to Microbiology. Wiley.
3. Schlegel, H. G., & Kogut, M. (1993). General Microbiology (7th ed.). Cambridge University Press.
4. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
5. Pelczar, M.J., Chan, E.C.S., Krieg, N.R. (1998). Microbiology. Mc Graw Hill India.
6. Tankeshwar, A. (2022, August 10). Gene Transfer Mechanism in Bacteria and It's types. Microbe Online. https://microbeonline.com/key-information-regarding-gene-transfer-mechanism-bacteria/
7. Waste Not, Want Not: Increasing Equity in Bioenergy Research and Beyond. (2022). Energy.gov. https://www.energy.gov/eere/bioenergy/articles/waste-not-want-not-increasing-equity-bioenergy-research-and-beyond

MICROBIOLOGY LAB (BT-352/ 20467)

L T P
0 0 3

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Prepare agar slant and culture of microorganism using various techniques
2. Perform different microbial staining
3. Seperation and extraction of biomolecules
4. Isolation of microorganism from soil samples and determine CFU
5. Perform microbial growth kinetics

l. Preparation of nutrient agar slants, plates and nutrient broth and their sterilization.

2. Inoculation of agar slants, agar plate and nutrient broth.

3. Culture of microorganism using various techniques.

4. Simple and differential staining procedure, endoscope staining, flagella staining, cell wall staining, capsular staining, negative staining.

5. Bacterial colony counting.

6. Observation of different vegetative, capsular and spore forms of bacteria & fungus.

7. Isolation of microorganism from soil samples and determination of the number of colony forming units.

8. Study of growth curve of *E.coli*.

Reference books

1. Cappuccino, J. G., & Sherman, N. (2011). Microbiology: A Laboratory Manual. Benjamin Cummings.
2. Amid, A. (2021). Multifaceted Protocols in Biotechnology, Volume 2 (1st ed. 2021). Springer.
3. Willey, J. M., Prescott, L. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. McGraw-Hill Education.
4. Tauro, P., Kapoor, K. K., & Yadav, K. S. (1986). An Introduction to Microbiology. Wiley.
5. Schlegel, H. G., & Kogut, M. (1993). General Microbiology (7th ed.). Cambridge University Press.
6. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
7. Pelczar, M.J., Chan, E.C.S., Krieg, N.R. (1998). Microbiology. Mc Graw Hill India.
8. Colony Counters: Manually vs. Using a Colony Counter. (n.d.). https://www.neutecgroup.com/resource-library/microbiology-lab-automation/application-notes/225-how-to-count-colonies-manually-vs-using-a-colony-counter
9. Nutrient Agar and Nutrient Broth: Composition, Preparation & Differences. (2021, February 4). LabMal. https://labmal.com/2019/08/13/nutrient-agar-and-nutrient-broth/

FLUID FLOW AND SOLID HANDLING (CH-301/ 2463)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the composition and importance of Solid Handling its properties and equipments.
2. Understand the definition and theory of Filteration and Sedimentation Processes.
3. Understand the role of Properties of Fluid Statistic.
4. Working and principle of Orifice meter, Nozzle and more eqiupments.
5. More on Reciprocation pumps, Rotary pumps and Fluidization.

Unit I:

Solid Handling: Properties of solids, screening, industrial screening equipment, determination of Particle size, screen analysis, size reduction of solids, Of reduction, operating intermediate and fine size reduction, power requirement and mechanism power driven, Crushers, grinders and conveyers.

Unit II:

Filtration: Theory, continuous and branch equipment, Flow of solids through fluids, Classification and Sedimentation.

Unit III:

Fluid Flow: Properties of fluids, Fluid Statistics: Euler's Equation Hydrostatic would pressure, measurement, transport of fluids, energy relationships, pipe fittings minor losses in flow.

Unit IV:

Flow measurements: Orifice meter, Nozzle and Venturi meters, rotameter and pitot tube.

Unit V:

Pumping and compressing: Reciprocation pumps, rotary pumps, centrifugal pumps and' blowers, Introduction of fluidization.

Reference Books:

1. Fox, R. W., McDonald, A. T., & Pritchard, P. J. (2003). Introduction to Fluid Mechanics (6th ed.). Wiley.
2. Gavhane, K. (2014). Unit Operations-II. Nirali Prakashan.
3. Mccabe, W., Smith, J., & Harriott, P. (2017). Unit Operations of Chemical Engineering (7th ed.). Mcgraw.
4. Rhodes, M. (2022). Introduction to Particle Technology (Reprint). John Wiley & Sons.
5. Choudhary, A. Orifice Meter, Venturi Meter, Pitot Tube and Rotameter. Pharmaguideline. https://www.pharmaguideline.com/2007/02/orifice-meter-venturi-meter-pitot-tube-and-rotameter.html

FLUID MECHANICS LAB (CH-351/ 20468)

L T P
0 0 2

Course Outcomes (COs)

On the successful completion of the course, students will be able to

1. Understand laminar to turbulent flow
2. Determine the lower critical Reynolds number, the meta- centric height of a ship model.
3. Determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape.
4. Determine the loss coefficient for the pipe fitting
5. Understand the flow behavior in a pipe bend and application of Bernoulli's theorem

1. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
2. To determine the experimentally the meta- centric height of a ship model.
3. To determine the coefficient of discharge of an orifice (or a mouth piece) of a given shape. Also to determine the coefficient of velocity and the coefficient of contractionof the orifice.
4. To calibrate an orifice meter and study the variation of the coefficient of discharge with the Reynolds number
5. To determine the loss coefficient for the pipe fitting.
6. To study the flow behavior in a pipe bend and to calibrate the pipe bend for discharge measurement.
7. To verify Bernoulli's theorem.

Reference Books:

1. Fox, R. W., McDonald, A. T., & Pritchard, P. J. (2003). Introduction to Fluid Mechanics (6th ed.). Wiley.
2. Gavhane, K. (2014). Unit Operations-II. Nirali Prakashan.
3. Mccabe, W., Smith, J., & Harriott, P. (2017). Unit Operations of Chemical Engineering (7th ed.). Mcgraw.
4. Rhodes, M. (2022). Introduction to Particle Technology (Reprint). John Wiley & Sons.
5. Choudhary, A. Orifice Meter, Venturi Meter, Pitot Tube and Rotameter. Pharmaguideline. https://www.pharmaguideline.com/2007/02/orifice-meter-venturi-meter-pitot-tube-and-rotameter.html
6. Anupoju, S. (2019, February 27). Experimental Verification of Bernoulli's Theorem. The Constructor. https://theconstructor.org/practical-guide/hydraulics-lab/experimental-verification-bernoullis-theorem/29663/

Statistical Techniques (MA-302/2464)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. To develop and conduct continuing education programs for engineering mathematics with a view to update their fundamental knowledge base and problem-solving capabilities in the various area of engineering.
2. Enable students to enhance mathematical skills and understand the fundamental concepts of pure and applied mathematics.
3. Develop, design and implement research projects completely and independently.
4. identify and define emerging problems related to one's area of interest.
5. Knowledge about degree of freedoms and ANOVA.

Unit I:

Data type, Classification and summarization of data, diagrams; Inographs, Measures of Central tendency : Arithmetic Mean, Geometric Mean, Harmonic Mean, Merits & Demerits of A.M., G.M., & H.M. Median, Mode

Unit II:

Measures of Dispersion: Range, mean deviation, Standard deviation, Variance, Coefficient of variance. Skewness, methods of measuring skewness, Kurtosis, measure of Kurtosis…,

Unit III:

Introduction to probability, Addition and Multiplication, laws of probability, Baye'sTheorem, Binomial distribution, Poison distribution, Normal distribution, Application of these distributions.

Unit IV:

Correlation, Type of correlation, Method of determining Correlation: Scatter Diagram Method, Karl Pearsons coefficient of correlation. Spearman's Rank coefficient of correlation, Regression Analysis, Type of regression models, Curve of regression, Line of regression.

Unit V:

Sampling, Hypothesis tests, Chi Square test and f-tests, Student-test, degree of freedom one way analysis of variant, ANOVA. Principles of experimental design.

Text books and references

1. Cochran, S. (2022). Statistical Methods (1st ed.). Wiley India.
2. Norman, T. J. & Bailey M.A. (1995). Statistical Methods in Biology (3rd ed.). Cambridge University Press.
3. Rangaswamy, R. (1995). A Text Book of Agricultural Statistics. Macmillan Publishers.
4. Rao, P. S. S. S., & Richard, J. (2004). An Introduction to Biostatistics: A Manual for Students in Health Sciences. Prentice Hall.
5. Frost, J. (2022). Chi-Square Test of Independence and an Example. https://statisticsbyjim.com/hypothesis-testing/chi-square-test-independence-example/
6. Rentala, S. (2019). Basics In Nursing Research And Biostatistics 1st/2019 (1/e). Jaypee Brothers Medical Pub.

DATA STRUCTURE AND ALGORITHMS USING C (CS-306 / 2465)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the concept of Dynamic memory management, data types, algorithms, analysis of algorithms by Asymptotic notations.
2. Understand basic data structures such as arrays, linked lists, stacks and queues.
3. Describe the hash function and concepts of collision and its resolution methods.
4. Solve problem involving graphs, trees and heaps.
5. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data in various data structures like linked list, stack, queue, graphs and tree.

Unit I:

Introduction to data structure and Algorithms: Performance: Analysis of Algorithm, Time Complexity, Big-oh notation, Elementary dataorganization data structure operation, organization data structure operations, Recurrences, Arrays, operations on arrays, representation of arrays in memory, single dimensionalmultidimensional arrays, Spare matrices character storing in C, string operation.

Unit II:

Statistics, Queues and Linked lists: Stack operation, PUSH and POP, Array representation of stacks, operation associated with Slacks Application of stack, Recursion, Polish expression, Representation queues' operation on queues', Priority queues Dquesues, Singly and circularly linked in C, string operations. Lists implements.

Unit III:

Tree: Basic terminology, Binary trees representation Algebraic expressions. Complete: Binary trees, extended binary trees, represent binary trees in memory. Linked representation of binary trees, traversing binary tracts & Searching binary searching algorithm, Heaps, general trees, threaded binary tree.

Unit IV:

Graphs: Terminology & representations, Graphs Multigraphs, Direct Sequential Representation of graphs, adjacency metrics, transversal, connected component "Spanning trees, Minimum Cost Spanning prisms and crustal Algorithm, BSF," DFS, Shortest path and transitive closure, Activity networks. Topological Sort and critical paths.

Unit V:

Searching and Sorting: Linear search ',' Binary Search, Internal and External Sorting , Bubble Sorting Insertion Sort, Quick Sort, Two a merge Sort, Heap Sort, sorting on different' keys, practical J/consideration for internal soaring. External Sorting, Storage', Devices: Magnetic tapcs Disk Storage, File organization and storage management.

Text books and references:

1. Horowitz, E. (1984). Fundamentals Of Data Structures. Galgotia Booksource
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2009). Introduction to Algorithms, 3rd Edition (The MIT Press) (3rd ed.). The MIT Press.
3. Weiss, M. A. (1996). Data Structures and Algorithm Analysis in C. Addison Wesley.
4. Ravikiran, A.S. (2022, October 26). Your One-Stop Solution For Graphs In Data Structures. Simplilearn.com. https://www.simplilearn.com/tutorials/data-structure-tutorial/graphs-in-data-structure
5. Tree Data Structure (2022). https://www.programiz.com/dsa/trees

IV
SEMESTER

IMMUNOLOGY (BT-401/ 2466)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand immunity and its different types including innate, and adaptive immunity, and the organ system which mediates immune response.
2. Understand different pathways and mechanisms which mediate immunity like exogenous and endogenous antigen processing pathways, T and B cell epitope identification and activation of immune cells and complement system.
3. Know about cytokines their role in regulation of immune responses against infections and different serological techniques used for detection of infections
4. Obtain the knowledge of different types of vaccines and their production and validation
5. Explain the difference in immunological responses in viral, bacterial and protozoan mediated infections and hypersensitivity.

Unit I:

Introduction to immunity, characteristics of innate and adaptive immunity, primary and secondary lymphoid organ, cell and molecule of immune system, humoral and cell mediated immunity, clonal selection.

Unit II:

Exogenous and endogenous pathways of antigen processing and presentation structure and function of MHC molecule, characteristics of T & B cell epitopes, Antibodies, polyclonal and monoclonal antibody, complement system, antigen and antibody reaction.

Unit III:

Structure function & application of cytokines, regulation of immune response, immune tolerance, serological techniques – ELISA RIA & IMMUNOBLLOTING.

Unit IV:

Production and application of monoclonal & polyclonal antibiotics, production of antibiotics, factor affecting in the immunogenicity, adjuvant, dose of antigen, vaccine & types of vaccine preparation.

Unit V:

Immunity against infectious virus bacteria & protozoa hypersensitivity.

Textbook & references:

1. Roitt, I. M., & Delves, P. J. (2001). Roitt's Essential Immunology, Tenth Edition (Essentials) (10th ed.). Wiley-Blackwell.
2. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2019). Basic Immunology: Functions and Disorders of the Immune System (6th ed.). Elsevier India.
3. Goldsby, R. A., Kindt, T. J., Kuby, J., & Osborne, B. A. (2002). Immunology, Fifth Edition (5th ed.). W. H. Freeman.
4. Lydyard, P. M. (2000). Instant Notes in Immunology. Adfo Books.
5. Stites, S. (1982). Basic & Clinical Immunology (Fourth Edition). Lange Medical Publications.
6. Flajnik, M. (2022). Paul's Fundamental Immunology (Eighth). LWW.
7. Alhajj M, Farhana A. Enzyme Linked Immunosorbent Assay. [Updated 2022 Feb 2]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK555922/

IMMUNOLOGY LAB (BT-451/ 20471)

L T P
0 0 3

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand antigens- antibody cross reaction.
2. Isolate purify and identify the immunoglobulin
3. Understand the mechanism of different im munological techniques e.g. Double diffusion, ELISA, RIA and immunoblotting techniques

1. Different types of antigens- antibody cross reaction.

2. Isolation, purification and identification of immunoglobulin from goat blood.

3. Double diffusion techniques for identification of antigen-antibody samples

4. Immunoelectrophoresis techniques.

5. ELISA

6. RIA

7. Immunoblotting using ELISA-dot or western blotting.

Reference books:

1. Stites, S. (1982). Basic & Clinical Immunology (Fourth Edition). Lange Medical Publications.
2. Flajnik, M. (2022). Paul's Fundamental Immunology (Eighth). LWW.
3. Alhajj M, Farhana A. Enzyme Linked Immunosorbent Assay. [Updated 2022 Feb 2]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK555922/
4. Aryal, S. (2022, September 5). Ouchterlony Double Immunodiffusion technique. Microbe Notes. https://microbenotes.com/ouchterlony-double-immunodiffusion-technique/
5. Voet, D., Voet, J.G. (1990). Biochemistry. New York: J Wiley.

GENETICS AND MOLECULAR BIOLOGY (BT-403 / 2468)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the concept of genetics.
2. Understand the mechanism of genes inheritance and genetic disorder.
3. Know about DNA replication and transcription.
4. Gain the knowledge of translation of genes into proteins.
5. Explain the cell organization, cell division and its regulation.

Unit I:

Fundamental principal of genetics, gene interaction, multiple alleles, complementation linkage, Recombination linkage mapping, extra- chromosomal inheritance chromosomal basis of heredity (characteristics). Pedigree analysis, transposable elements.

Unit II:

Sex Determination- Concept of allosomes and autosomes, Human Cytogenetics- Human Chromosomes, Karyotype, Structural and numerical alterations of chromosomes (Deletion, duplication, inversion, translocation, ploidy), common genetic disorders: Down syndrome, Klinefelter syndrome etc. Genetic diseases- Hemophilia, Sickle cell anemia etc., DNA repairing, Mutations.

Unit III:

DNA replication processes: Role of DNA polymerase and Topoisomerase, Reverse transcriptase. RNA Synthesis and processing: RNA polymerases, capping, elongation and termination, RNA Processing, RNA editing, Splicing, Polyadenylation etc.

Unit IV:

Protein synthesis and processing: Genetic code, aminoacylation of tRNA, aminoacyl tRNA synthetase, translational proof reading, translational inhibitors, post -translational modification of proteins, Regulation of gene expression at transcription and translation level.

Unit V:

Membrane structure and function, structural organization and function of intracellular organelles, cell cycle and its regulation.

Reference books:

1. Freifelder, D. (1987). Microbial Genetics. Jones & Bartlett Learning.
2. Alberts, B. (1994). Molecular Biology of the Cell. Garland Science.
3. Lodish, H. F., Berk, A., Darnell, J. E., Zipursky, S. L., Baltimore, D., & Matsudaira, P. (2000). Molecular Cell Biology. W.H. Freeman.
4. Snustad, D. P., & Simmons, M. J. (2015). Principles of Genetics. Wiley.
5. Molecular Events of DNA Replication | Learn Science at Scitable. (2008). https://www.nature.com/scitable/topicpage/major-molecular-events-of-dna-replication-413/?error=cookies_not_supported&code=f7f9940b-8d91-4ea5-807e-12ec143ad102
6. ATDBio - Transcription, Translation and Replication. (2021). https://atdbio.com/nucleic-acids-book/Transcription-Translation-and-Replication

MOLECULAR BIOLOGY LAB (BT-452 / 20472)

L T P
0 0 3

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Estimate Nucleic Acid in given sample with different methods
2. Determine the Tm Value of Nucleic Acid
3. Isolate and purify plasmid and genomic DNA.

1. Estimation of DNA content in the given sample by diphenylamine method.
2. Estimation of RNA content by orcinoll method.
3. Determination of Tm of DNA and RNA.
4. Isolation of plasmid DNA.
5. Isolation of bacterial / fungal genomic DNA.
6. Isolation of plant DNA.
7. Purification of DNA through columns.

Reference books:

1. Editorial Team. (2019, February 15). Estimation of DNA by Diphenyamine Method. Labmonk. https://labmonk.com/estimation-of-dna-by-diphenyamine-method
2. Editorial Team. (2019b, April 11). Estimation of RNA by Orcinol Method. Labmonk. https://labmonk.com/estimation-of-rna-by-orcinol-method
3. Gull, M. (2019). Plasmid. IntechOpen.
4. Alberts, B. (1994). Molecular Biology of the Cell. Garland Science.
5. Lodish, H. F., Berk, A., Darnell, J. E., Zipursky, S. L., Baltimore, D., & Matsudaira, P. (2000). Molecular Cell Biology. W.H. Freeman
6. DNA Purification, DNA Extraction Methods, Promega. (2022) https://nld.promega.com/resources/guides/nucleic-acid-analysis/dna-purification/

HEAT AND MASS TRANSFER OPERATION (CH – 401/ 2470)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course students will be able to

1. Understand the concept of conduction, convection and radiation.
2. Understand the classification of Heat transfer Equipments.
3. Know about mass transfer theories.
4. Gain the knowledge of Solid-gas equilibrium.
5. Explain the processes and significance of distillation and crystallization.

Unit I:

Introduction and general concept of heat transfer by conduction, convection and radiation.Conduction: Basic concepts of conduction in solids, liquids and gases, steady state temperature fields. One-dimensional conduction without heat generation e.g., Plane wall, Cylindrical, spherical surfaces & composite layers etc. Extended surface, fins. Introduction to unsteady state heat transfer. Convection: Fundamental and basic concepts. Hydrodynamics & thermal boundary layers, laminar & turbulent Heat transfer inside & outside tubes. Dimensional analysis, determination of internal and overall heat transfer coefficients. Radiation & Evaporation**:** Basic laws of heat transfer by radiation, black body & Gray body concepts, view factors, Kirchoff's law, solar radiation, combined heat.

Unit II:

Heat transfer Equipment: classification, principles and design criteria, types of exchanger's viz. double pipe, shell & tube, plate type, extended surface, cooling towers etc. Furnaces and their classification and applications. Heat transfer with phase change: Condensation of pure and mixed vapours, films wise & drop wise condensation, loading in condenser and heat transfer in boiling liquids, heat transfer coefficients.

Unit III:

Mass transfer theories, Diffusion, Molecular and Turbulent diffusion, diffusion coefficient, Ficks law of diffusion, measurement and estimation of diffusivity, diffusion in multicomponent gas mixtures, diffusion in solids, Knudsen and surface diffusion. Inter phase mass transfer: Mass transfer coefficient. Equilibrium solubility of gases in liquids. Mass transfer in fluidized beds.

Absorption and adsorption, gas- liquid equilibrium, Henrys law, Counter current, Concurrent, Multistage continuous contact operation. Description of adsorption process & their application. Types of adsorption, Absorption in packed columns, HTU.NTU & HETP concepts, design equation for packed column.

Unit IV:

Solid-gas equilibrium, definitions of moisture contents, types of batch and continuous dryers, rotary dryers, rate and mechanism of batch drying, continuous drying, time of drying, Single and Multistage process.

Unit V:

Distillation and crystallization, Raoults law and its application, pressure drops, flooding, transfer coefficient & relative volatility, Mc-cabe thile and Ponchon method for binary azeotrope. Flash vaporization & distillation. Crystallization, heat and mass transfer rates in crystallization, Classification and design of crystallizers.

Reference books:

1. Holman, J. P. (2009). Heat Transfer. McGraw-Hill Education.
2. Hawkins, G. A. (1954). Heat Transmission. William H. McAdams. McGraw-Hill, New York-London, ed. 3, 1954. xiv + 532 pp. Illus. $8.50. Science, 120(3128), 984–984. https://doi.org/10.1126/science.120.3128.984.a.
3. Gavhane, K. (2014b). Unit Operations-II. Nirali Prakashan.
4. Kern, D. Q. (2022). Process Heat Transfer (1st Edition). McGraw-Hill College.
5. McCabe, W. L., Smith, J. C., & Harriott, P. (2014). Unit Operations of Chemical Engineering. McGraw-Hill Education.
6. Treybal, R. E. (1998). Mass-Transfer Operations. McGraw-Hill Companies.
7. Ronquillo, R. (2022). Understanding Heat Exchangers - Types, Designs, Applications and Selection Guide. https://www.thomasnet.com/articles/process-equipment/understanding-heat-exchangers/
8. Hallas, N. J. (2011, February 9). CRYSTALLIZERS. https://www.thermopedia.com/cn/content/680/

PROTEIN & ENZYME ENGINEERING (BT-402/ 2471)

L T P
3 0 0

Course Outcomes (COs):

Upon completion of the course, the student shall be able to understand:

1. Introduction to protein and enzyme
2. Introduction to enzyme Kinetics
3. Introduction to industrial enzymes.
4. Applications of enzymes.
5. Isolation and purification of enzymes

Unit I:

Introduction, classification, & nomenclature of enzymes, active sites, is enzyme, coenzyme, cofactors, multienzyme complexes, intracellular and extra cellular enzyme, Physicochemical characteristic of enzyme.

Unit II:

Enzyme kinetics, measurement of K_m & V_{maxs} kinetics of competitive, non-competitive and un-competitive inhabitation of enzymes, effect of pH temperature substrate concentration on enzyme kinetics, allosteric enzyme and their kinetics.

Unit III:

Introduction to industrial enzymes – Topoisomerases, chymotrypsin, glyceraldehydes, phosphate dehydrogenase, lysozyme, carboxypeptidase, ribonuclease, aldolase, glucoisomerases, lactases, ribozyme.

Unit IV:

Molecular folding & defolding of enzymes, stability of enzymes, enzyme immobilization. Isolation, purification, and characterization of enzymes, industrial diagnosis and therapeutic application of enzymes.

Unit V:

Protein Engineering: Introduction- Basic principles, amino acids and their conformational accessibilities. Strategies for protein engineering. Random and site directed mutagenesis: various PCR based strategies; Role of low fidelity enzymes in protein engineering; Gene shuffling and directed evolution of protein, Protein backbone changes: Antibody engineering. All topics deal with case studies.

Reference books:

1. Martínez, L. S. M. C. S. O. (2021, February 11). Industrial uses of enzymes. https://www.sepmag.eu/blog/industrial-uses-of-enzymes
2. Biochemistry- D.J.Voet & J.G. Voet. 6th ed.
3. Bisswanger, H. (2017). Enzyme Kinetics: Principles and Methods (3rd ed.). Wiley-VCH.
4. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
5. Chand S., Enzyme Science and Engineering, IIT Delhi https://nptel.ac.in/courses/102102033

CHEMICAL ENGINEERING THERMODYNAMICS (CH-402/2472)

L T P
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Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Provide in-depth technical competence in engineering fundamentals.
2. Undertake problem identification, formulation and solution.
3. Utilize a systems approach to design and operational performance.
4. Apply a range of approaches to estimate fluid phase equilibria in one and two component systems.
5. Design key aspects of heterogeneous reacting systems and in particular , catalytic reactor systems.

Unit 1:

Basic concept: Fundamental concepts in thermodynamics heat and work The first law and conservation of energy. Joule's experiment. Applications to steady, nonsteady flow and other engineering problems. The second law, heat engines, Carnot cycle, thermodynamic scale of temperatures, entropy, third law and Zeroth law of thermodynamics Applications to engineering problems relating to equilibrium, maximum and minimum work.

UNIT II:

Properties of pure substances: Changes in thermodynamic properties and their inter relationship. The ideal gas. Fugacity and fugacity coefficient for real gases.

UNIT III:

Multicomponent system, partial molar properties. Mathematical models for the chemical potential. Ideal and non-ideal solutions, The Lewis /Randall rule activity and activity coefficient. The Gibbs Duhem equations.

Excess properties of mixtures.

UNIT IV:

Phase equilibrium: The gamma phi formulation of VLE, Criteria for equilibrium between different phases in multicomponent nonreacting systems. Applications to system of engineering interest, particularly to vapor- liquid equilibrium, Solid-liquid equilibrium, Osmotic equilibrium and solubility.

UNIT V:

Chemical equilibrium: The reaction coordinate, The standard Gibbs Energy Changes The equilibrium constant and the variation of yield in chemical reactions with pressure, temperature and composition.

Reference books:

1. Smith, J. (2022). Introduction to Chemical Engineering Thermodynamics(SIE) (7th, International Economy Edition ed.). McGraw-Hill.
2. Octave, L. (2006). Chemical Reaction Engineering (3rd ed.). Wiley.
3. Rasmuson, A., Andersson, R., Olsson, L., & Andersson, R. (2014). Mathematical Modeling in Chemical Engineering. Cambridge University Press.
4. Boyarsky, Y. M. (2011, February 14). Multicomponent Systems Thermodynamics. https://www.thermopedia.com/content/969/
5. Peng, D. Y. (1989). On the equations for excess Gibbs energy. Fluid Phase Equilibria, 51, 171–185. https://doi.org/10.1016/0378-3812(89)80362-0

CHEMICAL ENGINEERING OPERATION LAB (CH-451/20475)

L T P

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Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Operate packed bed reactor
2. Extract solid-liquid by using Soxhelt
3. Determine heat transfer coefficient, Boltzmann coefficient etc

1. Study and operation of a packed bed reactor

2. Determination of the rate of drying in a tray dryer.

3. Solid-liquid extraction- Soxhelt's experiment.

4. To find out the overall heat transfer coefficient of a double pipe heat exchanger.

5. To find out the overall heat transfer coefficient of 1-2 shell and tube heat exchanger.

6. To find out Stefan Boltzmann Constant and compare with the theoretical value.

7. Find out heat transfer coefficient during drop wise and film wise condensation

Reference books:

1. Smith, J. (2022). Introduction to Chemical Engineering Thermodynamics(SIE) (7th, International Economy Edition ed.). McGraw-Hill.
2. Octave, L. (2006). Chemical Reaction Engineering (3rd ed.). Wiley.
3. Rasmuson, A., Andersson, R., Olsson, L., & Andersson, R. (2014). Mathematical Modeling in Chemical Engineering. Cambridge University Press.
4. Sarangi, D. (2018, February 7). Drying Rate Curve-Calcium Carbonate. Labmonk. https://labmonk.com/drying-rate-curve-calcium-carbonate
5. Awati, R. (2022, August 10). Stefan-Boltzmann constant. WhatIs.com. https://www.techtarget.com/whatis/definition/Stefan-Boltzmann-constant

V

SEMESTER

ANALYTICAL METHODS IN BIOTECHNOLOGY (BT-501/ 3461)

L T P
3 0 0

Course Outcomes (COs):

Upon completion of the course, the student shall be able to understand:

1. The properties of biomolecules that are used for their analysis.
2. The principle concepts in using analytical and preparatory techniques.
3. How to quantify and assay for a biomolecule.
4. The student would have gained sufficient knowledge about the assays and analyzing data.
5. The student will be able to handle the equipment available and identify suitable and appropriate experiments for their research.

Unit I:

Chromatography: Adsorption, affinity, partition (GLC, GC, HPLC, TLC, RPC etc) Immobilized cells, Electrophoresis colloidal solution of biopolymers and their electrochemical properties. Different method of electrophoresis for proteins, nucleic, acids, small molecular Weight compound and immune precipitants, peptide mapping and combination of electro focusing and SDS-PAGE.

Unit II:

Hydrodynamics properties: Viscosity, diffusion of biopolymers, molecular weight determination, osmotic pressure, Reverse osmosis, and Doman effect, structure of bio membranes and their electrochemical properties, membrane potential, action potential and propagation of impulses.

Unit III:

Introduction to principles and application of (a) spectroscopic method (UV, Viz IR, Fluorescence, ORD, CD, & PAS), (b) NMR, ESR and mass spectrometry. Use of radioactive and stable isotopes and the detection in biological system, introduction to principle and working of light and electron microscopes.

Unit IV:

Automatic analyzer for amino acid, protein sequenator, peptide synthesizer and nucleic acid synthesizer, Theory of lyophilization and its application to biological system.

Unit V:

Cell sorter: Principle, working and application theory of centrifugation and application to biological system, Density centrifugation, Ultra centrifugation's principle and application.

Textbook of References:

1. Nelson, D. L., & Cox, M. M. (2012). Lehninger Principles of Biochemistry. W. H. Freeman.
2. Brown, T. A. (2020). Gene Cloning and DNA Analysis: An Introduction (8th ed.). Wiley-Blackwell.
3. Simoes-Costa, M. (2022). DNA-Protein Interactions: Methods and Protocols (Methods in Molecular Biology, 2599) (1st ed. 2023). Humana.
4. Wilson, K. A Biologist's guide to principles and techniques of practical biochemistry (A Series of student texts in contemporary biology) (3rd ed.). E. Arnold.
5. Plummer, D.T.(2022). Introduction To Practical Biochemistry, 3Ed (3rd ed.). Mc Graw Hill India.
6. Durand-Vidal, S., Simonin, J. P., & Turq, P. (2000). Electrolytes at Interfaces. Springer Publishing.
7. Martínez, L. M. (2021b, November 11). Cell centrifugation. https://www.sepmag.eu/blog/cell-centrifugation
8. Ettre, L. S., & Gehrke, C. W. (2020, December 19). The Development of the Amino Acid Analyzer. Chromatography Online. https://www.chromatographyonline.com/view/development-amino-acid-analyzer

BIOPROCESS ENGGINEERING-I (BT-502/ 3462)

L T P
3 0 0

Course Outcomes :

On the successful completion of the course, students will be able to

1. Understand and explain the definition of bioprocess techniques and their position in the scientific tree, including biosystem engineering
2. Explain aliphatic compounds, functional groups and organic compounds.
3. Analyze and present the principles of bioprocess engineering.
4. Understand and explain the development of bioprocess engineering in educational world and industry to support a bio-based economy
5. To apply engineering principles in determining and solving contemporary and complex problems related to bioprocessing.

Unit I:

Methods of inoculation and medium preparation, media design and optimization. Microbial batch growth in closed, semi-open and open cultivation system. Maintenance energy and yield concepts. Parameters of growth and analysis of growth data. Estimation of biomass.

Unit II:

Sterilization: Concept and methods. Sterilization of medium: kinetics of thermal death of micro-organisms, Batch sterilization, continuous sterilization. Sterilization of air: methods, filters and design of depth filters v/s plate filters. Efficiency and application of air filters.

Unit III:

Microbial kinetics of growth and substrate utilization, product formation in batch plug flow and chemo state culture, microbial pellet formation, flocculation kinetics and dynamics of pallet formation.

Unit IV:

Concepts of material and energy balance. Dissolved oxygen in liquids. Surface and natural aeration, Bubble aeration. Oxygen transfer resistances. Measurement of KLa-oxygen, and transfer in large vessels.

Unit V:

Agitation and mixing: mechanically & Non mechanically agitated systems, Mixing VsKLa , Power consumption and operating variables, medium rheology, Agitator for Newtonian and Non-Newtonian fluids.

Text book of references:

1. Doran, P. M. (1995). Bioprocess Engineering Principles (1st ed.). Academic Press.
2. Bailey, J., & Ollis, D.F. (2022). Biochemical Engg Fundamentals (2nd ed.). Mc Graw Hill India.
3. Tsao, G. T. (1976). Principles of microbe and cell cultivation, S. John Pirt, Halsted Press, Division of John Wiley and Sons, New York, 274 pages,$34.00. AIChE Journal, 22(3), 621–621. https://doi.org/10.1002/aic.690220342
4. Stanbury, P.F., Whitaker, A., & Hall, S.A. Principles of Fermentation Technology. (2016b). Butterworth-Heinemann.

BIOPROCESS ENGGINEERING-I Lab (BT-552/ 30466)

L T P
0 0 4

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Understand significance and application of different sterilization method
2. Prepare and optimize different fermenting media
3. Perform culture and growth kinetics under stationary and shake flask condition

1. Estimation of Kla by Na_2SO_3 oxidation method.
2. Plot growth curve of E.coli
3. Quantification of cell mass.
4. Quantification of cell number.
5. Separation of microbial cells from broth.
6. Sterilization of glassware's by dry heat.
7. Sterilization of glassware's by moist heat.
8. Preparation of fermenting media.
9. Determination of kinetic parameter for batch culture of yeast under stationary and shake flake conditions.
10. Growth kinetics studies of yeast in a beench top lab fermenter under controlled conditions.
11. Determination of volumetric oxygen transfer coefficient KLa, effect of aeration and agitation speed.
12. Preparation of immobilized enzymes & cell and evaluation of kinetic parameters.

Reference books:

1. Illanes, A., & Wilson, L. (2020). Parameters for the Evaluation of Immobilized Enzymes Under Process Conditions. Methods in Molecular Biology, 65–81. https://doi.org/10.1007/978-1-0716-0215-7_3
2. Estimation of growth kinetic parameters in batch fermentation. http://38.100.110.143/model/egk/theory.html
3. Jain, A., Jain, R., & Jain, S. (2020). Sterilization of Glassware; Preparation and Sterilization of Media. In: Basic Techniques in Biochemistry, Microbiology and Molecular Biology, 93–99. https://doi.org/10.1007/978-1-4939-9861-6_28
4. Bailey, J., & Ollis, D.F. (2022). Biochemical Engg Fundamentals (2nd ed.). Mc Graw Hill India.
5. Stanbury, P.F., Whitaker, A., & Hall, S.A. Principles of Fermentation Technology. (2016b). Butterworth-Heinemann.

INDUSTRIAL ECONOMICS AND PRINCILES OF MANAGEMENT
(HU-501/3463)

L T P
3 0 0

Course Outcomes :

On the successful completion of the course, students will be able to

1. Understand the composition and importance of desirable and undesirable constituents of plant and animal foods
2. Understand the definition, classification, structure and properties of macro & micro-nutrients
3. Understand the role of macro & micro-nutrients in human health
4. Prepare a dietary plan for different age groups of Indian considering RDA and interpret the effect of processing on food components
5. Assessment of nutritional status of human by various techniques

UNIT 1:

Introduction: Nature and significance of Economics. Meaning of Science Engineering and Technology and their relationship with economic development.

UNIT 2:

Basic concept: The Concept of Demand and Supply. Elasticity of Demand and Supply, Indifference curve analysis, Price effect, Income effect, Substitution Effect.

UNIT 3:

Money and banking: Functions of Money, Value of Money, Inflation and measures to control it. Brief Idea of functions of Banking system, Viz., Commercial and Central Banking, Business Fluctuation.

UNIT 4:

Management: Definition, Nature and Significance of Management, Evalution of Management thought, Contribution of Max Weber, Taylor and Fayol's

UNIT 5:

Human behaviour: Factors of Individual Behaviour, Perception, Learning and Personality Development, Interpersonal relationship and Group Behaviour

References:

1. Luthans, F. (2010). Organizational Behavior. McGraw-Hill Education.
2. Prasad L M. (2019). Principles And Practice Of Management. Sultan Chand & Sons-New Delhi.
3. Dewett, K.K. & Navalur, M.H. (2019) Modern Economic Theory. S. Chand & Company Ltd. Sultan Chand & Company
4. Money, Banking, and Financial Markets. (2021). Understand the principles, understand the future. https://www.moneyandbanking.com/
5. Hendriks, A. (2020, January 6). Top 10 best human behavior research blog posts in 2019. Top 10 Best Human Behavior Research Blog Posts in 2019 | Noldus. https://www.noldus.com/blog/top-10-human-behavior-2019

CHEMICAL REACTION ENGINEERING (CH-501/3464)

L T P
3 0 0

Course Outcomes :

On the successful completion of the course, students will be able to

1. Understand the rate of reaction and their factors that affect it and dependency of rate on temperature.
2. Understand the reaction mechanism of simple and complex reactions.
3. Understand how constant and variable volume batch reaction is validated by different mathematical methods.
4. How different parameters affect the performance of different type's reactors.
5. To know mechanism of catalytic and non catalytic reactions.

Unit I:

Chemical Reaction: Rate of chemical reaction, factors affecting the rate of chemical reaction, reaction rate constant, elementary and non-elementary reaction mechanism, Arrhenius equation, collision theory, Absolute reaction rate theory, prediction of reaction rate.

Unit II:

Kinetics of homogenous chemical reaction, rate equation of simple and complex reactions, irreversible reaction, parallel reactions, consecutive reactions, auto catalytic reactions and homogenous catalytic reactions.

Unit III:

Interpretation of reaction data in constant volume and variable volume batch reactions, integral and differential methods for the following kinetic data.

Unit IV:

Classification of chemical reactions, reactor designing for homogenous batch, semi-batch, plug flow and continuous stirred tank. Electrochemical reactors, isothermal as well as non-isothermal operations, space velocity and residence time in flow reactors, size comparison of single reactors – batch, plug flow and CSTR for first and second order single reactions. Multiple reactor system, plug flow reactions in series and for parallel, equal sized CSTRs in series.

Unit V:

Catalysts: preparation, activity and the factors which influence it. The effect of physical properties such as surface area and pore size on catalytic activity, methods of determination of their physical properties, catalyst poisoning, biocatalyst, heterogeneous catalytic reactions, absorption isotherms, kinetics of solid catalysed fluid reaction, rate controlling steps.

Reference books:

1. Smith, J. (2022). Introduction to Chemical Engineering Thermodynamics(SIE) (7th, International Economy Edition ed.). McGraw-Hill.
2. Octave, L. (2006). Chemical Reaction Engineering (3rd ed.). Wiley.
3. Rasmuson, A., Andersson, R., Olsson, L., & Andersson, R. (2014). Mathematical Modeling in Chemical Engineering. Cambridge University Press.
4. Gavhane, K. (2014a). Unit Operations-II. Nirali Prakashan.
5. Fogler, S. H. (2008). Elements of Chemical Reaction Engineering. (4^{th} ed.). Prentice Hall India Learning Private Limited
6. Reactor Design and Analysis — Introduction to Chemical and Biological Engineering. (n.d.). https://www.engr.colostate.edu/CBE101/topics/reactor_design.html
7. Catalysis. (2020). ScienceDaily. https://www.sciencedaily.com/terms/catalysis.htm

DESIGN & ANALYSIS OF ALGORITHMS (CS-506/3465)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Argue the correctness of algorithms using inductive proofs and invariants.
2. Analyze worst-case running times of algorithms using asymptotic analysis.
3. Describe the divide-and-conquer paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize divide-and-conquer algorithms. Derive and solve recurrences describing the performance of divide-and-conquer algorithms.
4. Describe the dynamic-programming paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize dynamic-programming algorithms, and analyze them.
5. Describe the greedy paradigm and explain when an algorithmic design situation calls for it. Recite algorithms that employ this paradigm. Synthesize greedy algorithms, and analyze them.

Unit I:

Introduction: Algorithms, analysis of algorithms, Growth of functions, Masters Theorem, designing of algorithms, sorting and order statistics, Heap sort, quick sort, sorting in Linear tune, Medians and order Statistics.

Unit II:

Advanced Data Structure: Red - Black Tree, Augmenting, Data Structure. B- Tree, Binomial Heaps, Fibonacci heaps, data structure for disjoint sets.

Unit III:

Advanced data and analysis techniques: Dynamic programming, Greedy Algorithms, Amortized analysis, back tracking.

Unit IV:

Graph Algorithms: Elementary graphs algorithms, Minimum Spanning Tree, Single source shortest paths, all pair shortest path, maximum flow, and Traveling salesman problem.

Unit V:

Selected topics: Randomized algorithms, string matching, NP completeness, and approximation algorithms

Text book & references:

1. Cormen, T. H., Leiserson, C. E., Rivest, R. L., & Stein, C. (2022). Introduction to Algorithms, fourth edition (4th ed.). The MIT Press.
2. Baase, S., Gelder, A. van, & Van Gelder, A. (2000). Computer Algorithms: Introduction to Design and Analysis. Addison-Wesley.
3. Ullman, A. H. (2002). The Design and Analysis of Computer Algorithms (1st ed.). Pearson India.
4. Khawaja, M. F. (2022). 3 Advanced Data Structures Every Programmer Should Know.
5. Ravikiran, A.S. (2022a, September 27). Your One-Stop Solution to Learn Kruskal Algorithm From Scratch. Simplilearn.com. https://www.simplilearn.com/tutorials/data-structure-tutorial/kruskal-algorithm.

DESIGN & ANALYSIS OF ALGORITHMS LAB (CS-551/30467)

L T P
0 0 4

Course Outcomes (COs):

1. Students will be able to calculate the time complexity of algorithm.
2. Students will be able to sort the given numbers using various sorting algorithms. Students will be able to write programs for the problems using Divide and Conquer.
3. Students will be able to write programs for the problems using Greedy Method.
4. Students will be able to write programs for the problems using Dynamic programming.
5. Students will be able to write programs for the problems using Backtracking.

Programming assignment on each algorithmic strategy:

1. Divide and conquer method (quick sort, merge sort, Strassens matrix multiplication)

2. Greedy method (knapsack problem, job sequencing, optimal merge patterns, minimal spanning tree).

3. Dynamic programming (multistage graphs, OBST, 0/1 Knapsack, traveling salesperson problem).

4. Back tracking (n-queens problem, graph coloring problem, Hamiltonian cycles).

5. Sorting: Insertion sort, heap sort, bubble sort.

6. Searching: Sequential and binary search.

7. Selection: Minimum/ Maximum, Kth smallest element.

Reference books:

1. Aggrawal, D. (2019). Handbook of Lab Manuals for Analysis and Design of Algorithms. Notion Press.
2. GeeksforGeeks. (2022, July 13). Divide and Conquer | Set 5 (Strassen's Matrix Multiplication). https://www.geeksforgeeks.org/strassens-matrix-multiplication/
3. Levitin, A. (2017). Introduction to the Design and Analysis of Algorithms. (3rd ed.). Pearson Education
4. Ninjas, C. (2021, August 17). How To Find The Kth Smallest Element In An Array? Coding Ninjas Blog. https://www.codingninjas.com/blog/2021/08/17/how-to-find-the-kth-smallest-element-in-an-array/
5. Hamiltonian Cycle using Backtracking. (2022, June 7). CodeCrucks. https://codecrucks.com/hamiltonian-cycle-using-backtracking/

VI
SEMESTER

BIOINFORMATICS (BT-601/3466)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course, students will be able to know about different bioinformatics tools and their applications.

1. Understand concepts and application of Bioinformatics and databases.
2. Understand about sequence similarity and sequence alignment.
3. Understand basic concept of Protein structure prediction and gene prediction by various methods.
4. Understand the basic concept of structure visualization tools and structure classification methods
5. Know about Phylogenetics and various tools for phylogenetic analysis.

Unit I:

File format for storage of sequence and structural data, Primary sequence database of nucleic acids and proteins, organism specific genome database, structural database, specialized sequence database (OMIM & Unigene), data retrieval with ENTREZ & SRS, Secondary database (Pfam, Prosite and Block)

Unit II:

Sequence alignment (Pairwise & multiple sequence alignment), database similarity searches (BLAST, FASTA and PSI – BLAST), Amino acid substitution matrices, profile and Motif.

Unit III:

Protein structure prediction (Secondary and Tertiary), Homology modelling, ORF prediction, Gene prediction.

Unit IV:

Structure visualization methods, structure classification, structural alignment and analysis, bioinformatics applications in drug designing, molecular modelling and simulation (basic concepts including concept of force fields).

Unit V:

Phylogenetics – tree construction methods and evaluation methods, neural network, E/M algorithms, Clustering (including k-means clustering), Hidden Markov models, genetic algorithms, support vector machine, Bayes rule and Bayesian analysis.

Text books:

1. Xiong, J. (2012). Essential Bioinformatics. Cambridge University Press.
2. Bryant, S., Bouffard, G., Baxevanis, A. D., & Ouellette, B. F. F. (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley.
3. Lesk, A. (2019). Introduction to Bioinformatics (5th ed.). Oxford University Press.
4. Edwards, D., Stajich, J., & Hansen, D. (2014). Bioinformatics: Tools and Applications (2009th ed.). Springer.
5. Team, Z. (2020). A brief guide to the different methods of phylogenetic tree construction. https://blog.zageno.com/guide-to-the-different-methods-of-phylogenetic-tree-construction
6. Protein Structure Prediction-Introduction. (2017, April 18). BiologicsCorp. https://www.biologicscorp.com/blog/protein-structure-prediction-methods-introduction/

BIOINFORMATICS LAB (BT-651/30471)

L T P
0 0 3

Course Outcomes (COs):

On the successful completion of the course, students will be able to know about different bioinformatics tools and their applications.

1. Understand concepts and application of Bioinformatics and databases.
2. Understand about sequence similarity and sequence alignment.
3. Understand basic concept of Protein structure prediction and gene prediction by various methods.
4. Understand the basic concept of structure visualization tools and structure classification methods
5. Know about Phylogenetics and various tools for phylogenetic analysis.

1. To study the structural data

2. Access and use of different online protein and gene alignment software.

3. Secondary structure prediction for amino acid sequences of a given protein.

4. Establishment of method for gene and protein phylogeny by taking specific example.

5. Exploring Meta Servers for 2D and 3D structure prediction

Reference books:

1. Xiong, J. (2012). Essential Bioinformatics. Cambridge University Press.

2. Bryant, S., Bouffard, G., Baxevanis, A. D., & Ouellette, B. F. F. (2005). Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley.

3. Lesk, A. (2019). Introduction to Bioinformatics (5th ed.). Oxford University Press.

4. Edwards, D., Stajich, J., & Hansen, D. (2014). Bioinformatics: Tools and Applications (2009th ed.). Springer.

5. Team, Z. (2020). A brief guide to the different methods of phylogenetic tree construction. https://blog.zageno.com/guide-to-the-different-methods-of-phylogenetic-tree-construction

6. ColabFold: AlphaFold2 using MMseqs2 (2021) https://colab.research.google.com/github/sokrypton/ColabFold/blob/main/AlphaFold2.ipynb

Plant Biotechnology (BT-602/3467)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course, students will be able to know transgenic plant and their applications.

1. Understand the principle and basic requirements for plant tissue culture. Also explain the difference between tissue and organ culture and their applicability.
2. Understand haploid culture and in vitro selection of mutants, micropropagation and micrografting.
3. To know about somaclonal variation for improved crop varieties in vitro cultures.
4. To obtain the knowledge of gene transfer methods in plants.
5. To explain the development of transgenic plants through genetic manipulations.

Unit I:

Introductory history, laboratory organization, nutrition of plant cells – media composition solid and liquid, biology plant in culture, tissue and organ culture – establishment and maintenance of callus and suspension culture, cellular differentiation and regulation of morphogenesis, somatic embryogenesis, control of organogenesis and embryogenesis, single cell methods, cytology of callus, tissue culture and genetic engineering.

Unit II:

Haploid production – Androgenesis: anther and microspore culture, Gynogenesis: embryo culture and rescue in agriculture and horticulture crops, Protoplast isolation, culture regeneration, somatic hybrid – cybrids, invitro selection of mutants for salt, disease, cold, drought herbicide and other stress condition, plant micropropagation, application of micropropagation in forestry, micrografting – invitro Clonal multiplication meristem culture and virus elimination – shoot tip culture.

Unit III:

Improved crop variety through somaclonal variation – invitro culture causes stability and utilization genetic and epigenetic basis, establishment of cell lines and evaluation, secondary metabolite culture in cell culture, application of tissue culture for crop improvement in agricultural, horticulture and forestry.

Unit IV:

Introduction to plant genetic engineering – plant transformation with Ti plasmid of Agrobacterium tumefaciens, Ti derived vector system, physical methods for gene transfer in plants – Microprojectile bombardment, electroporation, Manipulation of gene expression in plants, production of marker free transgenic plants.

Unit V:

Developing insect resistance, disease resistance, herbicide resistance, stress and genetic manipulation of flower pigmentation, developing quality of seed storage, Provitamin A and iron rich in rice, modification of food plant test and appearance, yield increase in plants, wild plant verities as source of novel genes, plants as bioreactor antibodies, polymers, foreign proteins in seeds genomic mapping efforts in rice & maize potential application.

Text Books:

1. Stewart, N.C. (2016). Plant Biotechnology and Genetics: Principles, Techniques, and Applications (2nd ed.). Wiley.
2. Trigiano, R. N., & Gray, D. J. (1999). Plant Tissue Culture Concepts and Laboratory Exercises, Second Edition. Taylor & Francis.
3. Bhojwani, S. S. & Razdan, M. K. (2022). Plant Tissue Culture: Theory And Practice. Bio-Green Books.
4. Introduction to Genetic Engineering. (2013). Sierra Club. https://www.sierraclub.org/missouri/blog/2013/12/introduction-genetic-engineering
5. The Techniques of Haploid Production. (2022). Plant Cell Technology | Your Partner in Plant Tissue Culture. https://www.plantcelltechnology.com/blog/the-techniques-of-haploid-production-4e0e3d/

FERMENTATION BIOTECHNOLOGY (BT-603/3468)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Examine the application of biological and engineering principles to problems involving microbial, mammalian, and biological/biochemical systems.
2. Recognize the fundamentals of fermentation technology.
3. Describe current knowledge in biological and biochemical technology, with a focus on industrial practices.
4. Comprehend growth and metabolism, genetics and metabolic engineering in the age of genomics and applications of the modern biological concepts in bioprocess developments.
5. Assess traditional and new concepts in bioprocess monitoring, and the biological basis for industrial fermentations and cell cultures.

Unit I:
History and development of fermentation industry, Inoculum development, Classification of fermentation process: introduction to submerged and solid-state fermentation, Primary and secondary metabolite.

Unit II:
Availability of various raw materials, storage, quality analysis and pre-treatment of raw materials.

Unit III:
Different regulatory mechanisms in controlling the catabolic and anabolic processes of microbes. Induction, nutritional repression, carbon catabolite repression, crabtree effect. feed bed inhibition and repression.

Unit IV:
Creation/procedures for developing mutant of the desired microbe's with the stable capacity of producing desired metabolites. Isolation and preservation of different types of mutants induction resistant, feedback inhibition resistant. Concept of overproduction of metabolites.

Unit V:
Fermentation of recombinant microbial cells for large scale production of genetically engineered primary and secondary metabolites.

Reference books:
1. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
2. Willey, J. M., Prescott, L. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. McGraw-Hill Education.
4. Rehm, H. (1989). Biotechnology, Special Microbial Processes. Wiley-Blackwell.
5. Aiba, S., Doelle, H. W., Ewings, K. N., Fan, L. T., Gharpuray, M. M., Hollywood, N. W., Lee, K. J., Lee, Y., Rogers, P. L., Skotnicki, M. L., & Tribe, D. E. (2013). Microbial Reactions (Advances in Biochemical Engineering/Biotechnology, 23). Springer.
6. Facts at your Fingertips: Industrial Microorganisms. (2020) Chemical Engineering. https://www.chemengonline.com/industrial-microorganisms/
7. Awasthi, P. (2016). Control of Metabolism in Microorganisms. Biology Discussion. https://www.biologydiscussion.com/organism/metabolism-organism/control-of-metabolism-in-microorganisms/50863

FERMENTATION BIOTECHNOLOGY LAB (BT-653/30472)

L T P
0 0 4

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Designing of fermentation processes for differenct product
2. Understand the fermentation process for the production of different product

1. Study of induction effect of galactosidase enzyme in *E.coli.*
2. Fermentation of ethyl alcohol using *Candida albicans.*
3. Fermentation of cetric acid using *Aspergillusniger.*
4. Creation of auxotropic mutants for lysine, valine and essential amino acids.
5. Designing of fermentation processes for penicillin and 6-APA.
6. Design of fermentation process for lysine.
7. Yeast fermentation for production of ethanol.
8. Fermentation of Penicilliumcrysogenum to produce penicillin.

Reference books:

1. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
2. Willey, J. M., Prescott, L. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. McGraw-Hill Education.
4. Rehm, H. (1989). Biotechnology, Special Microbial Processes. Wiley-Blackwell.
5. Aiba, S., Doelle, H. W., Ewings, K. N., Fan, L. T., Gharpuray, M. M., Hollywood, N. W., Lee, K. J., Lee, Y., Rogers, P. L., Skotnicki, M. L., & Tribe, D. E. (2013). Microbial Reactions (Advances in Biochemical Engineering/Biotechnology, 23). Springer.
6. Facts at your Fingertips: Industrial Microorganisms. (2020) Chemical Engineering. https://www.chemengonline.com/industrial-microorganisms/
7. Awasthi, P. (2016). Control of Metabolism in Microorganisms. Biology Discussion. https://www.biologydiscussion.com/organism/metabolism-organism/control-of-metabolism-in-microorganisms/50863

GENETIC ENGINEERING (BT-604/ 3469)

L T P
3 0 0

Course Outcomes

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

1. Understanding the basic steps of gene cloning and the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering.
2. Getting detailed knowledge of gene transfer methods and identifying suitable hosts for cloning.
3. Describes the gene library, screening and expression in bacteria/ yeast cells.
4. Acquiring theoretical knowledge in the techniques, tools, and application and safety measures of genetic engineering.
5. Studying the basics of signaling molecules, DNA sequencing, synthesis and related techniques.

Unit I:

Restriction and modification Enzymes, enzymes used in Recombinant DNA Technology (RDT): ligases, alkaline phosphatase and other enzymes useful in gene cloning, PCR for gene (DNA) detection.

Unit II:

Gene cloning: concepts and basic steps, features of cloning vectors, Vector used in genetic engineering: plasmid vector, bacteriophage (M13 and lamda vector), Ti plasmid, cosmid, phagemid, artificial chromosomes. Use of marker gene. Cloning of foreign genes: DNA delivery method physical and biological methods, Genetic transformation in prokaryote: transferring DNA into *E. coli* – chemical induction and Electroporation.

Unit III:

Gene library: construction of cDNA library and genomic library, screening of gene library-screening by DNA hybridization, immunological assay and protein activity; Marker gene: selectable and screenable marker, translation expression vector; lncreasing secretion of gene; recombinant protein production in yeast: *Saccharomyces cerevisiae* expression systems; mammalian cell expression Vectors.

Unit IV:

Cloning of sheep (Dolly) & other mammals; ethical issues and prospects for human cloning; two vector expression system; site-directed mutagenesis (SDM); DNA fingerprinting, transposon mutagenesis, gene targeting, *In-situ* hybridization, RAPD, RFLP, Gene therapy.

Unit V:

General principle of cell signaling, extra cellular signal molecule and their receptors, operation of signaling molecules over various distances sharing of signal information, cellular response to specific combination of extracellular signal molecules, Western, Southern and Nothern blotting, dot-blot hybridization, Antisense RNA technology DNA labeling, DNA Sequencing,.

Textbooks and references

1. Primrose, S. B., Twyman, R. M., & Old, R. W. (2002). Principles of Gene Manipulation (6th ed.). Wiley-Blackwell.
2. Lewin, B. (2008). Genes 9. Jones & Bartlett Learning.
3. University Harvey Lodish, Lodish, H., Berk, A., Kaiser, U. C. A., Kaiser, C., Krieger, M., University Chris A Kaiser, Scott, M. P., Bretscher, A., Ploegh, H., Matsudaira, P., University Hidde Ploegh, & University Paul Matsudaira. (2008). Molecular Cell Biology. W. H. Freeman.
4. Brown, T. A. (2020). Gene Cloning and DNA Analysis: An Introduction (8th ed.). Wiley-Blackwell.
5. Cooper, G. M., & Hausmann, R. E. (2013). The Cell: A Molecular Approach, Sixth Edition (Looseleaf) (6th ed.). Sinauer Associates, Inc.
6. Watson, J.D. (2017). Molecular Biology Of The Gene, 7Th Edn. Pearson Education.
7. The Life of Dolly. Dolly the Sheep. https://dolly.roslin.ed.ac.uk/facts/the-life-of-dolly/index.html
8. Aryal, S. (2022a, September 5). Gene Cloning- Requirements, Principle, Steps, Applications. Microbe Notes. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

GENETIC ENGINEERING LAB (BT-654/30473)

L T P
0 0 3

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Isolate and extract plasmid and genomic DNA
2. Cloning and quantification of DNA
3. Perform different blotting techniques

1. Extraction and isolation of plasmid DNA.

2. Isolation of genomic DNA.

3. Agarose gel electrophoresis to know the molecular weight of unknown DNA.

4. Agarose /PAGE electrophoresis to elute the desired DNA.

5. Restriction map preparation for a given DNA.

6. Estimation and quantification of DNA.

7. Cloning experiment for a given DNA fragment into a plasmid vector.

8. Transformation of the recombinant vector in *E.coli*

9. Southern Blotting.

10. Western Blotting.

Reference books:

1. Primrose, S. B., Twyman, R. M., & Old, R. W. (2002). Principles of Gene Manipulation (6th ed.). Wiley-Blackwell.
2. Lewin, B. (2008). Genes 9. Jones & Bartlett Learning.
3. University Harvey Lodish, Lodish, H., Berk, A., Kaiser, U. C. A., Kaiser, C., Krieger, M., University Chris A Kaiser, Scott, M. P., Bretscher, A., Ploegh, H., Matsudaira, P., University Hidde Ploegh, & University Paul Matsudaira. (2008). Molecular Cell Biology. W. H. Freeman.
4. Brown, T. A. (2020). Gene Cloning and DNA Analysis: An Introduction (8th ed.). Wiley-Blackwell.
5. Cooper, G. M., & Hausmann, R. E. (2013). The Cell: A Molecular Approach, Sixth Edition (Looseleaf) (6th ed.). Sinauer Associates, Inc.
6. Watson, J.D. (2017). Molecular Biology Of The Gene, 7Th Edn. Pearson Education.
7. The Life of Dolly. Dolly the Sheep. https://dolly.roslin.ed.ac.uk/facts/the-life-of-dolly/index.html
8. Aryal, S. (2022a, September 5). Gene Cloning- Requirements, Principle, Steps, Applications. Microbe Notes. https://microbenotes.com/gene-cloning-requirements-principle-steps-applications/

BIOPROCESS ENGINEERING-II (BT-3470)

L T P
3 0 0

Course Outcomes

On the successful completion of the course, students will be able to

1. Understand and explain the definition of bioprocess techniques and their position in the scientific tree, including biosystem engineering
2. Explain aliphatic compounds, functional groups and organic compounds.
3. Analyze and present the principles of bioprocess engineering.
4. Understand and explain the development of bioprocess engineering in educational world and industry to support a bio-based economy
5. To apply engineering principles in determining and solving contemporary and complex problems related to bioprocessing.

UNIT 1:

Microbial growth in closed, semi-open and open cultivation systems, turbiodostat, chemostat with feedback of biomass.

UNIT II:

Death of cells in growing culture, death rate, production of dead cells at the time of division, effect of cell death on growth. Condition affecting metabolic fates of carbon and energy substrates.

UNIT III:

Mass transfer in different reaction systems. Materials and energy balance in steady and unsteady reaction systems. Oxygen demand and supply . Effect of oxygen on microbial culture.

UNIT IV:

Types of bioreactors- batch, fed-batch, fluidized bed, plug flow reactor, air lift, bubble column and continuous stirred tank reactor. Scale-up of bioprocess; general aspect and scale up methods, practical considerations for bioreactor construction for cells and enzymes.

UNIT V:

Instrumentation for environmental control of fermentation system, physical environment sensors, Chemical environment sensors, direct and indirect control. PID controllers, fuzzy logic based controllers and artificial neural network based controllers. Bioprocess economics

Reference books:

1. Tsao, G. T. (1976). Principles of microbe and cell cultivation, S. John Pirt, Halsted Press, Division of John Wiley and Sons, New York, 274 pages,$34.00. AIChE Journal, 22(3), 621–621. https://doi.org/10.1002/aic.690220342
2. Doran, P. M. (1995). Bioprocess Engineering Principles (1st ed.). Academic Press.
3. Bailey, J. (2022). Biochemical Engg Fundamentals (2nd ed.). MC GRAW HILL INDIA.
4. Stanbury P.F., Whitaker A. & Hall S.J. (2016) Principles of Fermentation Technology. Butterworth-Heinemann.
5. O'Brien, M. (2016). A Guide to Instrumentation for Ethanol Fuel Production. The Industrial Steam, Valve, and Process Control Blog. https://blog.meadobrien.com/2016/06/a-guide-to-instrumentation-for-ethanol.html
6. Jha, N. (2015, September 29). Bioreactors Types: 6 Types of Bioreactors used in Bioprocess Technology. Biology Discussion. https://www.biologydiscussion.com/biotechnology/bioprocess-technology/bioreactors-types-6-types-of-bioreactors-used-in-bioprocess-technology/10090

VII
SEMESTER

Nano Biotechnology (4461)

L T P
3 0 0

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

1. Understand the basics of Nanotechnology and Nanobiotechnology.
2. Explain the interaction between biomolecules and nanoparticle surface and its applications.
3. Engineering at Nano scale, Optimize the synthesis of Biocompatibility of Nanomaterials.
4. Microbial production of nanoparticles.
5. Different types of DNA based Nanostructures.

Unit I:
Introduction to Nano Technology & Nano Biotechnology, History of Nano Technology & Nano Biotechnology, Cell-Nano Structure Interaction.

Unit II:
Protein based nano structures, printing of proteins (contact, micro contact, Affinity), micro contact printing polypeptide,: protein – protein interaction studies.

Unit III:
Engineered Nano pores, potential applications of Nano-pores, Biomineralization of magnetosomes in bacteria, Microbial production of alginates.

Unit IV:
Inorganic and organic nanoparticles production by Microbial rout, Quantum dots (nano robots), use of Quantum dots, polyhydroxy alkenoates in nanobiotechnology produced by microbes.

Unit V:
DNA based nanostructures, DNA protein nanostructures, DNA template electronics, DNA nanostructure for mechanics and computing biomimetic fabrication of DNA based metallic nanowires and networks.

References

1. Niemeyer, C. M., & Mirkin, C. A. (2004). Nanobiotechnology: Concepts, Applications and Perspectives (1st ed.). Wiley-VCH.
2. Goodsell, D. S. (2006). Bionanotechnology: Lessons from Nature.
3. Vo-Dinh, T. (2019). Nanotechnology in Biology and Medicine: Methods, Devices, and Applications, Second Edition. Amsterdam University Press.
4. Wang, Z. (2020). Protein-based functional nanocomposites | MRS Bulletin. Cambridge Core. https://www.cambridge.org/core/journals/mrs-bulletin/article/abs/proteinbased-functional-nanocomposites/631B71D2C0BCC68A324086AA9C9E2CF4
5. Berger, M. (2022, February 17). Using DNA to make nanoelectronics. https://www.nanowerk.com/spotlight/spotid=59822.php

NON-CONVENTIONAL ENERGY RESOURCES (OE-01/4462)

LTP
3 0 0

Course Outcomes:

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

1. Understand the basics of Non-conventional energy resources .
2. Understand the fundamental and application of Wind energy.
3. Understand the fundamental and application of Solar energy.
4. Understand the fundamental and application of Biogas Technology.
5. Understand the fundamental and application of Bioethanol and biodiesel technology.

UNIT I:

Various non-conventional energy resources introduction availability, classification, relative merits and demerits. Renewable energy resources, prospects of renewable energy; Solar energy fundamentals and application: geothermal energy resources, geothermal energy gradient, different types of geothermal energy, geothermal energy resources, geothermal gradient, different types of geothermal electric power plant and their operations for geothermal energy systems in India.

UNIT II:

Wind energy: fundamentals and applications, basic principle of wind energy conversion, wind energy conversion system, performance of wind machines, electric generation for wind. Introduction ocean energy conversion technologies, types of ocean thermal electric power generation system and their operation. Tidal power plant: hydro energy: introduction types re electric plants and energy conversion, Impulse machine and reaction turbine.

UNIT III:

Solar energy: fuel cell, solar energy: Photochemical and photovoltaic conversion and utilization methods, solar water heating, cooking, drying, and its use for other industrial processes, solar cells and their material and mode of operation. Direct and indirect methods solar energy storage, sensible heat and latent heat storage materials solar ponds. Biogas technology Feedstock for biogas production, Aqueous wastes containing biodegradable

UNIT IV:

Biogas technology: Feedstock for biogas production, Aqueous wastes containing biodegradable organic matter, animal residues- microbial and biochemical aspects parameters for biogas production kinetics and mechanism- Dry and wet fermentation. Digesters for rural applications- high rate digesters for industrial waste water treatment.

UNIT V:

Bioethanol and biodiesel technology: Production of fuel ethanol by fermentation of sugars, Gasohol as a substitute for leaded petrol- trans-esterification of oils to produce diesel

Reference books:

1. Rai, G. D. (2009). Non- Conventional Sources of Energy. Macmillan Publishers.
2. Rajput, R. K. (2014). Non Conventional Energy Source Utilization. S.Chand Publishing.
3. Kanoglu, M., Cengel, Y.A., Cimbala, J.M. (2020). Fundamentals And Applications Of Renewable Energy (1st ed.). McGraw Hill.
4. Krishna, N. (2022, September 13). How green hydrogen can decarbonise the future. Indian Biogas Association. https://biogas-india.com/how-green-hydrogen-can-decarbonise-the-future/
5. Wind, B. O. T. (2012, February 13). Solar Thermal Panels, Practical but Not Yet Popular – A Solar Overview. CleanTechnica. https://cleantechnica.com/2011/10/03/hot-panels-practical-but-not-yet-popular-%E2%80%93-a-solar-overview/

ENVIRONMENT BIOTECHNOLOGY (BT-701/ 4463)

L T P
3 0 0

Course Outcomes:

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

1. Understand and assimilate the specific concepts and terminology of environmental biotechnology.
2. Describe the scientific bases that are applied by environmental biotechnology.
3. Describe the properties of microorganisms with potential application to environmental biotechnology processes.
4. Explain the technologies, tools and techniques in the field of environmental biotechnology.
5. Know the role of microorganisms as biotechnological agents.

Unit I:

Concepts of the environments: Ecosystem, Factors of environmental degradation. Pollutants and their types: nature and source. Different biogeochemical cycles including nitrogen, carbon, hydrogen, oxygen etc

Unit II:

Biosensors for environmental testing: Physical, chemical and biological for sensing the pollutions. Pollution monitoring and measurement.

Unit III:

Waste disposal and management; legislation of environmental problems, Microbiological and biochemical aspects of waste treatment processes, Microbial strain improvement with a view to develop scavengers, Bioremediation. Biological treatment of solid wastes.

Unit IV:

Characteristics of wastewater; aerobic and anaerobic waste treatment processes. Process design, Single stage and two stage anaerobic digestion. Methanogenesis- Methanogenesis & Fermentative bacteria. Technical process & conditions. Kinetic models for biological waste treatment -Bioconversions of agricultural and other highly organic waste materials into gainfully utilizable products- Biogas, Biohydrogen, Cellulases, food and feed stocks, Vermiculture technology

Unit V:

Downstream processing in biological treatment process: Effluent disposal and reuse. Biofiltration for waste gas treatment, purification of biogas, Containment of biological treatment processes, wastewater treatment using aquatic plants, heavy metal removal by hairy roots.

Reference books:

1. Jördening, H., & Winter, J. (2005). Environmental Biotechnology: Concepts and Applications (1st ed.). Wiley-Blackwell.
2. Metcalf & Eddy, Inc., Tchobanoglous, G., Burton, F., & Stensel, H. D. (2022). Wastewater Engineering: Treatment And Reuse (4th ed.). Mc Graw Hill India.
3. Timmerman, P., & Munn, T. (2003). Encyclopedia of Global Environmental Change, Social and Economic Dimensions of Global Environmental Change. Wiley.
4. SafetyCulture. (2022, August 29). What is Waste Management? Waste Disposal Methods. https://safetyculture.com/topics/waste-management-system/
5. Fulekar, H. (2022). Environmental Biotechnology. T&F INDIA.

ANIMAL CELL CULTURE AND TISSUE ENGINEERING (BT-702/ 4464)

L T P
3 0 0

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Understand basic laboratory techniques and cell culture methods
2. Understand cell transformation, subculturing and development of transgenic animals
3. Know about utilization of cell culture in biomedical as well as industrial applications
4. Obtain the knowledge of tissue organization and tissue engineering
5. Explain biomaterial development, its use in tissue engineering and development of artificial tissues and organs

Unit I:

Basic laboratory techniques, cell culture media, Different type of cell culture methods for primary cell, Established cell line & organ culture.

Unit II:

Cell synchronization and cell transformation. Maintenance of cell culture through subculture and cloning, cryopreservation. Embryonic cell lines, gene transfers and transgenic animals and embryo transfer technology.

Unit III:

Application of cell in culture, pharmaceuticals, vaccines, monoclonal antibodies, recombinant protein.

Unit IV:

Introduction to tissue engineering: Tissue organization, Tissue components, Tissue types, Functional Subunits. Cell extracellular matrix interactions: Binding to the ECM, Modifying the ECM, Malfunction in ECM signaling. Direct cell-cell contact: Cell Junction ion tissues, malfunctions in direct cell-cell contact signaling.

Unit-V

Biomaterials in tissue engineering: Biodegradable polymers and polymer scaffold processing. Growth factor delivery, Bioreactor for tissue engineering: case studies e.g. Artificial skin, Nerve regeneration etc.

Reference books:

1. Freshney, I. R., & Capes-Davis, A. (2021). Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications (8th ed.). Wiley-Blackwell.
2. Academic Press, Kruse, P. F., & Patterson, M. K. (1973). Tissue Culture: Methods and Applications. Academic Press.
3. Blitterswijk, C. van, Boer, J. de, Van Blitterswijk, C., & De Boer, J. (2014). Tissue Engineering. Elsevier Gezondheidszorg.
4. Biomaterials vs Tissue Engineering - what is the difference? (2020). https://www.biolinscientific.com/blog/biomaterials-vs-tissue-engineering-what-is-the-difference
5. Molecular Devices. (2022). Monoclonal Antibodies (mAbs). https://www.moleculardevices.com/applications/monoclonal-antibodies-mabs

ELECTIVE-II

FOOD BIOTECHNOLOGY (BT-703/4465)

L T P
3 0 0

Course Outcomes:

On the successful completion of the course, students will be able to

1. Understand and microbial role in food processing differentiate chemical interactions and reactions of food components
2. Understand the role of fermentation ion preparing and preserving food
3. Understand the production of fermented foods and beverages
4. Understand the enzyme catalytic actions in food processing and classification of fruit juice
5. Understand the Post harvest technology and process of food preservation

Unit I:
Microbial role in food process, operation and production: new protein foods-SCP, mushroom, food yeast, algal proteins**.**

Unit II:
Fermentation as a method for preparing and preserving foods, food additives like coloring, flavors and vitamins.

Unit III:
Organisms and their use for production of fermented foods and beverages: pickling, alcoholic beverages, cheese, sauerkraut, idle, vinegar.

Unit IV:
Deoxygenating and designating by glucose oxidase, beer mashing and chill proofing or cheese making by proteases and various other enzyme catalytic actions in food processing, classification of fruit juice.

Unit V:
Post harvest technology and process of food preservation.

Reference books:

1. Frazier, W. C., Westhoff, D. C., & Vanitha, N. M. (2022). Food Microbiology, 5Th Edition (5th ed.). Mc Graw Hill India.
2. Heller, K. J. (2006). Genetically Engineered Food: Methods and Detection. Wiley.
3. Rehm, H. (1989). Biotechnology, Special Microbial Processes. Wiley-Blackwell.
4. Chakraverty, A., & Singh, R. P. (2014). Postharvest Technology and Food Process Engineering. Taylor & Francis.
5. Coyle, D. A. (2020, August 20). What Is Fermentation? The Lowdown on Fermented Foods. Healthline. https://www.healthline.com/nutrition/fermentation.
6. DM-6: Lesson 31. FERMENTED FOODS. (2012). http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5168

ENVIRONMENTAL BIOTECHNOLOGY LAB (BT-751 / 40466)

L T P
0 0 2

Course Outcomes (COs):

On the successful completion of the course, students will be able to

1. Perform physio-chemical and biological charecterization of waste water
2. Determine BOD, COD, MLVSS etc in waste water

1. Physico-chemical and biological characterization of waste water.
2. Determination of total solids, total dissolved solids, total suspended solids, volatile solids, fixed
3. Solid/ash content and moisture content in solid waste and waste water.
4. Determination of MLVSS.
5. Determination of sludge volume index and food to microorganisms.
6. Determination of Kjeldahl nitrogen, nitrate and nitrite nitrogen.
7. Determination of inorganic phosphates.
8. Determination of BOD of wastewater samples.
9. Determination of COD of wastewater samples.

Reference books:

1. Jördening, H., & Winter, J. (2005). Environmental Biotechnology: Concepts and Applications (1st ed.). Wiley-Blackwell.
2. Metcalf & Eddy, Inc., Tchobanoglous, G., Burton, F., & Stensel, H. D. (2022). Wastewater Engineering: Treatment And Reuse (4th ed.). Mc Graw Hill India.
3. Timmerman, P., & Munn, T. (2003). Encyclopedia of Global Environmental Change, Social and Economic Dimensions of Global Environmental Change. Wiley.
4. SafetyCulture. (2022, August 29). What is Waste Management? Waste Disposal Methods. https://safetyculture.com/topics/waste-management-system/
5. Fulekar, H. (2022). Environmental Biotechnology. T&F INDIA.
6. Antoni, B.M.D., Iracà, F., Romero, M. (2020). MLSS-MLVSS. https://pantareiwater.com/rd/howto/MLSS-MLVSS#:~:text=Determination%20of%20MLVSS&text=Weight%20the%20crucible%2Bfilter%20and,note%20(M3)%20%5Bmg%5D%3B

SEMINAR (BT-752/40467)

L	T	P
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The students will be required to present a seminar on – Literature pertaining to design of equipment/ processing of product of importance for human beings/production of metabolites of microbial /Plant / animal origin comprehend it and prepare a report for assessment.

INDUSTRIAL/ORGANIZATIONAL TRAINING (BT-753/40468)

L T P
0 0 2

The student will be require to undertake training in the biotech industry /organization after third year B.Tech.(VI semester) for a specified period (four weeks) and submit its report after completion for presentation, evaluation and viva-voce examination in the VII semester of their studies in the final year B.Tech. (VII semester).

MINI PROJECT (BT-754/40469)

L	T	P
0	0	4

The students will be required to search literature pertaining to design of equipment/processing of products of importance for human beings/production of metabolites of microbial / plant / animal origin for innovative research purpose. Student have to comprehend it and prepare a project report for assessment.

VIII SEMESTER

BIOSEPARATION AND DOWNSTREAM PROCESSING (BT-802/ 4467)

L T P
3 0 0

Course Outcomes

On the successful completion of the course, students will be able to

1. Understand the overview of Bioseperation.
2. Understand the concept of Filteration and Microfilteration.
3. Understand the role of Physical method-osmotic shock, grinding with abrasives, solid shear, liquid shear
4. Nature and significance of Product isolation: Extraction and adsorption methods. Liquid-liquid separation distillation
5. Assessment of Electrophoresis and Chromatography principles for product purification.

Unit I:

Introduction; An overview of Bioseperation, Separation of cells and other insoluble from fermented broth.

Unit II:

Filtration and Micro filtration. Centrifugation (batch, continuous. designing of centrifuges for desired product of desired capacity.

Unit III:

Cell disruption: Physical method-osmotic shock, grinding with abrasives solid shear, liquid shear. Chemical methods- alkali reagents, enzymatic methods.

Unit IV:

Product isolation: Extraction and adsorption method, solid-liquid separation, liquid-liquid separation, distillation, precipitation method using ammonium sulfate, organic solvents, high molecular weight polymers. Reverse osmosis.

Unit V:

Electrophoresis and Chromatography principles for product purification. Different electrophoresis techniques viz. iso electric focusing, chromatographic techniques viz. paper, gel filtration, column, ion exchange, affinity, GLC, HPLC. Dialysis, ultrafiltration. Product polishing: Crystallization and drying.

Textbooks & references:

1. Bailey, J. (2022). Biochemical Engg Fundamentals (2nd ed.). Mc Graw Hill India.
2. Rehm, H. (1989). Biotechnology, Special Microbial Processes. Wiley-Blackwell.
3. Aiba, S., Doelle, H. W., Ewings, K. N., Fan, L. T., Gharpuray, M. M., Hollywood, N. W., Lee, K. J., Lee, Y., Rogers, P. L., Skotnicki, M. L., & Tribe, D. E. (2013). Microbial Reactions (Advances in Biochemical Engineering/Biotechnology, 23) (Softcover reprint of the original 1st ed. 1982). Springer.
4. Moo-Young, M. (2019). Comprehensive Biotechnology (3rd ed.). Pergamon.
5. Board, B. (1992). Product Recovery in Bioprocess Technology (Biotol Biotechnology by Open Learning) (1st ed.). Butterworth-Heinemann.
6. Stanbury, P.F., Whitaker, A. Hall, S.J. Principles of Fermentation Technology. (2016a). Butterworth-Heinemann.
7. Willard, Merritt, Dean, & Settle. (2004). Instrumental Methods Of Analysis 7Ed (Pb 1986) (7th ed.). CBS Publishers & Distributors.
8. Wilson, K., & Goulding, K. H. (1992). A Biologist's Guide to the Principles and Techniques of Practical Biochemistry (3rd ed.). Cambridge University Press.
9. Types of Chromatography. (n.d.). Bio-Rad Laboratories. https://www.bio-rad.com/en-nl/applications-technologies/types-chromatography?ID=MWHARM15
10. Bioseparation Processes | Novel Food Processes and Engineering. (n.d.). https://blogs.cornell.edu/rizvilab/research-novel-food-processes-and-engineering/bioseparation-processes/

Elective-III

IPR, BIOSAFTEY & BIOETHICS (BT-803/ 4468)

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Course Outcomes

On the successful completion of the course, students will be able to

1. Understand the basics of property, intellectual property right and Difference between various forms of property also history of these.
2. Knowledge of patent act and amendment in patent act, GI.
3. Recognition of various forms of IPR, knowledge about patentable invention and their requirements.
4. Understand protection of rights and remedies against infringement.
5. To introduce basic concepts of bioethics and biosafety that is essential.

Unit I:

Jurisprudential definition and concept of property, rights, duties and their correlation. History and evolution of IPR – like patent, design and copy right.

Unit II:

Indian patent act 1970(amendment 2000), international convention in IPR, major changes in Indian patent system as post TRIPS effects, obtaining patent (ii) geographical indication.

Unit III:

Distinction among various forms of IPR, requirement of a patentable novelty, invention step and prior art and state of art, procedure.

Unit IV:

Right/ protection, infringement or violation, remedies against infringement- civil and criminal.

Unit V:

Biosafety and Bioethical issues in Biotechnology.

Reference books:

1. Knight, J. H. (2013). Patent Strategy: For Researchers and Research Managers (3rd ed.). Wiley.
2. Sateesh, M.K. (2020). Bioethics and Biosafety. Dreamtech Press.
3. Takagi, Y., Allman, L., & Sinjela, M. A. (2008). Teaching of Intellectual Property: Principles and Methods. Cambridge University Press.
4. Banerjee, S. (2021, October 16). IPR and crimes : criminal remedies for IPR infringement in India. iPleaders. https://blog.ipleaders.in/ipr-and-crimes-criminal-remedies-for-ipr-infringement-in-india/
5. Centre for Intellectual Property Research and Advocacy - NLSIU. (2021, March 29). Blog IPR Law-IPR Law India - Indian IP Law Resources. https://iprlawindia.org/blog/

Elective-IV

INDUSTRIAL BIOTECHNOLOGY (BT-804/ 4469)

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Course Outcomes

On the successful completion of the course, students will be able to understand

1. Fermentative production of organic acids, Fermentative product of enzymes.
2. Fermentative product of biofertilizers, Biopesticide, Single cell protein (SCP) and Baker's yeast.
3. Fermentative product of antibiotics, Production of vitamins like Vitamin B_{12}, amino acids.
4. Fermentative production of organic solvents i.e. ethanol, Butanol and Acetone, Alcoholic beverages.
5. Biotransformation- Steroid transformation, Important products through r-DNA technology, Production of biosurfactants, biopolymers, Bioprocess economics.

Unit I:

Fermentative production of organic acids: Lactic acid, citric acid and Acetic acid,Fermentative product of enzymes: Proteases, Lipases and Amylases.

Unit II:

Fermentative product of biofertilizers i.e. Rhizobium, BGA, Biopesticide i.e. *Bacillus thuringienesis,* Single cell protein (SCP) and Baker's yeast.

Unit III:

Fermentative product of antibiotics: penicillin, streptomycin, tetracycline and cephalosporin. Production of vitamins like Vitamin B_{12}, amino acids i.e. L-glutamic acid, phenylalanineand L-lysine.

Unit IV:

Fermentative production of organic solvents i.e. ethanol, Butanol and Acetone. Alcoholicbeverages i.e. Beer, wine, Rum, Gin, Whisky and Brandy.

Unit V:

Biotransformation- Steroid transformation, Important products through r-DNA technology: hepatitis b vaccines, interferon, insulin, somatotropic hormone. Production of biosurfactants, bioplymers like xanthan gum and dextrin. Bioprocess Economics.

Reference books:

1. Allen, P. W. (2018). *Industrial Fermentations*. Sagwan Press.
2. El-Mansi, E. M. T., Bryce, C. F. A., Demain, A. L., & Allman, A. R. (2006). Fermentation Microbiology and Biotechnology, Second Edition (No Series) (2nd ed.). CRC Press.
3. Frazier, W. C., & Westhoff, D. C. (2022). Food Microbiology, 5Th Edition (5th ed.). Mc Graw Hill India.
4. Willey, J. M., Prescott, L. M., Sherwood, L., & Woolverton, C. J. (2008). Prescott, Harley, and Klein's Microbiology. McGraw-Hill Education.
5. Das, D. (2017) Industrial Biotechnology. https://archive.nptel.ac.in/courses/102/105/102105058/
6. Fermentation process of antibiotics. (2018) Labmonk. https://labmonk.com/fermentation-process-of-antibiotics

PROJECT (BT- 851/ 40471)

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The students will be required to perform experiments related to objective defined in mini project to obtain the final result. Stdents have to prepare a thesis of their work which will be evaluated by external examiner followed by presentation and viva voce.

GUIDELINES
FOR THE PREPARATION OF
B.Tech. Thesis

A
PROJECT REPORT
ON

"TITLE"

Submitted for partial fulfillment of award of the degree

BACHELOR OF TECHNOLOGY

In
Name of the branch

To

Department of……,
Institute of Engineering and Technology

By
STUDENT 1
STUDENT 2
STUDENT 3
STUDENT 4

Under The Supervision of

Name of the GUIDE

Department of ……

Institute of Engineering and Technology,

Bundelkhand University

Jhansi -284128 (U.P.), India

Candidate's Declaration

I/we hereby declare that the work embodied in this dissertation entitled "**TITLE**", for the partial fulfillment of award of Degree of Bachelor of Technology in Biotechnology submitted in the Department of …….Institute of Engineering & Technology, Bundelkhand University, Jhansi, is an authentic work , under the guidance of **name of the GUIDE**, Asst. Prof. Department of …….Institute of Engineering & Technology, Bundelkhand University, Jhansi.

I/we have not submitted the work embodied here elsewhere for the award of any other degree.

STUDENT 1 (Roll no.)
STUDENT 2 (Roll no.)
STUDENT 3 (Roll no.)
STUDENT 4 (Roll No.)

Date-

Place-

Certificate

This is to certify that the work embodied in the project report entitled **"TITLE"** has been carried out by …..name of the students with roll no..for the partial fulfillment of award of the degree of **Bachelor of Technology_in Biotechnology** under my supervision. The work has been carried out by them at the department of…….., Institute of Engineering and Technology, Bundelkhand University, Jhansi (UP) is genuine and original.

Date:

NAME OF THE GUIDE

,

Department of …

IET, B.U. Jhansi

284128

ACKNOWLEDGEMENTS

(This section is for acknowledging all the individuals and organizations that were instrumental to your work. The candidate is free to modify this page as seen fit.

The acknowledgment of the thesis is written in gratitude to all those who were instrumental in bringing the thesis to fruition. The language used should be formal.

Acknowledge those who have assisted technically (including materials, supplies), intellectually (assistance, advice), and financially (funding agency, institutional support, travel grants).

It is mandatory to acknowledge the institute and the funding agency if any.)

TABLE OF CONTENTS

* Results and Discussion Sections could be combined, if needed.

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS (Optional)

S No	Abbreviation	Full Form

If a large number of abbreviations are used in the thesis, which may be unfamiliar to a reader, a list of abbreviations may be useful

References (Sample)

1. Papers with Single Author,
Bruce Rittmann, E. (1996) How input biomass affects sludge age and process stability. ASCE: Jour. Env. Engg, 122, 4-8.

2. Papers with Two Authors,
Bliss, P. J. and D. Barnas (1986) Modeling Nitrification in Plant Scale Activated Sludge. Water Science and Technology, 18,139-148.

3. Papers with more than two Author,
Capodaglio, A.G., H.V. Jones, V. Novotny and X. Feng (1991) Sludge bulking analysis and forecasting: application of system identification and artificial neural computing technologies. Water Res., 25, 1217–24.

4. Books
APHA, AWWA and WPCF Standard methods for the examination of water and wastewater, 17th Edition, Washington, D.C.: American Public Health Association, 1989.

PAGE DIMENSIONS AND MARGIN

Paper size : 80 gsm. Standard A4 size (210 mm X 297 mm)

Margins

Top edge : 1 inch (25 mm)

Left side : 1 ½ inch (38 mm)

Bottom edge : 1 inch (25 mm)

Right side : 1 inch (25 mm)

Print out : Laserjet or Inkjet printer, printed on only one side

Font size : Times New Roman of 12 pts (regular Text)

Spacing : 1.5 line spacing

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Binding : Soft binding (edge with black color strip)

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B.Tech . : 3 (Candidate (as individual), Guide, Department)