UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

NOTIFICATION

On the recommendations of Academic Council made in its 19th (4/2023) meeting held on 13.09.2023, the Syndicate in its 64th (4/2023) meeting held on 03.11.2023 has approved the curricula of the following academic programs for implementation w.e.f Fall 2023, already notified provisionally vide No. SU/Acad/23/1015 dated 01.11.2023:

1.	BS in Urdu	(Annex-'A')
2.	BS in Islamic Studies	(Annex-'B')
3.	BS in English (Linguistics)	(Annex-'C')
4.	BS in English (Language & Literature)	(Annex-'D')
5.	BS in Media and Communication Studies	(Annex-'E')
6.	BS in Physical Education	(Annex-'F')
7.	BS in Fine Arts	(Annex-'G')
8.	BS in Textile Design	(Annex-'H')
9.	BS in Graphic Design	(Annex-'I')
10.	BS in Chemistry	(Annex-'J')
11.	BS in Physics	(Annex-'K')
12.	BS in Statistics	(Annex-'L')
13.	BS in Botany	(Annex-'M')
14.	BS in Mathematics	(Annex-'N')
15.	BS in Geology	(Annex-'O')
16.	BS in Geography	(Annex-'P')
17.	BS in Zoology	(Annex-'Q')
18.	BS in History	(Annex-'R')
19.	BS in Pakistan Studies	(Annex-'S')
20.	BS in Education	(Annex-'T')
21.	BS in Sociology	(Annex-'U')
22.	BS in Social Work	(Annex-'V')
23.	BS in Economics	(Annex-'W')
24.	BS in Psychology	(Annex-'X')
25.	BS in International Relations	(Annex-'Y')
26.	BS in Political Science	(Annex-'Z')

2. Further, on the recommendations of Academic Council made in its 19th (4/2023) meeting held on 13.09.2023, the Syndicate in its 64th (4/2023) meeting held on 03.11.2023 has approved the curricula of the following academic programs for implementation w.e.f Fall 2023:-

1.	BS in Information Management	(Annex-'ZA')
2.	BS in Arabic	(Annex-'ZB')
3.	BS in Persian	(Annex-'ZC')
4.	BS in Punjabi	(Annex-'ZD')
5.	BS in Digital and Social Media	(Annex-'ZE')
6.	BS in Strategic Communication	(Annex-'ZF')
7.	BS in Theatre, Film & Television	(Annex-'ZG')
8.	BS in Interior Design	(Annex-'ZH')
9.	BS in Bio-Chemistry	(Annex-'ZI')
10.	BS in Biotechnology	(Annex-'ZJ')
11.	B.Ed (Hons.) Elementary	(Annex-'ZK')
12.	BS in Special Education	(Annex-'ZL')
13.	BBA (4 Years)	(Annex-'ZM')
14.	BS in Commerce	(Annex-'ZN')
15.	BS in Banking and Finance	(Annex-'ZO')
16.	BS in Entrepreneurship and SME Management	(Annex-'ZP')
17.	BS in Public Administration	(Annex-'ZQ')
18.	BS in Business Analytics	(Annex-'ZR')

Curriculum

BS Biotechnology
2023

1. **Title of Degree Program:** BS in Biotechnology
2. **Program Learning Objectives:** The Bachelor of Science in Biotechnology program is designed to equip students with a comprehensive understanding of the interdisciplinary field of biotechnology. The program's learning objectives revolve around fostering a strong foundation in biological sciences, molecular biology, genetics, and relevant laboratory techniques. Students are expected to develop proficiency in manipulating biological systems for practical applications, such as biopharmaceuticals, agricultural advancements, and environmental management. Additionally, the program aims to cultivate critical thinking skills, ethical considerations, and effective communication within the context of biotechnology. Graduates of the program are intended to emerge with the ability to contribute to innovative research, address real-world challenges, and excel in various roles within the biotechnology industry, research institutions, and regulatory bodies. Through a blend of theoretical knowledge and hands-on experience, the BS Biotechnology program seeks to prepare students for a dynamic and rapidly evolving field that merges biology, technology, and innovation.
3. Program Structure:

Duration	Minimum 4-Years (8-Semesters), Maximum 6-Years (12-Semesters)
Admission Requirements:	At least 45% marks in HSSC (PartI/II) Pre- Medical or equivalent
Degree Completion Requirements:	Minimum 128 credit hours (Single Major)

4. **General Education (Gen Ed) Requirements: (Mandatory/Core Curses):**
The minimum requirement for Gen Ed is 30 credits hours and will be offered in first four semesters only.

Sr. No.	Semester	Course Code	Course Title	Credit Hours	Prerequisite
1.	1	URCG-5118	Functional English	3(3-0)	Nil
2.	1	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
3.	1	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
4.	1-8	URCG-5111	Translation of Holy Quran	NC	Nil
5.	2	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
6.	2	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
7.	2	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
8.	2	URCG-5116	Science of Society-I	2(2-0)	Nil
9.	3	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
10.	3	URCG-5119	Expository Writing	3(3-0)	Nil
11.	3	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
12.	4	URCG-5115	The science of Global Challenges	3(2-1)	Nil
13.	4	URCG-5124	Entrepreneurship	2(2-0)	Nil
14.	4	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
GE Courses Credit Hours Total				31	

5. Single Major Courses:

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1.	BIOT-5101	Introduction to Biotechnology	3(3-0)	Nil
2.	BIOT-5102	Animal Physiology	3(2-1)	Nil
3.	BIOT-5103	Ecology, Biodiversity and Evolution	3(3-0)	Nil
4.	BIOT-5104	Cell Biology	3(2-1)	Nil
5.	BIOT-5105	Biochemistry-I	3(2-1)	Nil
6.	BIOT-5106	Classical Genetics	3(3-0)	BIOT-5103
7.	BIOT-5107	Molecular Biology	3(3-0)	BIOT-5104
8.	BIOT-5108	Biochemistry-II	3(2-1)	BIOT-5105
9.	BIOT-5109	Research Methodology and Skills Enhancement	3(3-0)	Nil
10.	BIOT-5110	Immunology	3(3-0)	Nil
11.	BIOT-5111	Microbiology	3(2-1)	Nil
12.	BIOT-5112	Methods in Molecular Biology	3(2-1)	Nil
13.	BIOT-6113	Bioinformatics	3(2-1)	BIOT-5107
14.	BIOT-6114	Genomics and Proteomics	3(3-0)	BIOT-5106
15.	BIOT-6115	Biosafety and Bioethics	2(2-0)	Nil
16.	BIOT-6116	Principles of Biochemical Engineering	3(2-1)	BIOT-5107
17.	BIOT-6117	Seminar-I	1(1-0)	Nil
18.	BIOT-6118	Food Biotechnology	3(2-1)	BIOT-5111
19.	BIOT-6119	Pharmaceutical Biotechnology	3(3-0)	BIOT-5111
20.	BIOT-6120	Agriculture Biotechnology	3(3-0)	Nil
21.	BIOT-6121	Animal Biotechnology	3(3-0)	Nil
22.	BIOT-6122	Environmental Biotechnology	3(2-1)	Nil
23.	BIOT-6123	Recombinant DNA Technology	3(2-1)	BIOT-5112
24.	BIOT-6124	Industrial Biotechnology	3(2-1)	Nil
25.	BIOT-6125	Cytogenetics and Plant Breeding	3(3-0)	Nil
26.	BIOT-6126	Forensic DNA typing		
27.	BIOT-6127	Health Biotechnology	3(3-0)	Nil
28.	BIOT-6128	Nano-Biotechnology	3(3-0)	Nil
29.	BIOT-6129	Seminar-II	1(1-0)	Nil
Major Courses Credit Hours Total			**80**	

6. **Interdisciplinary/Allied courses: minimum 12 credit hours:**
Interdisciplinary/Allied courses will be offered after 4th semester

1.	CHEM-6103	Analytical Chemistry	3(2-1)	Nil
2.	MATH-5101	Calculus-1	3(3-0)	Nil
3.	STAT-6228	Bio-statistics	3(3-0)	Nil
4.	CMEC-6101	Programming fundamentals	3(2-1)	Nil
Interdisciplinary Courses Credit Hours Total			**12**	

7. Field experience/internship: Minimum 03 credit hours:
Lasting 6-8 weeks and ideally scheduled during summer breaks after 6th semester.

1.	BIOT-6130	**Field experience / internship**	**3(3-0)**	

8. Capstone project: Minimum 03 credit hours:
This project, after the sixth semester, requires faculty supervision and evaluation following department guidelines

1.	BIOT-6131	**Capstone project**	**3(3-0)**	

Scheme of Studies
BS in Biotechnology

Semester-I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-1	URCG-5118	Functional English	3(3-0)	Nil
GE-2	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
GE-3	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
GE-4	URCG-5111	Translation of Holy Quran	NC	Nil
Major-1	BIOT-5101	Introduction to Biotechnology	3(3-0)	Nil
Major-2	BIOT-5102	Animal Physiology	3(2-1)	Nil
Major-3	BIOT-5103	Ecology, Biodiversity and Evolution	3(3-0)	Nil

Semester Total Credit Hours: 17

Semester-II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-5	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
GE-6	URCG-5116	Science of Society-I	2(2-0)	Nil
GE-7	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
GE-8	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
Major-4	BIOT-5104	Cell Biology	3(2-1)	Nil
Major-5	BIOT-5105	Biochemistry-I	3(2-1)	Nil
Major-6	BIOT-5106	Classical Genetics	3(3-0)	BIOT-5103

Semester Total Credit Hours: 17

Semester-III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-4	URCG-5111	Translation of Holy Quran	NC	Nil
GE-9	URCG-5119	Expository Writing	3(3-0)	Nil
GE-10	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
GE-11	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
Major-7	BIOT-5107	Molecular Biology	3(3-0)	BIOT-5104
Major-8	BIOT-5108	Biochemistry-II	3(2-1)	BIOT-5105
Major-9	BIOT-5109	Research Methodology and Skills Enhancement	3(3-0)	Nil

Semester Total Credit Hours: 17

Semester-IV

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-12	URCG-5115	The science of Global Challenges	3(2-1)	Nil
GE-13	URCG-5124	Entrepreneurship	2(2-0)	Nil
GE-14	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
Major-10	BIOT-5110	Immunology	3(3-0)	Nil
Major-11	BIOT-5111	Microbiology	3(2-1)	Nil
Major-12	BIOT-5112	Methods in Molecular Biology	3(2-1)	Nil

Semester Total Credit Hours: 16

Summer Semester *(For student exiting program to have Associate Degree)*

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Compulsory	BIOT-6130	Internship	3(3-0)	Completion of minimum 60 credit hours

Semester-V

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-4	URCG-5111	Translation of Holy Quran	NC	Nil
Major-13	BIOT-6113	Bioinformatics	3(2-1)	BIOT-5107
Major-14	BIOT-6114	Genomics and Proteomics	3(3-0)	BIOT-5106
Major-15	BIOT-5115	Biosafety and Bioethics	2(2-0)	Nil
Major-16	BIOT-6116	Principles of Biochemical Engineering	3(2-1)	BIOT-5107
Major-17	BIOT-6117	Seminar-I	1(1-0)	Nil
IN/DISC-01	CHEM-6103	Analytical Chemistry	3(2-1)	Nil

Semester Total Credit Hours: 15

Semester-VI

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-18	BIOT-6118	Food Biotechnology	3(2-1)	BIOT-5111
Major-19	BIOT-6119	Pharmaceutical Biotechnology	3(3-0)	BIOT-5111
Major-20	BIOT-6120	Agriculture Biotechnology	3(3-0)	Nil
Major-21	BIOT-6121	Animal Biotechnology	3(3-0)	Nil
IN/DISC-02	MATH-5101	Calculus-1	3(3-0)	Nil

Semester Total Credit Hours: 15

Summer Semester

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Compulsory	BIOT-6130	Internship	3(3-0)	Completion of minimum 60 credit hours

Semester-VII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-4	URCG-5111	Translation of Holy Quran	NC	Nil
Major-22	BIOT-6122	Environmental Biotechnology	3(2-1)	Nil
Major-23	BIOT-6123	Recombinant DNA Technology	3(3-0)	BIOT-5112
Major-24	BIOT-6124	Industrial Biotechnology	3(2--1)	Nil
Major-25	BIOT-6125	Cytogenetics and Plant Breeding	3(3-0)	Nil
IN/DISC-03	STAT-6228	Bio-statistics	3(3-0)	Nil

Semester Total Credit Hours: 15

Semester-VIII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-26	BIOT-6126	Forensic DNA typing	3(3-0)	Nil
Major-27	BIOT-6127	Health Biotechnology	3(3-0)	Nil
Major-28	BIOT-6128	Nano-Biotechnology	3(3-0)	Nil
Major-29	BIOT-6129	Seminar-II	1(1-0)	Nil
IN/DISC-04	CMEC-6101	Programming fundamentals	3(2-1)	Nil
Compulsory	BIOT-6131	Capstone Project	3(3-0)	Completion of minimum 95 credit hours

Semester Total Credit Hours: 16

Degree Program Total: 131

DETAILED DESCRIPTION OF GENERAL Education COURSES

URCG-5105 **Islamic Studies (Compulsory)** **2(2-0)**

Introductory/compulsory foundation course

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qir'an and Sunnah..

- To make students understand the relevance and pragmatic significance of Islam in their lives.
- To make learners comprehend the true spirit of Islam with reference to modern world.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions tothe current challenges of being.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

Contents

Introduction to Qur'anic Studies

1) Basic Concepts of Qur'an
2) History of Quran
3) Uloom-ul-Quran

مطالعہ قرآن)تعارف قرآن ، منتخب آیات کا ترجمہ و تفسیر: سورۃ البقرہ آیات 1-5، 482-482؛ سورۃ الحجرات آیات 1-18؛ سورۃ الفرقان آیات 26-77؛ سورۃ المومنون آیات 1-11؛ سورۃ الاحزاب آیات 2، 41، 64- 66؛ 24، 52- 55؛ سورۃ الانعام آیات 151 -
156؛ سورۃ الصف آیات 1- 12؛ الحشر آیات 18- 44؛ آل عمران آیات 154- 154؛ النحل آیات 14-12؛ لقمٰن آیت 44؛ حم السجدہ آیت 56)

Introduction to Sunnah

1) Introduction of Hadith
2) Legal Status of Hadith
3) History of the compilation of Hadith
4) Kinds of Hadith

حدیث کا تعارف، حدیث کی دینی حیثیت، حفاظت و تدوین حدیث، حدیث کی اقسام

متن، حدیث: 1درج ذیل موضوعات پر احادیث کا مطالعہ

1- اعمال کا اجر نیت پر منحصر ہے۔ 4- بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔6کتاب وسنت کو ہر قسم کی آمیزش سے بچانے کا ذریعہ ہیں2- ارکان اسلام 5- اسلام ، ایمان ، احسان اور علامات کی نشانیاں، 2-بچوں کی نماز کی تلقین 7- دین کا گہرا فہم بلا کسی خاص
عبادت ہے 8- حصول علم، مال و 5 ۔روز محشر کا محاسبہ، 14- حقوق بلا کسے سلسلہ سلسلہ حقوق ت قرآن اور عمل کی اہمیت و فضیلت،

الاعباد کا لحاظ رکھنا بھی لازم ہے11۔ حسن خلق کی عظمت اور فحش و بد گوئی کی مذمت 14۔ دنیا و آخرت کی بھلائی کی ضامن چار چیزیں، 16۔ مالک کو دینے والی ذات چیزیں،12۔ بے عمل دماغ کا عبرت ناک انجام 15۔ ہر شخص نگران ہے اور ہر شخص
مسئول

1) Sirah of the Prohet
2) Importance of the Study of Sirah
3) Character building method of the Prophet

(سیرت النبیﷺ) مطالعہ سیرت کی ضرورت و اہمیت ، منابع سیرت و شخصیت کا نبوی اور عملی نمونے ، اقامت دین کا
نبوی طریق کار، اقوام ت دین بعد خالفت راشدہ، میثاق مدینہ ، خطبہ حجۃ الوداع، اخلاقی تعلیمات ، تشکیل اجتماعیت اور اسوہ حسنہ
،قرآن مجید میں سیرت سرور عالم کا بیان، غزوا ت نبوی ﷺ کے مقاصد و حکمتیں(

Islamic Culture & Civilization

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

2. اسلامی تہذیب و تمدن) اسلامی تہذیب کا مفہوم، اسلامی کے عوامل و عناصر، اسلامی تہذیب کی خصوصیات، ، اسلامی تہذیب
، علمی ، معاشرتی اور سماجی اثرات ، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و رجحانات، طبعی ، جغرافیائی اور معاشرتی علوم میں مسلمانوں کا کردار، نامور مسلمان سائنسدان(

Pre-Requisite: Nil

Recommended Books

1) Hameed ullah Muhammad, —Emergence of Islam‖ , IRI, Islamabad
2) Hameed ullah Muhammad, —Muslim Conduct of State
3) Hameed ullah Muhammad, ‗Introduction to Islam
4) Ahmad Hasan, —Principles of Islamic Jurisprudence‖ Islamic Research, Institute, International Islamic University, Islamabad (1993)
5) Dr. Muhammad Zia-ul-Haq, —Introduction to Al Sharia Al Islamia‖ Allama Iqbal Open University, Islamabad (2001)
6) Dr. MuhammadShahbaz Manj, Teleeemat-e- Islam

URCG-5111 **Translation of the Holy Quran-I** **NC**

Topic	Details
Semester/Level	In some discipline 1st semester and in some discipline 2nd Semester/ ADP Program 1st Year
Course Code	URCQ-5111
Course Title	Translation of the Holy Quran – I
Credit Hours	1(0-1)
Objectives	• To familiarize the students to keys and fundamentals of recitation ofthe holy Quran. • To develop the skill of the students of recitation the last revelation. • Students will learn the basic Arabic grammar in a practical way. • To develop an eagerness among the students to explore the lastdivine Book.
Course Contents:	• ناظرہ مع ترجمہ - تیسواں پارہ • بنیادی عربی گرامر اسم اور اس کے متعلقات : اسم فاعل، مفعول، تفضیل، فعل مجہول اور اس کی اقسام : ماضی، مضارع، امر، نہی حرف اور اس کی اقسام : حروف جار، حروف مشبہ بالفعل
Memorization:	تیسویں پارے کی آخری دس سورتیں (حفظ مع ترجمہ)

Translation of the Holy Quran- II

Topic	Details
Semester/Level	In some discipline 3rd semester and in some discipline 4th Semester/ ADP Program 2nd Year
Course Code	URCQ-5111
Course Title	Translation of the Holy Quran – II
Credit Hours	1(0-1)
Objectives	▪ Students will come to know about the real nature, significance and relevance of the Islamic beliefs in light of the text of the Holy Quran. ▪ Students will seek knowledge of translation and transliteration of the Holy Book Quran. ▪ To familiarize the students with the concept of Ibādah (Its significance,scope and relevance) and its types in Islam. ▪ Students will learn literal and idiomatic way of translation of the Holy Book. ▪ Students will learn about the polytheism and its incompatibility in Islamhighlighted by the Holy Quran. ▪ To highlight the significance of learning through using all human faculties provided by the almighty Allah and familiarize the students about condemnation of ignorance mentioned in the Quranic text. ▪ To develop Awareness among the students about rights and duties ofdifferent circles of society in the light of Holy Quran. ▪ To introduce the students to Quranic Arabic grammar in practicalmanner.

Course Contents:	○ ایمانیات اور عبادات بلا پر ایمان ،فرشتوں پر ایمان ،رسولوں پر ایمان ،آسمانی کتابوں پر ایمان یوم آخرت پر ایمان ، تقدیر پر ایمان نماز ،روزہ ،زکوۃ،حج ،جہاد ○ معاشرے کے حقوق • خاندان کی تکوین • حق مہر • رضاعت و حمل • والد کو ذلیل کرنے کے ممانعت • شوہر کی نافرمانی • طلاق • بیوہ کی عدت کے احکام • نکاح کا پیغام بھیجنا • عورت کی وراثت (اس کے شوہر کی طرف سے) • والدین کے حقوق • بیویوں اور اولاد کے بیچ عداوت ○ خاندان کے حقوق • مہمان کی عزت • اجازت طلب کرنے کے اصول • مجلس کے آداب • تعاون اور بھائی چارہ • گروہ بندی • محبت • لوگوں کے درمیان صلح • عفو ودرگزر، غصہ پر قابو اور معاف کرنا • شعوب و قبائل • لوگوں کے بیچ اختلافات • حمایت و نگہداری

Grammar:	• قرآنی عربی گرامر کے اصول اور انکے اطلاقات)جن قرآنی پر اطلاق سے توضیحات (
Details of Chapters and verse Numbers:	▪ مرتب آیات مع ترجمہ وتجوید ▪ البقرہ))۱۱۷، ۲۳۸، ۴۵، ۱۱۸، ۲۷۸، ۱۷۷، ۴۵، ۳۴۷، ۱۵۸، ۷۱۸، ۴۲۸، ۵۳، ۴۲۸، ۴۷، ۲۸۷، ۳۴۸، ۲۲، ۸۲، ۲۸۷، ۴۲۸، ۲۴۸، ۱۱۷، ۲۳۷، ۲۲۷، ۱۱۸، ۵۲۷، ۳۲۷، ۲۷۸، ۲۴۷، ۷۵۸،۲۲۷، ۱۸۸، ۲۸۸، ۱۳۸، ۲۸۸، ۲۸۸، ۷۳۸، ۱۳۸، ۴۳۸، ۱۳۸ ، ۸۲ ، ۵۲۷، ۳۳۸، ۸۲۷، ۱۲۷، ۳۲(▪ النساء)۴۲، ۸۲، ۲۴، ۲۳۷، ۲۲، ۱۲، ۳۷، ۲۲، ۱۲،۲۲، ۲۳، ۲۱۷، ۸۷، ۴۳، ۲۸۷، ۵۳، ۷۷، ۵، ۲۱۷، ۵۸، ۴۸، ۷۷، ۷۷، ۲۸۷، ۷۲۷، ۴۳، ۱۸، ۴۳، ۷۲۷، ۲، ۷، ۱۸، ۷، ۲۷، ۲۵۷، ۵۴، ۲۸۷، ۷۲(▪ االنعام)۸۸، ۸۲،۵۷،۱۳۷، ۷۴۷، ۲۵، ۵۴(▪ ال عمران)۱۲، ۲۳، ۴۲، ۴۸۷، ۵۲، ۵۵۷، ۲۷،۷ (▪ المائده)۵۴، ۸، ۸۲، ۲۷،۲۳، ۸۲، ۸، ۴(▪ االعراف)۴۳، ۲۲۷، ۲۲۷ (▪ توبه)۱۸، ۲۷،۷۱(▪ ہود)۸۷(▪ الزمر)۲(▪ النور)۵۴، ۸۴،۲۸، ۱۸، ۱۲، ۲۸(▪ محمد)۳۳(▪ انفال)۸۲، ۱۸(▪ الرعد)۳(▪ الطالق)۵(▪ الحج)۴(▪ ابراہیم))۵۵،۳۸(▪ االسراء)۳۸، ۵۸(▪ االحقاف)۴۷(▪ المومنون)۱۸(▪ العنکبوت)۲۵،۴۸، ۲(▪ النحل)۸۸(▪ لقمان)۵،۴۷، ۵۷(▪ االحزاب))۴۳، ۲۳،۱۴، ۲۵(▪ الشعراء)۱(▪ الروم)۷۸(▪ مریم)۲۸،۵۷ (▪ المجادلہ)۸۷، ۷۷(

Translation of the Holy Quran – III

Topic	Details
Semester/Level	In some discipline 5th semester and in some discipline 6th Semester/ BS (5th Semester intake) 1st / 2nd
Course Code	URCQ-5111
Course Title	Translation of the Holy Quran – III
Credit Hours	1(0-1)
Objectives	• To introduce ethics and highlight its importance, need and relevancefor individual and collective life. • To illuminate the students with the Quranic norms of Morality i.e. truthfulness, patience, gratitude, modesty, forgiving, hospitality etc. • To familiarize the students with immoral values like falsify, arrogance,immodesty, extravagance, backbiting etc. • To inculcate ethical and moral values in our youth. • To develop a balanced dynamic and wholesome personality. • To introduce the students to Quranic Arabic grammar in practicalmanner.
Course Contents:	o اخلاق)تعارف،ضرورت واہمیت ،اقسام،مغربیت (اخلاق حمیدہ : • برائی کو نیکی سے ہٹانا • نیکی کے کاموں میں مسابقت • لوگوں کے درمیان صلح • عدل وانصاف • سچائی • ایثار • سلیم قلب • مہمان نوازی • لغویات سے اعراض • عاجزی و انکساری • نگاہ اور آوازکو پست رکھنا • چال میں میانہ روی • شرمگاہوں کی حفاظت • صبر • شکر • امور میں میانہ روی اخلاق رذیلہ : • ظلم اور زیادتی • غرور و تکبر • نفسانی خواہشات کی پیروی • بدگمانی • جھوٹ • چغلی اور نمیمت • تمسخر اور شیخی خوری • لہو و لعب • برے ناموں سے پکارنا • احسان جتانا اور تکلیف دینا • فضول خرچی اور حد سے بڑھنا • حسد اور تنگ دلی • بے پروگی

Grammar:	• قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)
Details of	▪ منتخب آیات مع ترجمہ وتجوید

Chapters and verse Numbers:	▪ البقره)٨٧٧، ٤٥٨، ٣٢، ٨٢٧، ٨١٧، ٨٤٧، ٨١٧، ٨٤، ٣٤٧، ١١٧، ١٤٨، ٤٨٧، ٨٨٨، ١٨، ١١، ٨٢٧، ٢٥٧، ١٢٧، ٢١٧، ٥٢٨، ٣٢٨، ٨٢٨، ٨٧٨، ١٢، ٧٣٨، ١٧، ٥٣، ٥٨٧، ٢٤٨، ١٨، ٧١، ٣٢، ٢٨٨، ٤٢٧، ٢١(▪ آل عمران)٥٤٧، ٥٧، ٥٨، ٤٢٧، ٨٣٧، ٢٥٧، ٥٣٧، ٤٥٧، ١٧، ١١٨، ٤٨٧، ٣٣٧، ٥٧٧، ٥١٧، ٥١٧، ٢٨، ٢١، ٧٥٧، ١٥٧، ٢٤٧(▪ النساء)٤٣٧، ٣٨، ٨٨، ٢١٧، ١١٧، ٤١٧، ٥٤، ١٨، ١٨، ٣١٧، ٢٣، ٤٨، ٥٨، ١٥، ١٤، ٥٨(▪ المائدة)٢٤، ١٤، ٣٢، ٣٧، ٢، ٧٥، ٢٧(▪ النحل)١٢،٢٨٧، ٤١٧، ٣٧٧، ١٣، ٢٨٧، ٤٨٧(▪ الرعد) ٤٨، ١٨، ٥٨، ٨٨، ٢(▪ االعراف)٧٣، ٢٢، ٧٤، ٢٥٧، ١٥، ٥، ١٨، ٥٥٧، ٢٢٧، ٤٢، ٧٢(▪ القصص)٥٤، ٥٢(▪ نصلت)٥٣(▪ االنعام)٨٣، ١١، ١١، ١٣٧، ٤٤٧، ١٢٧(▪ النمل)١٢، ٢٥(▪ الحج)١٣، ٢٤، ١٢، ٢٢، ١١(▪ الحجرات)٢، ٧٧، ٢، ٧٧، ٣، ٨٧، ٤٧، ١٧(▪ االحزاب)٣٨، ١٤، ٢٤، ٢٤، ٨٤، ٤٤، ٢٤، ٤٣، ٥٨، ٤٣(▪ الحشر)٢(▪ طه) ٨(▪ االنعام)٥٢٧، ٧٥٧، ٢٧٧، ٧٤٧، ٣٢، ١٨٧(▪ ق)٥٣(▪ االنفال)١٨، ٢٥، ٧٢(▪ الفتح)٤٧(▪ يونس)١٧، ٢٧، ٨٧، ٢٢، ٨٨، ٨٨(▪ الفرقان)٣٢، ٧٨، ١٢، ٣٢(▪ النور)٣٨، ٢، ٥، ١٣، ٧٣، ٣٣، ٣٣، ٧٢، ٧٣، ٨٨(▪ لقمان)٢، ٣٣، ٢٧، ٨٣، ٢٧(▪ االسراء) ١٣، ١٧٧، ٤، ١٣(▪ المزمل)٢٧(▪ المدثر)٢، ٥(▪ المدثر)٥١(▪ الفاطر)٨٣(▪ الفتح)٢٨(▪ البلد)١٧(▪ الزمر)٣، ١٧(▪ الحجر)٤٢(▪ النجم)٧٣(▪ الرحمن)١٢(▪ هود)٢، ٨١٧، ٣(▪ الكهف)٨، ٢٤(▪ الشورى)١٣(▪ غافر)٢٨، ١٨(▪ الحديد)١٨، ١٨(▪ مريم)٢٤(▪ النازعات)٧٥(▪ التوبه)٤٢، ٥٢، ١١(▪ الهمزه)٧(

Translation of the Holy Quran - IV

Topic	Details
Semester/Level	In some discipline 7th semester and in some discipline 8th Semester/ BS (5th Semester intake) 3rd / 4th
Course Code	URCQ-5111
Course Title	Translation of the Holy Quran – IV
Credit Hours	1(0-1)
Objectives	• To familiarize the students with commandments of trade and inheritancementioned in the Quranic text (with the help of Urdu translation). • Students • To introduce the students to scientific facts and miracles of the HolyQuran and Quranic stress on deep study of Allah's explored universe. • To motivate the students for reading and exploring the last Holy Bookrevealed by Almighty Allah. • Through memorization students will develop their relation with lastrevelation.
Course Contents:	○ تجارت اور وراثت: • مال کی تقسیم • نادان کا مال • عوام الناس کا مال • عورتوں کا مال • ذمیوں کا مال • کفار کا مال • جائز مال • معاہدے • رہن • قرض ○ سائنسی حقائق: • تخلیق کائنات • اجرام فلکی • شجر و حجر • زمین و آسمان کے اسرار • ہوائیں اور طوفان • بحار اور جویٰ

	• حشرات االرض • پہاڑ اور سمندر
Grammar :	• قرآنی عربی گرامر کے اصول اور انکے اطالقات)متن قرآنی پر اطالق سے توضیحات (
Details of Chapters and verse Numbers:	▪ منتخب آیات مع ترجمہ وتجوید ▪ البقرہ)۷۲۸، ۴۷۸۸، ۴۲۸، ۲۷۸، ۵۲۸، ۴۱۸، ۲۷، ۴۲۸، ۱۱۷، ۴۲۸، ۲۷، ۴۱۸، ۸۲۸، ۸۲۸، ۵۱۸، ۷۱۸، ۳۲، ۱۱۷، ۴۷۸، ۲۱۸، ۲۱۸، ۲۷، ۱۸، ۳۸۸، ۲۸، ۴۴۸، ۵۲۷، ۲۲۸، ۵۲۷، ۵۲۷، ۱۴، ۱۲، ۵۲۷، ۱۴، ۱۷۸، ۲۷، ۲۸، ۷۱، ۸۲، ۳۲(▪ ال عمران)۱۷۷، ۵۳۷، ۱۳۷، ۱۲۷، ۱۸، ۲۴(▪ النساء)۲۸، ۸، ۲۸، ۷۲۷(▪ المائدہ)۲۲، ۴۲، ۴۱، ۲۲، ۱۲(▪ التوبہ)۲۲، ۵۸، ۲۲، ۵۸، ۵۸، ۱۲، ۵(▪ االعراف)۸۱۷، ۴۲۷، ۱۴، ۲۴، ۳۲۷، ۳۲۷، ۱۲۷، ۱۵، ۳۳۷، ۲۱۷، ۲۲۷(▪ الرعد)۱۷، ۵(▪ الطور)۵۵(▪ االنعام)۲۴، ۳۲، ۷۵۷، ۲۵۷، ۲۳(▪ االزلل)۲۸، ۲۳، ۷۵(▪ الکہف)۷۴، ۲۱۷، ۱۵، ۸۳، ۴۵، ۱۷، ۴۵(▪ الجاثیہ)۴(▪ فاطر)۱۸، ۸۷، ۳۷(▪ العنکبوت)۱۸، ۳۲، ۷۵(▪ الروم)۱۴(▪ االسراء)۱۱، ۲۲(▪ الرعد)۸(▪ السبا)۱۷، ۳، ۸۸(▪ یونس)۲۲، ۷۱۷، ۵۸، ۵۸، ۴، ۸۸(▪ یوسف)۵۲، ۵۷(▪ الفرقان)۸۲، ۳۴(▪ لقمان)۲۸، ۲۷(▪ طہ)۵۷۷، ۳۴(▪ النحل)۴۱، ۷۷، ۷۲، ۲۵، ۲۱، ۲۲، ۲۲، ۴۷۷، ۲، ۲(▪ النمل)۵۲، ۵۲، ۲۲، ۱۲، ۸۲، ۲۷، ۱۷، ۲۷(▪ السجدہ)۱۸(▪ الحدید)۲(▪ ھود)۳۵، ۲(▪ یونس)۱۳، ۷۵(▪ الروم)۲۳، ۲۳، ۱۴، ۲۷، ۵۸، ۲۵(▪ فصلت)۲۳، ۲۳(▪ الحج)۷۲، ۴۲، ۸۸، ۳۱(▪ الحجر)۲۷، ۸۸(▪ االنبیاء)۷۳، ۱۳، ۱۵(▪ الزاریات)۱۵(▪ الزلزلہ)۷(▪ القصص)۲۱، ۲۱، ۱۲، ۷۲، ۸۲(▪ النور)۱۳، ۸۸، ۸۸، ۱۵، ۴۵، ۳۵(▪ الجمعہ)۷۷، ۸۲، ۱۷، ۷۷، ۴(▪ القمر)۱(▪ الواقعہ)۲۲(▪ الفطر)۱۸، ۳۷(▪ الملک)۲۷(▪ الصف)۱۷(▪ الجن)۳۷(▪ الشوری)۲۸(▪ الزخرف)۷۷(▪ لنمل)۷(▪

URCG-5112 Fables, Wisdom Literature, and Epic 2(2+0)

This course has three components containing both readings and related activities: The first component is about fables-that is, stories with animal characters having human attributes. The second component concerns wisdom literature and looks specifically at some of the stories, both in prose and poetry, of the famous Persian literary figure Sa'di. We shall introduce this author to you. The third component is on the world's largest epic—the Shāhnāma (Book of Kings) of another literary giant, Firdausi.

Contents

1- Fables
- Kalīla wa Dimna or The Fables of Bidpai
  a) The Lion and the Bull, or the emblem of two friends whom a liar contrives to disunite.
  b) Investigation of the conduct together with the defence of Dimna.
  c) The Ring-dove, or the emblem of sincere friends.
  d) The Owls and the Crows, or the danger of being deceived by an enemy
- Bāng-i Darā or The Call of the Marching Bell

  1 .ایک مکڑا اور مکھی 2 .ایک پہاڑ اور گلہری 3 .ایک گانے اور بکری 4 .پر ندے کی فر یاد
  5 .دریا موج 6 .جگنو 7 .ایک پرندہ اور جگنو

2- Wisdom Literature
- GULISTĀN-E SA'DĪ
  a) Those who make an effort to display their virtues, do the same to conceal their vices
  b) The foundation of injustice in the world began with small unjust deeds
  c) Burden bearing oxen and asses are better that oppressors
  d) The pain you give to others eventually finds its way back to you
  e) Power and riches cannot exalt one in status
  f) The fleeting moment of an angry decision has everlasting consequences
  g) A pair of hands working at one's will are better than those clasped in obedience, waiting for orders
  h) It is fruitless to celebrate the death of an enemy as one will never be spared from it either
  i) Destruction of the good names of the departed cannot protect your own
  j) Do not turn away from knowledge even if one has to get it from the teachings of the ignorant

3- Epics
- SAHNAMA
  a) Rustam and Sohrab

Recommended Texts

1. John T. Platts, *The Gulistan; or, Rose Garden of Shaikh Muslihu'dDīn Sa'dī of Shīrāz* (London: Wm. II. Allen, 1876)
2. Wheeler Thackston, *A Millennium of Classical Persian Poetry* (Maryland: Ibex Publishers, 2000), 5-8.

URCG-5115 The Science of Global Challenges 3(2-1)

Climate Change i.e., Global Warming, Natural and Anthropogenic Activities and their impact; **Energy** i.e., Renewable and non-renewable energy resources; **Water Security** i.e., water scarcity and waste water treatment; **Land Degradation** i.e., salinity, water logging, deforestation, land erosion;

Food Security and roll of Biotechnology in food production; **Global Health Pandemics** i.e., Infectious diseases, vaccine, development of drug discovery for newly explored diseases

Practical:

1: Preparation of standard solution and their standardizations

2: Soil and Water Analysis

Recommended Text:

Usman, M. (2022). *Science of Global Challenges*. Ilmi Kitab Khana, Lahore

Suggested Books

1: Thieman, W.J. & Palladino, M.A. (2014). *Introduction to biotechnology*. Edinburgh Gate UK: Pearson Education Limited.

2: Daugherty, E. (2012). *Biotechnology: Science for the New Millennium*, 1st Edition, Revised, USA: Paradigm Publication.

3: Karaduman, I. C. (Ed.) (2014) *Global Challenges for the world*. Obronnosc. Zeszytl Naukowe. Turkey

URCG-5116 **Science of Society-I** **2(2+0)**

This course will introduce students to the study of the modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including economics, politics, anthropology, psychology and sociology, and learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and non-western contexts. Instruction will include the use of written texts, audio-visual aids and field visits

Contents

1- What is quantitative reasoning?
2- Overview of Contributions of Mathematicians especially Muslim scholars
3- Different types of standard numbers and their role in practical life scenarios.
4- Understanding relationship between parts and whole
5- Practical life scenarios involving units and rate
6- Unit analysis as a problem-solving tool
7- Dealing with very big and small numbers & their applications
8- Understanding uncertainty and its applications.
9- Money management (profit, loss, discount, taxation, and other scenarios involving percentage)
10- Money management in practical life scenarios like investments and federal budget, simple and compound interest
11- Saving plans and economy
12- Practical scenarios involving expressions
13- Equating two expressions in one variable & using it to solve practical problems
14- Introduce geometrical objects through architecture and landscape. Dealing with social and economic issues involving geometrical object
15- Venn diagrams and their applications

Recommended Texts

1- Bennett, J. & Briggs, W. (2015). *Using and understanding mathematics* (6th Edition). Pearson Education, Limited..
2- Aufmann, R., Lockwood, J., Nation, R. & Clegg, D. (2007). *Mathematical thinking and reasoning.* Brooks Cole.

Recommended Readings

1- Blitzer, R. (2014). *Precalculus.* (5th Edition). Pearson Education, Limited.
2- Demana, F., Waits, B., Foley, D. & Kennedy, D. (2016). *Precalculus.* (7th Edition). Addison Wesley

URCG-5118 **Functional English** **3(3+0)**

The course aims at providing understanding of a writer's goal of writing (i.e. clear, organized and effectivecontent and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the grammatical academic writing skills. The coursewould enable the students to develop argumentative writing techniques. The students would be able to logically add specific details on the topics such as facts, examples and statistical or numerical values. Thecourse will also provide insight to convey the knowledge and ideas in an objective and persuasive manner.Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Contents

1. Developing Analytical Skills
2. Transitional devices (word, phrase and expressions)
3. Development of ideas in writing
4. Reading Comprehension
5. Precis Writing
6. Developing argument
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Organization and Structure of a Paragraph
10. Organization and structure of Essay
11. Types of Essays

Recommended Texts

3. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
4. Eastwood, J. (2011). A Basic English grammar. Oxford: Oxford University Press.
5. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
6. Swan, M. (2018). *Practical English usage* (8th ed.). Oxford: Oxford University Press.

Recommended Readings

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.
2. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
3. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
4. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association
5. Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford: Oxford University Press

URCG-5119 **Expository Writing** **3 (3+0)**

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a Project-based Learning approach. Unit themes target the development of 21st century skills and focus on self-reflection and active community engagement. The course completion will enable the students to develop communication skills as reflective and self-directed learners. They will be able to intellectually engage with different stages of writing process, and develop analytical and problem-solving skills to address various community-specific challenges.

Contents

1. Self-Reflection
    - Introduction to the basics of the writing process
    - Introduction to the steps of essay writing
    - Prewriting activities: Brainstorming, listing, clustering and freewriting
    - Practicing Outlining of the essay
2. Personalized Learning
    - Learning Process, Learning Styles, Goal Setting and Learning Plan
3. Oral Presentation
    - Structure and Significance, Content Selection and Slide Presentation, Peer Review
4. Critical Reading Skills
    - Introducing Authentic Reading (Dawn and non-specialist academic books/texts)
    - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed reading and note-taking, Standard Test Practice: TOEFL and IELTS, Model Review Reports and Annotated Bibliographies
5. Community Engagement
    - Student-led brainstorming on local versus global issues, Identifying research problems
    - Drafting research questions, Drafting interview/survey questions for community research (in English or L1)
    - Engaging students in Critical reading, Presenting interview/ survey information, Field work
    - Writing Community Engagement Project
6. Letter to the Editor
    - Types of letters, Format and purpose of letter to the editor, Steps in writing letter-to-editor

Recommended Texts

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.

Recommended Readings

1. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

URCG-5120 **Exploring Quantitative Skills** **3(3-0)**

Since ancient times, numbers, quantification, statistics and mathematics has played a central role in scientific and technological development. In the 21st century, Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues, an individual now faces in daily life. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about statistics and mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

Contents

1. Introduction to quantitative reasoning
2. Overview of contributions of Mathematicians and Statisticians especially Muslim scholars.
3. Types of standard numbers
4. Proportions, rates, ratio and percentages
5. Odds and odds ratio
6. Scale of measurements
7. Number sequence and series
8. Unit analysis as a problem-solving tool
9. Data handling (small and large)
10. Data errors, absolute and relative and their applications
11. Descriptive statistics
12. Rules of counting: multiplication rule, factorial, permutation and combination
13. Probability and its application in real life
14. A graphical perspective through Venn Diagram
15. Financial indicator analysis, and money management (profit, loss, simple and compound interest)
16. Practical scenarios involving algebraic expressions: linear and quadratic

Recommended Texts

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). Quantitative Reasoning in Mathematics and Science Education. 1 st Ed., Springer, USA.
2. Peck, R., Olsen, C., & Devore, J. L. (2015). Introduction to statistics and data analysis. 5th Ed., Brooks Cole, USA.
3. Devlin, K. J. (2012). Introduction to mathematical thinking. Palo Alto, CA: Keith Devlin.

Suggested Readings

1. Triola, M. F., Goodman, W. M., Law, R., & Labute, G. (2006). Elementary statistics. Reading, MA: Pearson/Addison-Wesley.
2. Blitzer, R., & White, J. (2005). Thinking mathematically. Pearson Prentice Hall.URCG- 5119

URCG-5121 **Tools for Quantitative Reasoning** **3(3-0)**

This course is based on quantitative reasoning 1 course. It will enhance the quantitative reasoning skills learned in quantitative reasoning 1 course. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to importance of statistical and mathematical skills in different professional settings, social and natural sciences. These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues. This course will prepare the students to apply quantitative reasoning tools more efficiently in their professional and daily life activities. This course will help them to better understand the information in form of numeric, graphs, tables, and functions.

Contents

1.Types of data and its graphical representation (Histogram, Stem and Leaf display, Box Plot, Scatter diagram, Historigam, Bar chart, etc).
2.Solving practical problems using linear and exponential models.
3.Population growth models
4. Analytical approach to solve simultaneous equations
5. Inequalities and their application
6.Comparing quantities using analytical tools.
7. Logical reasoning and their application in modern age.
8. Logical reasoning and decision making.
9. Data tendencies via measure of location
10. Variability and Measure of dispersion
11. Measuring relationships via Regression analysis and correlation
12.Statistical inference: sampling techniques, estimation techniques and hypothesis testing for decision and policy making

Recommended Texts

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education.* 1st Ed., Springer, USA.
2. Sharma, A. K. (2005). *Text book of elementary statistics.* Discovery Publishing House.
3. Blitzer, R. (2014). *Precalculus*, 5th Ed.. Pearson Education, Limited. New York

Suggested Readings

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics.* 12th Ed, Sultan Chand & Sons.
2. Aufmann, R. N., Lockwood, J., Nation, R. D., & Clegg, D. K. (2007). *Mathematical thinking and quantitative reasoning.* Cengage Learning
3. Blitzer, R., & White, J. (2005). *Thinking mathematically.* Pearson Prentice Hall.

URCG-5122 Ideology and Constitution of Pakistan 2(2+0)

This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan. It will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary

Content

1- Ideology of Pakistan
   - Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
   - Two Nation Theory and Factors leading to Muslim separatism.
2- Constitutional Developments
   - Salient Feature of the Government of India Act 1935
   - Salient Feature of Indian Independence Act 1947 Objectives Resolution
   - Salient Feature of the 1956 Constitution
   - Developments leading to the abrogation of Constitution of 1956
     Salient features of the 1962 Constitution
   - Causes of failure of the Constitution of 1962
   - Comparative study of significant features of the Constitution of 1956, 1962 and 1973
3- Fundamental rights
4- Principles of policy
5- Federation of Pakistan
   - President Parliament
   - The Federal Government
6- Provinces
   - Governors
   - Provincial Assemblies
   - The Provincial Government
7- The Judicature
   - Supreme Court
   - High Courts
   - Federal Shariat Courts Supreme Judicial Council
   - Administrative Courts and tribunals
8- Islamic Provisions in Constitution
9- Significant Amendments of Constitution of Pakistan 1973

Recommended Books

1. Constitutional and Political History of Pakistan by Hamid Khan
2. Mahmood, Shaukat and Shaukat, Nadeem. Constitution of the Islamic Republic of Pakistan, 3rd re edn. Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973. Lahore, Law Pub., 1975.

Recommended readings

1. Rizvi, Syed Shabbar Raza. Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary. 2nd re edn. Lahore: Vanguard, 2005.
2. The Text of the Constitution of the Islamic Republic of Pakistan, 1973 (as amended).
3. Fundamental Laws of Pakistan by A.K. Brohi

URCG-5123 Applications of Information and Communication Technologies (ICT) 3 (2+1)

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace. Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

Contents

1- Introduction, Overview of Information Technology.
2- Hardware: Computer Systems & Components, Storage Devices.
3- Software: Operating Systems, Programming and Application Software.
4- Databases and Information Systems Networks.
5- File Processing Versus Database Management Systems.
6- Data Communication and Networks.
7- Physical Transmission Media & Wireless Transmission Media.
8- Applications of smart phone and usage.
9- The Internet, Browsers and Search Engines.
10- Websites and their types.
11- Email Collaborative Computing and Social Networking.
12- E-Commerce.
13- IT Security and other issues.
14- Cyber Laws and Ethics of using Social media.
15- Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
16- Other IT tools/software specific to field of study of the students if any.

Recommended Book

1- Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat, Susan L. sebok; 17th edition.

Recommended Readings

1- Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill HigherEducation; 26th edition.
2- Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.

URCG-5124 **Entrepreneurship** **2(2+0)**

This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

Contents

1. Background: What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. Forms of Business Ownership: The Sole proprietorship, Partnership, Joint Stock Company
3. Entrepreneurship: The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. The Challenges of Entrepreneurship: The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. Inside the Entrepreneurial Mind: From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. Products and technology, identification opportunities
7. Designing a Competitive Business Model and Building a Solid Strategic Plan: Building a strategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. Conducting a Feasibility Analysis and Crafting a Winning Business Plan: Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis. Why Develop a Business Plan, The Elements of a Business Plan, What Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.
9. Building a Powerful Marketing Plan: Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research. Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
10. E-Commerce and the Entrepreneur: Factors to Consider before Launching into E-Commerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
11. Pricing Strategies: Three Potent Forces: Image, Competition, and Value, Pricing Strategies and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing
12. Attracting Venture Capitalist: Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back &Suggestions on Student Project,
13. Idea Pitching: Formal presentation, 5-minutes pitch, funding negotiation and launching.

Recommended Books

1. Scarborough, N. M. (2011). *Essentials of entrepreneurship and small business management.* Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458.

Recommended Readings

1. Burstiner, I. (1989). *Small business handbook.* Prentice Hall Press.

URCG-5125 Civics and Community Engagement 2(2+0)

The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship. After completing this course, students will be able to Understand the concepts of civic engagement, community development, and social responsibility, rights and responsibilities of citizenship, cultural diversity in local and global context, significance of civic participation in promoting social justice, equity and democracy.

Content

1- Introduction to Civics & Community Engagement
   - Overview of the course: Civics & Community Engagement
   - Definition and importance of civics
   - Key concepts in civics: citizenship, democracy, governance, and the rule of law
   - Rights and responsibilities of citizens
2- Citizenship and Community Engagement
   - Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills, Approaches and Methodology for Active Citizenship
3- Identity, Culture, and Social Harmony
   - Concept and Development of Identity, Group identities
   - Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity, Globalization and Culture, Social Harmony,
   - Religious Diversity (Understanding and affirmation of similarities & differences)
   - Understanding Socio-Political Polarization
   - Minorities, Social Inclusion, Affirmative actions
4- Multi-cultural society and inter-cultural dialogue
   - Inter-cultural dialogue (bridging the differences, promoting harmony)
   - Promoting intergroup contact/ Dialogue, significance of diversity and its impact
   - Importance and domains of Inter-cultural dialogue
5- Active Citizen: Locally Active, Globally Connected
   - Importance of active citizenship at national and global level
   - Understanding community
   - Identification of resources (human, natural and others)
   - Utilization of resources for development (community participation)
   - Strategic planning, for development (community linkages and mobilization)
6- Human rights, constitutionalism and citizens' responsibilities
   - Introduction to Human Rights, Human rights in constitution of Pakistan
   - Public duties and responsibilities, Constitutionalism and democratic process
7- Social Institutions, Social Groups, Formal Organizations and Bureaucracy
   - Types of Groups, Group identities, Organizations
   - Bureaucracy, Weber's model of Bureaucracy
   - Role of political parties, interest groups, and non-governmental organizations
8- Civic Engagement Strategies
   - Grassroots organizing and community mobilization
   - Advocacy and lobbying for policy change
   - Volunteerism and service-learning opportunities
9- Social issues/Problems of Pakistan

- Overview of major social issues of Pakistani society

10- Social Action Project

Recommended Books

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

Recommended Readings

1. Glencoe McGraw-Hill. (n.d.). Civics Today: Citizenship, Economics, and Youth.
2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.). Pearson.
3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building and Democracy in the United States. Kettering Foundation Press.
4. Bloemraad, I. (2006). Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada. University of California Press.
5. Kuyek, J. (2007). Community Organizing: Theory and Practice. Fernwood Publishing.
6. DeKieffer, D. E. (2010). The Citizen's Guide to Lobbying Congress. TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). Advocacy and Opposition: An Introduction to Argumentation (8th ed.). Routledge.
8. Kretzmann, J. P., & McKnight, J. L. (1993). Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets. ACTA Publications.
9. Patterson, T. E. (2005). Engaging the Public: How Government and the Media Can Reinvigorate American Democracy. Oxford University Press.
10. Love, N. S., & Mattern, M. (2005). Doing Democracy: Activist Art and Cultural Politics. SUNY Press.

URCG-5126 **ETHICS** **2(2-0)**

1. Meaning and Scope of Ethics.
2. Relation of Ethics with:
   (a) Religion
   (b) Science
   (c) Law
3. Historical Development of Morality:
   (a). Instinctive Moral Life.

(b). Customary Morality. (c). Reflective Morality.

4. Moral Theories:

(a). Hedonism (Mill) (b). Intuitionism (Butler)
(c). Kant's Moral Theory.

5. Moral Ethics and Society.

(a). Freedom and Responsibility. (b). Tolerance
   (c). Justice
   (d). Punishment (Theories of Punishment)

6. Moral Teachings of Major Religions:a). Judaism

b). Christianity c). Islam

7. Professional Ethics:

a). Medical Ethics b). Ethics of Students
c). Ethics of Teachers d). Business Ethics

REFERENCE BOOKS:

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition
4. Ameer Ali, S. The Ethics of Islam. Culcutta: Noor Library Publishers, latest edition
5. Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University of

URCQ-5128 **Quantitative Reasoning I** **3(3+0)**

Since ancient times, numbers, quantification, and mathematics has played a central role in scientific and technological development. In the 21st century Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues an individual now faces in daily life. The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

Contents

1- What is quantitative reasoning?
2- Overview of Contributions of Mathematicians especially Muslim scholars
3- Different types of standard numbers and their role in practical life scenarios.
4- Understanding relationship between parts and whole
5- Practical life scenarios involving units and rate
6- Unit analysis as a problem-solving tool
7- Dealing with very big and small numbers & their applications
8- Understanding uncertainty and its applications.
9- Money management (profit, loss, discount, taxation, and other scenarios involving percentage)
10- Money management in practical life scenarios like investments and federal budget, simple and compound interest
11- Saving plans and economy
12- Practical scenarios involving expressions
13- Equating two expressions in one variable & using it to solve practical problems
14- Introduce geometrical objects through architecture and landscape. Dealing with social and economic issues involving geometrical object
15- Venn diagrams and their applications

Recommended Texts

1- Bennett, J. & Briggs, W. (2015). *Using and understanding mathematics* (6th Edition). Pearson Education, Limited..
2- Aufmann, R., Lockwood, J., Nation, R. & Clegg, D. (2007). *Mathematical thinking and reasoning.* Brooks Cole.

Recommended Readings

1- Blitzer, R. (2014). *Precalculus*. (5th Edition). Pearson Education, Limited.
2- Demana, F., Waits, B., Foley, D. & Kennedy, D. (2016). *Precalculus.* (7th Edition). Addison Wesley

Seerat of the Holy Prophet مطالعہ سیرت النبی صلی اللہ علیہ وسلم

Course Code URCG-5127

Title	Description
Semester	
Nature of Course	
No. of C.Hrs.	1(1-0)
Total Teaching weeks	18
Objectives of the Course	۔ طلباء کو مطالعہ سیرت طیبہ کی ضرورت و اہمیت سے آگاہ کرنا ۔ تعمیر شخصیت میں مطالعہ سیرت طیبہ کے کردار کو واضح کرنا ۔ بعثت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا ۔ رسول اکرم صلی اللہ علیہ وسلم کی مکی اور مدنی زندگی کا اس طرح مطالعہ کروانا کہ طلباء ان واقعات سے DOs کا استنباط کر سکیں ۔ طلباء کو عہد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالات زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا خاندانی حسب و نسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لڑکپن اور جوانی کے حالات زندگی
2	بعثت نبوی کے وقت دنیا کے حالات (۱)	۱۔ بعثت نبوی کے وقت اہم خطے ۲۔ عرب، مصر، حبشہ، بازنطینی سلطنت
3	بعثت نبوی	۱۔ مکی عہد میں دعوت اسلام
4	بعثت نبوی	۱۔ مدنی عہد میں دعوت اسلام
5	خصائص النبیؐ	آپ کا طور پیغمبر امن
6	خصائص النبیؐ	بحیثیت استاد و معلم
7	خصائص النبیؐ	بحیثیت تاجر
8	خصائص النبیؐ	بحیثیت سربراہ ریاست
9	خصائص النبیؐ	ذاتی محاسن اور عالمگیر اثرات

ناموس رسالت	محسنِ انسانیتؐ	10
غیر مسلموں سے تعلقات	اسوہ حسنہ اور عصر حاضر	11
اسوہ حسنہ کی روشنی میں گھریلو زندگی	اسوہ حسنہ اور عصر حاضر	12
مستشرقین اور مطالعہ سیرت	اسوہ حسنہ اور عصر حاضر	13
وطن سے محبت اور سیرت	اسوہ حسنہ اور عصر حاضر	15
مستشرقین کے اعتراضات اور ان کے جوابات	اسوہ حسنہ اور عصر حاضر	16

نصابی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ابن ہشام	السیرۃ النبویۃ
2	مولانا شبلی نعمانی/سید سلیمان ندوی	سیرۃ النبی صلی اللہ علیہ وسلم
3	قاضی محمد سلیمان سلمان منصورپوری	رحمۃ للعالمین
4	مولانا سید ابوالحسن علی ندوی	نبی رحمت صلی اللہ علیہ وسلم
5	ڈاکٹر یسین مظہر صدیقی	عہد نبوی کا نظام حکومت
6	ڈاکٹر خالد علوی	انسانِ کاملؐ

حوالہ جاتی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	سید ابوالاعلیٰ مودودی	سیرت سرور عالم صلی اللہ علیہ وسلم
2	مولانا صفی الرحمن مبارکپوری	الرحیق المختوم
3	پیر محمد کرم شاہ الازہری	ضیاء النبی صلی اللہ علیہ وسلم
4	ڈاکٹر اکرم ضیاء العمری	السیرۃ النبویۃ الصحیحۃ
5	مولانا عبدالرؤف داناپوری	اصح السیر

DETAILED DESCRIPTION OF MAJOR COURSES

BIOT-5101 Introduction to Biotechnology 3(3+0)

To acquaint students with the basic concepts and significance of biotechnology as it stands today. The subject covers basic scientific knowledge and its application in biotechnology. The course also deals with the major elements of the global significance of biotechnology, the categories of biotechnology processes and products, and in the context of "traditional" vs "modern" biotechnology processes. The key developments in the history of biotechnology and the enabling technologies - fermentation, downstream processing; recombinant methods, analysis and automation, genomics, proteomics, metabolomics will be discussed to provide tools and basic knowledge in order to understand biotechnology. The emerging areas of biotechnology, for example Agricultural Biotechnology, Protein, Forensic Biotechnology, Bioremediation, Aquatic Biotechnology, Regulatory agencies and issues that impact Biotechnology industry will be discussed as well. In addition to that, a provocative and issues in Biotechnology, genetically modified food, genetic testing, embryos for research/human cloning, ethical/legality/social questions & dilemmas will be incorporated.

Contents

1. Biotechnology- definition and history
2. Foundations of biotechnology and interdisciplinary pursuit
3. Branches and/or applications of biotechnology in medicine and diagnostics
4. Applications of biotechnology in Agriculture (crop yield, resistance against biotic and abiotic factors, food, livestock, fisheries, etc.)
5. Production of biotechnological products, transgenics, microbial etc.
6. Application of biotechnology in environment
7. Applications of biotechnology in industry etc.
8. Safety in biotechnology
9. Public perception of biotechnology
10. Biotechnology and ethics
11. Use of modern biotechnology
12. Biotechnology and the developing world

Recommended Texts

1. Thieman, W.J. & Palladino, M.A. (2014). *Introduction to biotechnology.* Edinburgh Gate UK: Pearson Education Limited.
2. Daugherty, E. (2012). *Biotechnology: Science for the New Millennium*, 1st Edition, Revised, USA: Paradigm Publication.

Suggested Readings

1. Smith, J.E. (2012). *Biotechnology*, 5th Edition, UK: Cambridge University Press.
2. Nicholl, T.S.D. (2012). *An Introduction to Genetic Engineering*, 2nd Edition, UK: Cambridge University Press .
3. Ratlegde, C. and Kristiansen, B. (2006). *Basic Biotechnology,* 2nd Edition, UK: Cambridge University Press.
4. Thomas, J.A. and Fuchs, R.L. (2002). *Biotechnology and Safety Assessment*, 3rd Edition, UK: Academic Press.

BIOT-5102 **Animal Physiology** **3(2+1)**

The major aims of this course are to provide students with a basic understanding of the fundamental processes and mechanisms that serve and control the various functions of the body.To familiarize students with the principles and basic facts of Animal Physiology and with some of the laboratory techniques and equipment used in the acquisition of physiological data. The emphasis will be on mammalian physiology but there will be some coverage of other vertebrate taxa. The course will focus on organ-system physiology, however, cellular and molecular mechanisms will be discussed in order to present a current view of physiological principles. Furthermore, emphasis will be placed on nervous, muscular, cardiovascular, respiratory, renal, digestive, and endocrine physiology. Where appropriate, basic chemical and physical laws will be reviewed in order to enhance and to promote student understanding. This course provides comprehensive introduction to students on Homeostasis, Biomembranes, Skins, Physiology of Muscles and skeletons etc.

Contents

1. Introduction. Homeostasis. Biomembranes.
2. Skins, Physiology of Muscles and Skeletons: protection, support and movement
3. The Nervous System: spinal and cranial nerves, neurons, membrane potentials and nerve transmission; senses and sensory receptors
4. Endocrine Glands and their Hormone Messengers, Chemistry of hormones and mechanism of hormone action, Hormonal system of invertebrates and vertebrates
5. Cardiac physiology; introduction to cardiac cycle, vertebrate & invertebrate. Cardiovascular system; introduction, solute exchange, blood pressure. of vertebrates and invertebrates
6. Immune and Lymphatic Systems of vertebrates, Respiratory system; introduction, gas exchange & transport, control, Nutrition and the Digestive System
7. Urine, Reproduction in Animals. Extra renal osmoregulatory organs, Fluid and acid-base balance; Metabolic fates of nutrients in heterotrophs.

Practicals

Dissection of frog and study of digestive, reproduction, arterial, venous and respiratory system. Blood cells. Dissection of pigeon and study of its various systems. Dissection of mouse and study of various systems. Study of Nervous tissue (brain) of Mammals.

Recommended Texts

1. Richard, W., Gordon, A., & Margaret, A. (2004). *Animal Physiology.* (1st Ed.). New York: Mc Graw Hill Inc
2. Guyton, (2001). *Texts book of medical physiology.* (9th ed.). New York: Mc Graw Hill Inc

Suggested Readings

1. Kent, G.C., & Miller, S. (2001). *Comparative anatomy of vertebrates.* New York: McGraw Hill Inc
2. Campbell, N.A. (2016). *Biology.* (11th Ed.). California: Benjamin/Cummings Publishers, Inc

BIOT-5103 **Ecology, Biodiversity and Evolution** **3(3+0)**

This course aims to introduce students to the fundamentals of ecology, biological diversity and evolution – key areas that are pertinent to modern day biology. The course also aims to provide an introduction to the properties of life and cells leading to genetic and biological diversity. The objective of this course is to describe the molecular and structural unity of life and to explain how the diversity of living things is generated and perpetuated, and exemplify this diversity among and within life's three domains. After going through this course the students would be able to enhance their knowledge of biological diversity with emphasis on variation leading to natural selection. The course also describes the basic properties of populations and interactions among different types of organisms within an ecosystem. The course also demonstrates the fundamental processes underlying adaptive evolution, speciation and extinction, population growth and regulation, species coexistence, and maintenance of biodiversity.

Contents

1 An Introduction to ecology and the biosphere,
2 History of life, The Origin of Species, how do new species Form, models of speciation;
3 What Determines the distribution of life on earth
4 Factors that influence earth's climate.
5 Energy flow and nutrient cycling in ecosystems
6 Population ecology, Population growth and regulation
7 community ecology, Community Interactions
8 Ecosystems and restoration ecology
9 Conservation biology and global change
10 Conserving earth's biodiversity
11 Importance of biodiversity and major threats to biodiversity
12 Factors effecting biodiversity
13 Sustainability essential for a healthy future, causes and consequences of extinction.
14 Impact of environment on loss of genetic diversity and speciation; *in situ* and *ex situ* conservation.
15 Major groups of plants, Colonization of plants on land
16 Evolution of seed plants, Major adaptations in plants, domestication and improvement of crops
17 Diversity of animal kingdom: Invertebrates and Vertebrates.

Recommended Texts

1. Audesirk, T., Audesirk, G., Byers, B.E. (2017). Biology: *Life on earth.* (11th Ed). New Jersey, USA: Pearson Hoboken
2. Campbell, N.A. (2016). *Biology.* (11th Edition). California,.USA: Benjamin/Cummings Publishing Company

Suggested Readings

1. Aston, et al. (2004). Ecological Genetics: Planning and application. UK: Blackwell Science
2. Costa, L.G., & Eaton, D.L. (2006). Gene-Environment interactions: Fundamentals of ecogenetics. (1st Ed.). NJ: John-Wiley & Sons
3. Louis, P., & Pojman, L.P. (2007). Environmental ethics: Readings in theory and application. (5th Ed.). Belmont: Wadsworth Publishing

BIOT-5104 **Cell Biology** **3(2+1)**

This course will introduce to foundation theories, concepts and practices in biology. Cell biology is study of the structure and function of prokaryotic and eukaryotic cells. In this course we will focus on Eukaryotic cells (Animals, Plants) and will cover topics such as membrane structure and composition, transport and trafficking. The cytoskeleton and cell movement, the breakdown of macromolecules, and generation of energy and integration of cells into tissues. We will also cover important cellular processes such as cell cycle regulation as mitosis and meiosis, signal transduction, functions of different compartments and the overall structure/ultrastructure of cells. The isolation, structure, location, and functions of different cellular organelles will be discussed including Endoplasmic Reticulum, Golgi complex/Golgi apparatus, Lysosomes, Mitochondria, power house of cell, Microbiodies, Nucleus, as well as visualized by electron microscopy. The development of critical thinking processes and proficiency in scientific reading and writing will be emphasized throughout the course.

Contents

1. Introduction to cell theory including historical perspective
2. Overview of membrane structure and chemical constituents of the cell
3. Function, isolation and molecular organization of cellular organelles specifically the endoplasmic reticulum DNA replication in prokaryotes and eukaryotes
4. Lysosome, micro-bodies Post transcriptional processing (e.g., RNA splicing, alternative splicing, editing).
5. Mitochondrial ultra-structure and function
6. Composition and structure of membranes
7. Recombination and transposable elements
8. Skin sensors of heat and cold, skin sensors of mechanical stimuli, sonar, smell, taste and vision in vertebrates
9. Membrane receptors and transport mechanisms
10. Structure and function of chromosomes; cell cycle
11. Nucleus, Mitosis and Meiosis
12. Cell movement - structure and function of cytoskeleton, centriole
13. Cilia and flagella

Practicals

Microscopy and staining techniques; study of prokaryotic, eukaryotic, plant and animal cells; cell structure in the staminal hair of Tradescantia; study of different types of plastids; cellular reproduction; Mitosis: smear/squash preparation of onion roots.

Recommended Texts

1. Vrema, P.S., (2005). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology,Multicolor Edition, India: Chand and Company Ltd.

2. Lodish, *et al.*, (2012). Molecular Cell Biology, 7th Edition, New York: W.H. Freeman.

Suggested Readings

1. Karp., (2002). *Cell and Molecular Biology*, 3rd Edition, New York: John Wiley & Sons.
2. Alberts, et al., (2009). *Essential Cell Biology*, 3rd Edition, New York: Garland Publishers.
3. Cooper, G.M. and Hausman, R.E., (2009). *The Cell: A Molecular Approach*, 5th Edition, USA: Sinauer Associates, Inc.

BIOT-5105 **Biochemistry-I** **3(2+1)**

The subject aims to provide an advanced understanding of the core principles and topics of Biochemistry and their experimental basis, and to enable the students to acquire a specialised knowledge and understanding of selected aspects by means of series of lectures and lab experiments. Through this course the students would be able to acquire fundamental knowledge of the molecules of life (also knowns as biomolecules) such as nucleic acids, carbohydrates, proteins and fatty acids, as well as their function in the context of a living cell as they provide the body with energy. The students will also become familiar with the biochemical functions of water and buffer inside the cell. The students will also be able to recognize the different classes of enzymes and coenzymes and their role in the biological processes in the body. The students will also get knowledge about hormones in terms of their structure, function and role in regulating the metabolism.

Contents

1. Introduction to biochemistry
2. Water, pH, buffers, and biochemical composition of cells
3. Carbohydrates - structure and classification
4. Proteins - overview with emphasis on their composition and structure
5. Classification and function of proteins
6. Lipids - structure, classification and biological significance
7. Enzymes - properties, nomenclature, classification
8. Factors affecting enzyme activity including inhibitors and potentiators,
9. Basic kinetics, derivation of K_m and V_{max}; coenzymes and vitamins
10. Nucleic acids - structure and function.

Practicals

Standard laboratory operating and safety procedures, Preparation of laboratory solutions, buffers and pH determination; qualitative and quantitative tests for carbohydrates, proteins and lipids; enzyme assays and the effect of pH, temperature and other factors on enzyme activity.

Recommended Texts

1. Nelson, D.L. and Cox, M. M., (2012). *Lehninger principles of biochemistry,* 6th Edition, New York: W.H. Freeman.
2. Hames, D. and Hooper, N., (2006). *Instant notes biochemistry,* 3rd Edition, USA: Taylor & Francis Group.

Suggested Readings

1. Berg, J., Tymoczko, J. and Stryer, L., (2006) . (Eds), *Biochemistry,* 6th Edition, New York: W.H. Freeman and Company.
2. Voet, D. and Voet, T.G., (2008). *Biochemistry,* 4th Edition, New York: John Wiley & Sons.
3. Murray, *et al.,* (2012). *Harper's ilustrated Biochemistry,* 29th Edition, New York: McGraw-Hill Medical Publishing.
4. Ferrier, D.R., (2013). *Lippincott's Biochemistry,* 6thEdition, USA: Lippincott Williams & Wilkin Publishing Company.

BIOT-5106 **Classical Genetics** **3(3+0)**

To acquaint students with classical aspects of genetics. An introduction to the principles of genetics, including topics from classical Mendelian concepts to the contemporary molecular biology of the gene. Upon successful completion of this course, students should be able to demonstrate the following competencies: (1) an understanding of the central theories and methodologies that define the field of genetics and its various sub disciplines (traditional, molecular, and population genetics) and the ability to use the vocabulary that embodies this knowledge; (2) an understanding that science is a continual process of investigation and interpretation and that scientific knowledge progresses via the support and rejection of competing hypotheses, collective decisions that are based on empirical evidence and logical interpretation using inductive and deductive reasoning; (3) the ability to develop a scientifically informed position on some of the bioethical and social issues related to the practice and application of genetics research.

Contents

1. Classical Mendelian genetics
2. Monohybrid crosses
3. Dominance, recessiveness.
4. Codominance and semidominance
5. Principle of independent assortment;
6. Dihybrid and trihybrid ratios;
7. Gene interactions; epistasis and multiple alleles
8. ABO blood type alleles and Rh factor alleles in humans
9. Probability in Mendelian inheritance
10. Structure of chromosomes
11. Organization of genes and genomes;
12. Nucleic acid function; DNA as warehouse of genetic information
13. Experimental evidence that DNA is genetic material
14. Sex determination, Linkage and crossing over.

Recommended Texts

1. Snustad, D.P., & Simmons, M.J. (2008). *Principles of Genetics.* (5th Ed.). New York: John Willy & Son
2. Klug, W.S., and Cumming, M.R. (2008). *Concepts of Genetics.* (9th Ed.). USA: Prentice Hall

Suggested Readings

1. Pierce, B. (2004). *Genetics: A conceptual approach.* (2nd Ed.). New York: W.H. Freeman.
2. Brooker, R., (2011). *Genetics: Analysis and principles.* (4th Ed.). USA: McGraw-Hill.
3. Pierce, B.A. (2011). *Genetics: A conceptual approach.* (4th Ed.) New York: W.H. Freeman Publisher.

BIOT-5107 **Molecular Biology** **3(3+0)**

Molecular Biology is the study of biological systems at the molecular level. Molecular Biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division and development. It is large and ever changing discipline. In this course, students will acquaint with the chemistry and biology of nucleic acid structure (DNA, RNA) and the mechanics of replication, transcription, post transcription modification, translation, post translational modifications in prokaryotes (particularly bacteria) and eukaryotes. The central goal is understanding the gene regulation at all levels both in prokaryotes and eukaryotes. In this course, students will account for causes for DNA damages and genetic changes and explain the different mechanisms that underlie these changes and how cells handle this at the molecular level account for how changes in the genome can result in the different genetic diseases, including cancer diseases and transposable elements will be also discussed.

Contents

1. Introduction to molecular biology and history
2. Structure and function of DNA
3. Chromatin and structure of chromosomes
4. Protein structure and function
5. DNA replication in prokaryotes and eukaryotes
6. Transcription in prokaryotes and eukaryotes
7. Post transcriptional processing (e.g., RNA splicing, alternative splicing, editing).
8. Translation
9. Post-translational processing in eukaryotes
10. Protein folding, targeting and turnover
11. DNA damage and repair
12. Recombination and transposable elements
13. Signaling and control of gene regulation in prokaryotes
14. Signaling and control of gene regulation in eukaryotes

Recommended Texts

1. Alberts, B., et al. (2007). *Molecular biology of the cell.* (5th ed.). New York: Garland Science.
2. Lodish, H., et al. (2012). *Molecular cell biology.* (7th ed.). New York: W.H. Freeman.

Suggested Readings

1. Berg, J.M., et al. (2006). *Biochemistry.* (6th Ed.). New York: W.H. Freeman.
2. Schleif, R. (1993). *Genetics and molecular biology.* (7th Ed.). UK: The Johns Hopkins University Press.

BIOT-5108 **Biochemistry-II** **3(2+1)**

This course is a continuation of principles of Biochemistry - I, and aims to familiarize students with the key concepts of intermediary metabolism of proteins, nucleic acids, carbohydrates and lipids. The course also aims to provide knowledge on the principles of thermodynamics and their applications in bioenergetics. This subject will provide an advanced understanding of the core principles and topics of metabolism and to enable students to acquire a specialised knowledge and understanding of selected aspects by means of series of lectures and lab experiments. Special emphasis will be placed on, but not limited, to the biochemical basis of metabolism including the biosynthesis and breakdown of lipids, amino acids, nucleic acids and some important special products derived from amino acids. Through this course the students will also be able to integrate and evaluate biochemical and physiological concepts and mechanisms related to normal healthy states to diseases or pathologic states.

Contents

1. Introduction to metabolism and basic aspects of bioenergetics and biochemical thermodynamics (endergonic and exergonic reactions)
2. Carbohydrate metabolism and regulation (glycolysis, glycogenolysis; gluconeogenesis; pentose phosphate pathway), Citric acid cycle (reactions, energetics and control)
3. Electron transport chain, oxidative phosphorylation, shuttle mechanisms
4. Lipid metabolism (energy yield from fatty acid oxidation, ketone bodies, acyl glycerol, compound lipids, cholesterol)
5. Photosynthesis; Calvin Cycle
6. Metabolism of nitrogenous compounds (amino acid synthesis, catabolism, purine and pyrimidine synthesis), Nucleic acid metabolism and control
7. Urea cycle and Integration of metabolism

Practicals

Basic biochemical methods such as iodine test for polysaccharides, fermentation of sugars by Baker's yeast; isolation of amylose and amylopectin from starch; extraction of glycogen from liver; acid and enzymatic hydrolysis of glycogen; extraction and estimation of lipids from plant tissue/seed and lipid separation from different tissues; fractionation by thin layer chromatography (TLC).

Recommended Texts

1. Nelson, D. L. and Cox, M. M., (2012). *Lehninger Principles of Biochemistry*, 6th Edition, New York: W.H. Freeman .
2. Hames, D. and Hooper, N., (2006). *Instant Notes on Biochemistry*, 3rd Edition, USA: Taylor & Francis Group.

Suggested Readings

1 Berg, J., Tymoczko, J. and Stryer, L., (2006). (Eds), *Biochemistry*, 6th Edition, New York: W.H. Freeman and Company.
2 Voet, D. and Voet, T.G., (2008). *Biochemistry*, 4th Edition, New York: John Wiley & Sons.

BIOT-5109 Research Methodology and Skills Enhancement 3(3+0)

This course will familiarize students with various methods and tools used for conducting research and latest trends in the field of biotechnology through reading and understanding scientific literature. Introducing the students to various different types of manuscripts and the methods/steps involved in preparing a good scientific manuscripts, different online tools to find the articles related to the research topic, fetching the valuable information from articles, designing research projects, methods to collect data and interpretation of that data to come to the concluding point. This course will also help the students in learning the important skills to present their scientific knowledge in an effective way by using different techniques like posters and presentations, which are common method used in scientific community to share their knowledge. Introduction and importance of intellectual property rights will also be elaborated to improve the knowledge of students about patenting and securing their research, avoiding the unethical academic practices (Plagiarism) and its severe consequences.

Contents

1. Introduction; unethical academic practices (plagiarism)
2. Need of research and research types
3. Extraction and review of literature
4. Identifying a research problem and formulating a hypothesis
5. Designing a study; data collection, interpretation and analysis
6. Writing a research report, project, thesis and/or research article or review
7. Preparing posters
8. Making scientific presentations
9. Intellectual property.

Recommended Texts

1. Bryman, A. (2001). *Social Research Methods*. (2nd Edition). New York, USA: Oxford University Press.
2. Awan, J.A. (2003). *Scientific Presentation*. Faisalabad, Lahore: Unitech Communication.

Suggested Readings

1. Kothari, C.R. (2004). *Research Methodology: Methods and Techniques*. (2nd Edition). New Delhi: New Age International Publishers.
2. Durrani, S.A. (2004). *Technical Writing*. Islamabad, Islamabad: Higher Education Commission.
3. Kumar, R. and Kindersley, D. (2010). *Research Methodology: A Step by Step Guide for Beginners*. (3rd Edition). Ventura, USA: SAGE Publications.

BIOT-5110 **Immunology** **3(3+0)**

The purpose of this course is to acquaint students with the basic principles of innate and adaptive immune systems. The multiple roles, functions of immune system, and its consisting of cells and the relation of how this lead to diseases. The course will consider both innate and adaptive immunity and include the structure and function of key receptors including immunoglobulin, T cell receptors and innate pattern recognition receptors. The mechanisms of antibody formation and molecular aspects of cellular immunity including T and B cell interactions and lymphocytes memory formation, will be emphasized, and connections to modern biomedical science will be highlighted. These will include presentations and discussions on autoimmunity, immunity against major microbial pathogens (viruses, bacteria, parasites) transplantation and tumor immunology. Different types of Vaccines including traditional and modern vaccine and their importance as protection from different viral and bacterial pathogen. Types of allergies and how they affect human life.

Contents

1. Overview of the immune system as the body's main defense mechanism.
2. Elements of innate and acquired immunity
3. Cells and organs of the immune system.
4. Properties of antibodies and antigens together with their structure.
5. Antibody function and interactions
6. Monoclonal and polyclonal antibodies.
7. Genetics of antibody structure and diversity
8. Expression of immunoglobulin genes.
9. Major Histocompatibility complex.
10. T-cell and B-Cell.
11. Complement system
12. Hypersensitivity
13. resistance and immune response to infectious diseases
14. Cell-mediated effector response, leukocyte migration and inflammation
15. Vaccine, Traditional vaccines, Modern Vaccines
16. Autoimmunity
17. Transplantation immunology

Recommended Texts

1. Kuby, J. (2006). *Immunology.* (6th Ed.). New York: WH Freeman
2. Abbas, A.K., & Lichtman, A.H. (2010). *Basic immunology: Functions and disorders of the immune system.* (3rd Ed.). Philadelphia: Saunders Publisher

Suggested Readings

1. Janeway, C.A., et al. (2001). *Immunobiology. The immune system in health and disease.* (5th Edition). New York, Garland Science Publisher
2. Anderson, W.L. (1999). *Immunology.* (1st Ed.). New Jersey: Wiley-Blackwell.

BIOT-5111 **Microbiology** **3(2+1)**

This course aims to familiarize students with fundamentals of prokaryotic and eukaryotic microbial life including viruses. In this course students will learn about culturing of bacteria, nutritional requirements of microbes and control of microbes. Students will also learn about the importance of microbes in our life. The course also describes how microorganisms are used as model systems to study basic biology, genetics, metabolism and ecology. This course will also help to student about knowledge of antibiotics and their mode of action. Students learning this course will be able to complete a substantial research project related to microbiology; seek and employ insights from others in implementing the project; evaluate a significant challenge or question faced in the project in relation to core concepts, methods or assumptions in microbiology; and describe the effects of learning outside the classroom on his or her research or practical skills.

Contents

1. Overview and history of microbiology including microbial diversity (Archaea, bacteria, fungi,algae, protozoa)
2. Nutrition and growth of microbes
3. Metabolism of microbes
4. Cultivation of microbes
5. Viruses
6. Control of microorganisms: Sterilization and disinfection,
7. Antimicrobial agents
8. Antibiotics, antibiotic resistance and susceptibility
9. Antifungal and antiviral agents; cell death
10. Symbiosis, Carbon, nitrogen, sulfur and phosphorus cycles
11. Microbiology of soil, Microbiology of freshwater and seawater.

Practicals

Sterilization techniques; culturing of bacteria in liquid and on solid medium; Gram-staining of bacteria; colony and cell morphology; bacterial cell count and growth curves; biochemical tests.

Recommended Texts

1. Plczer, M.J., Chan, E.C.S., & Krieg, N.R. (2008). *Microbiology.* (5th Ed.). New Dehli: Tata McGraw Hill Publisher
2. Talaro, K.P. (2009). *Foundations in Microbiology: Basic principles.* (7th Ed.). NY: McGraw Hill Publisher

Suggested Readings

Tortora, G.J., & Funke, B.R. (2016). *Microbiology: An introduction.* (12th Ed.). UK: Pearson

1. Alcamo, I.E. (2016). *Fundamentals of Microbiology.* (9th Ed.). USA: Jones and Bartlett Publishers
2. Cappuccino, J.G., & Sherman, N. (2016). *Microbiology: A laboratory manual.* (10th Ed.). UK: Pearson Education

BIOT-5112 **Methods in Molecular Biology** **3(2+1)**

This course is designed to identify the fundamental aspects of molecular biology techniques and to apply the principles of molecular methods in a design in order to sense, study or control a biological system. This introductory course will explore the process of doing scientific research in a molecular biology lab. Students will learn numerous techniques in the lab, including DNA isolation, PCR, gel electrophoresis etc. This course is intended for the students with little or no experience in a molecular biology lab, and it will prepare these students for the more advanced molecular lab courses and training. The aim of the course is that the students should assimilate a substantial theoretical basis to understand the key experimental techniques used in modern molecular biology research. Students will also be equipped with theoretical and practical basis for further academic studies or professional practice in areas related to molecular biology.

Contents

1. Solution dilutions, Sterilization techniques,
2. DNA/RNA extraction techniques,
3. Horizontal, vertical, pulse field, denaturing gradient gel electrophoresis;
4. Analysis of proteins by native and SDS-PAGE; 2-D gels;
5. Polymerase chain reaction (PCR) – Types of PCR (inverse, touch-down, nested, hemi-nested, pit stop,
6. Multiplex, reverse transcriptase, RACE, Real-time qPCR, Applications of PCR; Detection of mutations and/or SNPs;
7. Analysis of nucleic acids by gel electrophoresis
8. Enzyme-linked immunosorbant assay; Southern, Western, Northern blotting.
9. Biosensors, Transducers.

Practicals

Preparation of stock and working solutions; isolation of nucleic acids and their quantification; restriction digestion of DNA and preparation of restriction maps; gel electrophoresis, agarose and polyacrylamide gels; polymerase chain reaction (PCR); preparation of chemically competent cells; transformation of bacteria with plasmid DNA.

Recommended Texts

1. Walker, J.M., & Rapley, R. (2008). *Molecular biomethods handbook: Methods in molecular biology,* 2nd Ed.). New Jersey, USA: Humana Press.

2. Bartlett, J.M.S., & Stirling, D. (2008). *Methods in Molecular Biology, PCR Protocols.* (2nd Ed.). New Jersey, USA: Humana Press Inc

Suggested Readings

1. Griffiths, A.J.H., Wessler, S.R., Carrol, S.B., & Doebley, J. (2015). *Introduction to genetic analysis.* (11th Ed.). USA: W. H. Freeman and company
2. Wink, M. (2011). *An Introduction to molecular biotechnology: Fundamentals, methods, and applications.* (2nd Ed.). USA: Wiley Blackwell
3. Wilson, K., & Walker, J. (2010). *Principles and techniques of biochemistry and molecular biology.* (7th Ed.). UK: Cambridge University Press

BIOT-6113 **Bioinformatics** **3(1+2)**

Bioinformatics is defined broadly as the study of the inherent structure of biological information. The objective of the course is to introduce students to the rapidly evolving field of bioinformatics. The term "bioinformatics" often means different things to different scientists, and the goal of this course is not to cover all those things. The main objective of this course is to familiarize the students with biological data mining from online databases and the use of various bioinformatics tools for extracting and processing biological data. After completing this course, the students will gain an understanding of the computational challenges (and their solutions) in the analysis of large biological data sets; they will also understand how some of the commonly used bioinformatics tools work, how to use these tools effectively, and how to read and evaluate the research articles in the field.

Contents

1. Introduction; bio-computing
2. Biological databases - types and retrieval of nucleic acid (or genomic) or protein sequence information
3. Sequence alignment - pairwise, multiple
4. Phylogenetics; *in silico* identification of protein motifs and domains
5. Structural bioinformatics of proteins and RNAs including protein modeling and prediction of their interactions with other proteins and small molecules
6. Identification of genes and promoter regions within genomes; networks
7. Strategies for whole genome sequencing and assembly

Recommended Databases And Tools

NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc. Bioedit, Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip, MEGA4.0 etc.

Recommended Texts

1. Claverie, J.M., & Notredame, C. (2014). *Bioinformatics for Dummies.* (4th Ed.). USA: Wiley Publishing.
2. Xiong, J. (2016). *Essential Bioinformatics.* (3rd Ed.). UK: Cambridge University Press.

Suggested Readings

1. Mathura, V., & Kangueane, P. (2016). *Bioinformatics: A concept-based introduction.* USA: Springer.
2. Mount, D.W. (2001). *Bioinformatics Sequence and Genome Analysis.* (4th Ed.). USA: Cold Spring Harbor Laboratory Press.
3. Sperschneider, V. (2016). *Bioinformatics: Problem solving paradigms.* USA: Springer.

BIOT-6114 **Genomics and Proteomics** **3(3+0)**

The overarching goal of this course is to provide students with a thorough overview of both the theoretical and experimental aspects of structural and functional genomics as well as proteomics. Proteomics complements genomics and is useful when scientists want to test their hypotheses that were based on genes. Even though all cells of a multicellular organism have the same set of genes, the set of proteins produced in different tissues is different and dependent on gene expression. This course will introduce the students to the genetics, organization of genome and various practical approaches to know the sequence of genes/genome. Moreover, Gene expression and the biologicals systems which interfere with the gene expression will also be discussed. Proteins and their role in cell signaling will be elaborated. By the end of this course, each student will be familiar with the terminology, underlying principles and strategies, and the technical methodology involved in genomics and proteomics. They will be able to compare and contrast the strengths and limitations of these technologies.

Contents

1. Organization and structure of genomes
2. Genetic mapping (RFLP, microsatellite, SNP)
3. High-resolution physical mapping (STS, EST)
4. Flow cytometry; somatic cell and radiation hybrids
5. Artificial chromosomes in bacteria and yeast
6. Hierarchical and whole genome shotgun sequencing
7. DNA sequencing strategies - manual and automated sequencing, pyrosequencing
8. Solexa, Helicos, Roche 454, real-time and nanopore sequencing;
9. Sequence assembly, obstacles and solutions
10. Estimating gene number – over-prediction and under-prediction, homology searches, exon prediction programs, integrated gene-finding software packages; structural variation in the genome and its applications
11. Microarray and RNA interference; proteomics; cellular communication/signalling pathways; protein-protein interactions and validation - yeast two hybrid system
12. Affinity purification-mass spectrometry (AP-MS), tandem affinity purification (TAP) tagging, fluorescence resonance energy transfer (FRET) and co-immunoprecipitation.

Recommended Texts

1. Strachan, T. and Read, A.P. (2010). *Human Molecular Genetics.* (4th Edition). New York, USA: Garland Science.
2. Saccone, C. and Pesole, G. (2003). *Handbook of Comparative Genomics: Principles and Methodology.* (1st Edition). Hoboken, UAS: Wiley-Liss.

Suggested Readings

1. Town, C. (2002). *Functional Genomics.* (1st Edition). New York, USA: Springer.
2. Krebs, J.E., Golstein, E.S., Kilpatrick, S.T. (2010). *Lewin's GENES X.* (10th Edition). Middlesex, USA: Jones and Bartlett Publishers.

BIOT-6115 **Biosafety and Bioethics** **2(2+0)**

This course will explore a rich content on prevention, standards and ethical principles which provide a basic awareness about biological integrity, focusing both on ecology and human health. We will discuss what actually the biosafety is? What are the major biohazards related to laboratory chemicals and instruments, what are some good laboratory practices, which should be followed strictly to avoid the biohazards. International rules and risks related to genetically modified organisms, awareness regarding genetic information will also be discussed. Euthanasia is an important topic to discuss as it is under debate and many countries support this concept. Hence, the ethical issues regarding euthanasia will be discussed in detail. In addition to this, an important knowledge regarding ethical and moral concerns associated with patenting, benefit sharing and knowledge about role of national bioethics committees will also be delivered. Emerging cloning technologies as well as major biosafety levels/standards will be also be incorporated to enhance the understanding of students regarding biosafety.

Contents

1. Introduction to Biosafety
2. Definition
3. Concept
4. Uses and abuses of genetic information
5. Biohazards
6. Good laboratory practices
7. Risks related to genetically modified organisms (GMO)
8. International rules and regulations for biosafety and GMOs
9. Introduction to bioethics
10. Ethical issues related to GMOs
11. Euthanasia
12. Reproductive and cloning technologies
13. Transplants and eugenics
14. Patenting
15. Commercialization and benefit sharing
16. Role of national bioethics committees
17. Biosafety guidelines from a national perspective

Recommended Texts

1. Krishna, V.S. (2007). *Bioethics and Biosafety in Biotechnology*. New Delhi, India: New Age International Publishers.
2. WHO (2006). *Laboratory Biosafety Manual*. (3rd Edition). New Delhi, India: AITBS Publishers and Distributors

Suggested Readings

1. Pakistan Environmental Protection Agency. (2005) National Biosafety Guidelines. (*Available online*)
2. The laboratory Biosafety Guidelines.3rd edition. USA: WHO.
3. BioTrad, and Access and benefit Sharing: From Concept to Practice. (A handbook for policymakers and regulators). Switzerland: UUNTCD.

BIOT-6116 **Principles of Biochemical Engineering** **3(2+1)**

To acquaint the students with the fundamentals of biochemical engineering. The objective of this course is to introduce the basic concepts of biomolecule and the cell function and how they are applied to bioreactor analysis and its design. The students will also be able to develop a clear picture of what enzymes are, what their function is and the mechanistic models describing their function in biochemical reactions. Through this course, the students will grasp knowledge about the mechanisms and energetics of metabolic pathways in the cell and the various patterns and calculations involved in describing cell growth. This course focuses on the interaction of chemical engineering, biochemistry, and microbiology. Mathematical representations of microbial systems are featured among lecture topics. Kinetics of growth, death, and metabolism will also be covered during this course. Continuous fermentation, agitation, mass transfer, and scale-up in fermentation systems, and enzyme technology round out the subject material.

Contents

1. Introduction to microorganisms and biological molecules
2. Principles of enzyme catalysis; methods of enzyme and cell immobilization; enzyme kinetics
3. Internal mass transfer effect on immobilized growth; Stoichiometry models of microbial growth; structured model, of microbial growth
4. Bioreactors - continuous stirred tank bioreactors, plug-flow and packed bed bioreactors, imperfect mixing
5. Fed batch bioreactors, gas liquid mass transfer in bioreactors, power requirement for bioreactor, sterilization and heat transfer in bioreactors
6. Introduction to bioproduct recovery
7. Biological product manufacturing, Economic analysis of bioprocesses, Case study: penicillin.

Practicals

Unstructured microbial growth with application of Monod model; inhibition kinetics and nutrient uptake rate; methods of immobilization via binding and physical retention; yield coefficient and stoichiometry; production of enzymes by structured and segregated models; bioreactor design and analysis (batch, fed-batch and continuous); enzyme catalysis in the CSTR; packed bed and plug flow bioreactor; rheology of fermentation broth; mixing and gas-liquid mass transfer, heat transfer, media and bioreactor sterilization techniques; techno-economic analysis of a typical bioprocess.

Recommended Texts

1. Katoh, S., et al. (2015). *Biochemical egineering: A textbook for engineers, chemists and biologists.* (2nd ed.). Germany: Wiley-VCH.
2. Najafpour, G. (2015). *Biochemical engineering and biotechnology.* (2nd Ed.). USA: Elsevier Science

Suggested Readings

1. Douglas, S.C., & Blanch, H.W. (1997). *Biochemical engineering.* (2nd Ed.). USA: CRC Publishers.
2. Katoh, S., & Yoshida, F. (2009). *Biochemical engineering: A textbook for engineers, chemists and biologists*. Germany: Wiley-VCH.

BIOT-6118 **Food Biotechnology** **3(3+0)**

Food biotechnology is a process scientists use to enhance the production, nutritional value, safety, and taste of foods. Food technology is a branch of food science that deals with the production processes that make foods. Early scientific research into food technology concentrated on food preservation. Nicolas Appert's development in 1810 of the canning process was a decisive event. The purpose of this course is to acquaint students with the role of microorganisms in food and the food industry in addition to principles of enzymology, and food engineering. The course emphasizes modern techniques in food microbiology, biotechnology and food analysis. Course focused on recent developments and applications of modern genetics as well as enzyme, cell, tissue, and organ-based biological processes to produce and improve foods, food ingredients, and functional foods. Other areas of strong interest are fermentation to improve foods, food ingredients, functional foods, and food waste remediation.

Contents

1. Food composition
2. Probiotics
3. Fermented foods
4. Food enzymes
5. Colors and additives
6. Overview of metabolic engineering of bacteria for food ingredients
7. Techniques used for production of food ingredients by microbes
8. Genetic modification of plant starches for food application
9. Biotechnological approaches to improve nutritional quality and shelf life of fruits and vegetables
10. Microbial food spoilage and food borne diseases; detection and control of food borne bacterial pathogens
11. Food safety and quality control; international aspects of quality and safety assessment of food derived by modern biotechnology.

Practicals

Pure culture study of fermented products such as yogurt, bread, pickles, acetic acid etc.; isolation and handling of microbial flora of fermented products as *Lactobacilli, Saccharomyces, Aspergillus, Acetobacter* etc.; preparation of fermented products using pure cultures; effect of pH on the microbial flora of different fermented products.

Recommended Texts

1. Joshi, V.K. (2012). *Food Biotechnology*. (1st Edition) . Delhi: I K International Publishing House.
2. Campbell-Platt, G. (2009). *Food Science and Technology*. (1st Edition). Hoboken: Wiley-Blackwell.

Suggested Readings

1. Belitz, H.D. (2009). *Food Chemistry*. (4th Edition). New York: Springer.
2. Nielsen, S.S. (2010). *Food Analysis*. (4th Edition). New York: Springer.
3. Singh, R.P. (2008). *Introduction to Food Engineering*. (4th Edition). New York: Academic Press.

BIOT-6119 **Pharmaceutical Biotechnology** **3(3+0)**

Pharmaceutical biotechnology is an emerging field in the pharmaceutical industry owing to its many benefits over the conventional pharmaceutics. This course will familiarize the students to the basic differences between the biopharmaceutical and pharmaceutical, general process of drug development, properties of effective drug. In the drug development process, each step starting from the selection of lead molecule to the purification of biopharmaceutical and its final packing will be elaborated in details to make the students able to understand all the precautionary measures taken at each step and the hurdles (contaminations) that can make the production of biopharmaceutical a challenging task. Various technologies like genomics, proteomics, structural genomics etc. which help in the selection of lead molecule will be discussed. Moreover, the methods/test conducted at various stages of drug testing, role of excipients and various polymers which are commonly used in pharmaceutical industry to improve the drug characteristics/activity and controlled drug release systems will also be explained. Furthermore, legal and regulatory issues associated with the biopharmaceuticals will also be discussed.

Contents

1. Introduction and basic concepts of pharmaceutical biotechnology
2. Properties of an effective drug; drug development process; selection of a lead molecule from available pool
3. Lab scale studies, pilot scale studies and clinical trials (Phase I, II and III).
4. Drug toxicity; impact of genomics and other related technologies on drug discovery
5. Use of DNA and protein microarrays in identification of disease targets and for monitoring effectiveness of drugs
6. Pharmacogenomics; plants and microorganisms as sources of drugs
7. Polymers: classification, polymerization and characterization
8. Controlled drug release system and its advantages and disadvantages over conventional release methods; legal and regulatory issues.

Recommended Texts

1. Kayser, O. (2012). *Pharmaceutical Biotechnology: Drug Discovery and Clinical Application.* (2nd Edition). Hoboken, USA: Wiley-Blackwell.
2. Walsh, G. (2007). *Pharmaceutical Biotechnology: Concepts and Applications.* (1st Edition). Hoboken, USA: Wiley.

Suggested Readings

1. Ende, D.J. (2010). *Chemical Engineering in the Pharmaceutical Industry: R & D to Manufacturing.* (1st Edition). Hoboken, USA: Wiley.
2. Subramanian, G. (2012). *Biopharmaceutical Production Technology.* (1st Edition). Hoboken, USA: Wiley-VCH.
3. Crommelin, *et al.*, (2007). *Pharmaceutical Biotechnology: Fundamentals and Applications.* (3rd Edition). London, United Kingdom: Informa Healthcare.

BIOT-6120 **Agriculture Biotechnology** **3(3+0)**

Agricultural Biotechnology is the use of new scientific techniques based on our understanding of DNA to improve crops and livestock that are not possible with conventional breeding alone. This can be achieved in part by modern molecular plant breeding techniques such as marker-assisted selection (MAS). A course designed to incorporate basic elements of science with a variety of technology applications that are used to modify living organisms. Areas of emphasis include basic science laboratory procedures, implementation of the scientific method of discovery, plant science. Agricultural Biotechnology covers the study of the concepts, methods and a range of tools employed to understand and manipulate the genetic make-up of organisms to increase the production or processing of agricultural products. This course provides comprehensive introduction on Plant breeding; Cell and tissue culture; Plant transformation; methods of transformation in plants including competence, electroporation, microinjection, Particle gun and *Agrobacterium*; methods for assessing transformation etc. More specifically, this course introduces Biosafety guidelines. At the end of this course, the students will have in depth knowledge about the methods to be used for transgenic crops resistant against insects etc.

Contents:

1. Introduction to Plant breeding
2. Scope and importance in crop improvement
3. Tissue culture and its history
4. Totipotency and Morphogenesis
5. Nutritional requirements
6. Techniques and Types of in vitro cultures
7. Haploid production and uses
8. Protoplast isolation
9. Somaclonal variation and crop improvement
10. Somatic embryogenesis
11. Gene delivery methods in plants
12. Transient and stable expression systems
13. Chloroplast transformation and polyethylene glycol (PEG) mediated transformation
14. Viruses as expression vectors
15. Methods for assessing transformation of transgenic crops
16. Biosafety guidelines
17. Recent research articles

Recommended Texts

1. ICAR (2014). Priciples of Plant Biotechnology. E Course agrimoon.com.
2. C. Neal Stewart, Jr. 2008. Plant Biotechnology And Genetics: Principles, Techniques, And Applications. John Wiley & Sons.

Suggested Readings

3. Kempken, F. (2010). *Genetic Modification of Plants: Agriculture, Horticulture and Forestry* (Biotechnology in Agriculture and Forestry). New York, USA: Springer.

BIOT-6121 **Animal Biotechnology** **3(3+0)**

The purpose of this course is to acquaint students with techniques for engineering transgenic animals and embryonic micromanipulations. Importance of animals as providers of food and non-food items, improving the characteristics of animals by genetic manipulations using various different techniques e.g. transformation, transfection, microinjection etc. screening of transgenic animals at DNA or protein levels will be included in this course. Along with these, this course will also include the biotechnological techniques in animal breeding, different animal breeding strategies, role of synthetic bio peptides like somatotropin, synthetic gonadotropin-releasing hormone in animal health, production and use of monoclonal antibodies in diagnosis of animal diseases and as therapeutic agents to treat the disease, role of cytokines and their potential use in diagnosis of microbial infections. Furthermore, introduction to micromanipulation, various techniques used for micromanipulation of farm animal embryos for increasing the animal number will also be discussed.

Contents

1. Introduction and history of transgenic animals
2. Role of synthetic peptides/proteins in animal health
3. Use of monoclonal antibodies as a diagnostic/therapeutic agents
4. Cytokines and their potential therapeutic value as applicable to the diagnosis of microbial infections 5. Micromanipulations of farm animal embryos
5. Use of biotechnological techniques in animal breeding strategies
6. Gene transfer through embryo microinjection
7. Ethical and social issues in animal biotechnology.

Recommended Texts

1. Freshney, I.R. (2010). *Culture of Animal Cells: A Manual of Basic Techniques and Specialized Application.* (6th Edition). Hoboken, USA: Wiley-Blackwell.
2. Masters, J.R. (2000). *Animal Cell Culture.* (3rd Edition). New York, USA: Oxford University Press.

Suggested Readings

1. Barnum, S. (2004). *Biotechnology: An Introduction,* (Updated Edition (with Infotrac). Belmont, USA: Brooks Cole Publishing.
2. Tourte, Y. and Catherine, T.C. (2005). *Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications.* New Delhi, India: Science Publishers.
3. Houdebine, L.M. (2003). *Animal Transgenesis and Cloning.* (1st Edition). Hoboken, USA: John Wiley and Sons.

BIOT-6122 **Environmental Biotechnology** **3(2+1)**

As environment plays an important role in the well-being of human and all other species living on the earth. This course will help the students to learn about the various factors of the environment and ways in which biotechnology is helping in improving/conserving the environment. The factors which disturbed the environmental balance e.g. different types and sources of pollution, methods/tools which can be used to measure pollution levels and help in reducing pollution burden will also be discussed in detail. Role of genetic manipulations and different strategies which can be used for genetic manipulation of living organisms for the betterment of environment, role of biodegradation and biotransformation of hazardous chemicals in reducing the pollution and improving the environment for species including human will also be the part of this course. To further emphasize the importance of environmental biotechnology, students will also be introduced to the various products of environmental biotechnology which are being used to improve the environment.

Contents

1. Introduction to environmental biotechnology; fundamentals of biological interventions
2. Genetic manipulation strategies in environmental biotechnology
3. Pollution indicators and pollution control strategies
4. Bioreactors
5. Domestic waste water treatment; industrial effluent treatment; sludge treatment
6. Contaminated land and bioremediation
7. Phytoremediation; landfills and composts
8. Concept of integrated environmental biotechnology
9. Biodegradation and biotransformation of hazardous chemicals
10. Products of environmental biotechnology.

Practicals

Biodegradation of environmental pollutants by microorganisms; bacteriology of drinking water; microscopic studies of water specimens collected from various locations; field survey of polluted areas and field study for pollution indicators (e.g., plants, microorganisms and air).

Recommended Texts

1. Vallero D. (2015). *Environmental Biotechnology. A Biosystems Approach.* (2nd Edition). New York: Academic Press
2. Chatterji A.K. (2011). *Introduction to Environmental Biotechnology.* (3rd Edition). Delhi: Prentice-Hall of India

Suggested Readings

1. Evans, G.M. and Furlong, J.C. (2010). *Environmental Biotechnology Theory and Application.* (2nd Edition). Hoboken, New York: Wiley-Blackwell.
2. Srinivas, T. (2008). *Environmental Biotechnology.* (1st Edition). New Delhi: New Age. International Publishers.

BIOT-6123 **Recombinant DNA Technology** **3(2+1)**

To acquaint the students with basic techniques and tools used in gene manipulation and its practical uses. This subject is aimed to introduce the student to the wide range of methodologies that are commonly known as Recombinant DNA Technology. These methodologies, most of them developed at the end of the last century, are one of the pillars of modern biotechnology and the students will become familiar with these methodologies during course of this module. The general objective of this courses is to provide a solid basis allowing the student to apply these methodologies when designing biotechnological processes. After completing this course, the students will have a knowledge about the main cloning vectors, main characteristics of vectors and how to use them in the different strategies for the cloning of DNA fragments. It will also familiarize students with the application of recombinant DNA Technology in various fields such as agriculture, health, industry, environment and basic research.

Contents

1. Introduction and History of Recombinant DNA technology
2. DNA modifying enzymes, restriction endonucleases, restriction mapping
3. Vectors and their types, cloning vectors including plasmids, bacteriophages, cosmids
4. YAC vectors, shuttle and expression vectors; tumor inducing (Ti) plasmids; transformations
5. Cloning strategies, expression of recombinant proteins and their purification by affinity chromatography; Expression in prokaryotes and eukaryotes, Site-directed mutagenesis, genomic and cDNA libraries, chromosome walking
6. Sequencing strategies; Application of recombinant DNA Technology (agriculture, health, industry, environment and basic research).

Practicals

DNA and plasmid isolation, Preparation of restriction maps, designing expression constructs, Transformation techniques, Blotting techniques.

Recommended Texts

1. Griffiths, A. J. H., Wessler, S. R., Carrol, S. B. and Doebley, J. (2020). *Introduction to Genetic Analysis.* (12th Edition). New York, USA: W. H. Freeman and company.
2. Brown, T.A. (2016). *Gene Cloning and DNA analysis.* (7th Edition). Hoboken, USA: Wiley-Blackwell Publishing.

Suggested Readings

1. Primrose, S.B. and Twyman, R.M. (2006). *Gene Manipulation and Genomics.* (6th Edition). New Jersey, USA: Blackwell Publishing.
2. Watson, J.M., Caudy, A.A., Meyers, R.A. and Witkowski, J.A. (2007). *Recombinant DNA: Gene and Genomes.* (3rd Edition). New York, USA:W.H. Freeman and Company.

BIOT-6124 **Industrial Biotechnology** **3(2+1)**

The main aim of biotechnology is to improve and ease the life of human and industry is playing an important role in producing various valuable products for the betterment of mankind and make their work easier and quicker. Industrial biotechnology uses the biotechnological approaches involving the microorganisms to generate various products at production scale. This subject will help to enhance the knowledge of students about the microorganism that are commonly used in industry, nutritional requirements of these industrial microorganism and the various types of media which can be used to fulfill these nutritional requirements. Screening of valuable strains of microorganism and their culture collections, importance of fermentation technology and various types of fermenters which can be used for the growth of these microorganism at industrial scale, purification and extraction of fermented products, role of proteins produced by industrial microorganisms as food products, biocatalyst and bio insecticides will be explained.

Contents

1. Industrial biotechnology – introduction and scope
2. Microorganisms commonly used in industry; media and nutritional requirements of industrial organisms
3. Screening for productive strains and strain improvement; culture collections
4. Fermentation and fermenters; extraction of fermented products; production of beer, wines, spirits and vinegar
5. Use of single cell proteins as food products; biocatalysts; microbial insecticides
6. Production of metabolites: organic acids and amino acids
7. Vaccines and antibiotic production

Practicals

Isolation of *lactobacillus* from dairy products, fruit juices, etc.; fermentation of different sugars by bacteria (or other microorganisms); identification of proteases/ amylases producing bacteria; extraction of hydrolytic crude enzymes from microbes; effect of environmental factors (e.g., pH, temperature, salt, etc.) on activity of crude enzymes.

Recommended Texts

1. Watson K. (2016). *Industrial Biotechnology*, (Vol 1 & 2). Delhi: Atithi Medical Book Ltd.
2. Hazare et al (2014). *Handbook of Food and Industrial Biotechnology.* Florida: CRC Publishers.

Suggested Readings

1. Shara, L.A. (2009). *Industrial Biotechnology*. (1st Edition). New York: Nova Science Publishers.
2. Singh, R. and Ghosh, S. (2004). *Industrial Biotechnology*. New Delhi: Global Vision Publishing House.
3. Prasad, N.K. (2012). *Downstream Process technology, A New Horizon in Biotechnology*. Delhi: PHI Learning Ltd.

BIOT-6125 **Cytogenetics and Plant Breeding** **3(3+0)**

The course "Cytogenetics and Plant Breeding" aims to provide students with a comprehensive understanding of the principles and techniques of cytogenetics and their applications in plant breeding. The course objectives include developing knowledge and skills in plant chromosome structure and behavior, cytogenetic techniques for studying genetic variation, and their utilization in plant breeding programs. Students will gain insights into the principles of cytogenetic analysis and breeding strategies for improving crop traits.

Contents:

1. Introduction to Cytogenetics and Plant Breeding
2. Plant Chromosome Structure and Organization
3. Cytogenetic Techniques: Karyotyping, Chromosome Banding,
4. Fluorescence In Situ Hybridization
5. Chromosome Behavior: Meiosis and Mitosis
6. Polyploidy and Aneuploidy in Plant Breeding
7. Cytogenetic Mapping and Genome Analysis
8. Dentification of Chromosomal Aberrations
9. Cytogenetic Techniques for Genetic Variation Analysis
10. Molecular Cytogenetics: FISH and GISH
11. Application of Cytogenetics in Plant Breeding
12. Breeding Strategies for Crop Improvement
13. Marker-Assisted Selection and Cytogenetic Markers
14. Molecular Marker Analysis
15. Genomic Approaches in Plant Breeding

Recommended Texts:

1. Ram J. Singh (2003). Plant Cytogenetics (2nd Edition).
2. John J. King and Michael M. J. King (2010). Chromosome Structure and Aberrations.
3. George Acquaah (2012). Principles of Plant Genetics and Breeding (2nd Edition).

Suggested Readings

1. S. K. Jain (2010). Cytogenetics.
2. Gurmukh S. Dhaliwal, Arvind Kumar, and Paramjit Khurana (2018). Breeding Field Crops.
3. N. K. Dadlani (2018). Principles of Plant Breeding.

BIOT-6126 **Forensic DNA Typing** **3(3+0)**

DNA profiling is renowned as a technique that is used in forensic investigations to match criminals against samples obtained from crime scenes DNA Analysis Forensic DNA typing has evolved over time by developing analytical methods for smaller and smaller fragments that, at the same time, are increasingly variable in the human population The purpose of this course is to familiarize the students to the importance of DNA in criminal investigations. This course will revise the basics of DNA and its inheritance patterns which will help the students to understand the results of forensic DNA typing specially the DNA markers which are mainly used in DNA typing. This course will focus on the methods of current forensic DNA typing emphasizing on short tandem repeats (STRs), new genetic markers and new technologies. Furthermore, this course will also explain the process of DNA testing from different types of samples through DNA extraction, DNA quantitation, DNA amplification, and statistical interpretation.

Contents

1. Introduction to genetics, describing what DNA is and the basics of inheritance.
2. Introduction to forensic science.
3. To examine how DNA and genetics can be utilised in a criminal investigation.
4. .Look at different types of DNA which might be useful in a forensic case.
5. How it is examined in the laboratory and we will also analyse these DNA profiles generated in the laboratory.
6. How genetics has changed over the years and the effects that this has had to forensic investigation
7. How future advances in genetics might affect future criminals and investigations.

Recommended Texts

1. Shewale, J.G., and Liu, R.H. (2017). *Forensic DNA Analysis: Current Practices and Emerging Technologies*. Boca Raton, USA: CRC Press.
2. Koblinsky, L., Liotti, T.F., and Oeser-Sweat, J. (2015). *DNA: Forensic and Legal Applications*. Hoboken, USA: Wiley.

Suggested Readings

1. Butler, J.M. (2017). *Fundamentals of Forensic DNA Typing*. New York, USA: Academic Press.
2. Butler, J.M. (2016). *Advanced Topics in Forensic DNA Typing: Methodology*. New York, USA: Academic Press.
3. Houck, M.M., and Siegel, J.A. (2017). *Fundamentals of Forensic Science*. New York, USA: Academic Press.
4. Butler, J.M. (2015). *Forensic DNA typing: Biology, Technology, and Genetics of STR Markers*. New York, USA: Academic Press.

BIOT-6127 **Health Biotechnology** **3(3+0)**

The purpose of this course is to acquaint students with biotechnology in healthcare including diagnostic tools, immunization and therapeutics. The course will emphasize the understanding of the molecular basis of the disease and role of molecular and genetic markers in the disease onset, progression and diagnosis. Various mutations and polymorphisms involved in the disease, infectious agents and their associated pathologies and importance of active and passive immunization to combat these pathologies. Different types of Vaccines including traditional and modern vaccine and their importance as protection from different viral and bacterial pathogen. Emerging needs for organ transplantation, causes of organ failure and problems associated with organ transplantation. Students will also be familiarized with the importance of animals as disease models, organ and food providers. Introduction to the traditional and modern treatment methods, role of pharmacogenetics, gene therapy, stem cell technology and various drug delivery systems in treating a disease will also be explained.

Contents

1. Introduction to health biotechnology;
2. Social acceptance of medical biotechnology;
3. Molecular basis of disease; molecular and genetic markers
4. Detection of mutations and infectious agents; active and passive immunization
5. Vaccines (live, killed, recombinant DNA vaccines, subunit vaccines, DNA vaccines, edible vaccines).
6. Organ transplantation;
7. Applications of transgenic animals (animal models of diseases, farming and enhancement of farm animals).
8. Drug delivery systems; blood transfusion and grafting techniques
9. Pharmacogenetics; gene therapy; biopharmaceuticals from plants; stem cell technology

Recommended Texts

1. Pongracz, J. and Keen, M. (2009). *Medical Biotechnology*. (1st Edition) . Haryana: Elsevier Health Sciences.
2. Schacter, B.Z. (2005). *Biotechnology and Your Health: Pharmaceutical Applications*. New York: Chelsea House Publishers.

Suggested Readings

1. Bustillo, L.G.T. and Pena, I.G. (2012). *Biotechnology: Health, Food, Energy and Environment Applications (Biotechnology in Agriculture, Industry and Medicine)*. New York: Nova Science Publication.
2. Dogramatzis, (2010). *Health care Biotechnology*. (1st Edition). Boca Raton, USA: CRC Press.

BIOT-6128 **Nano-Biotechnology** **3(3+0)**

The nano-biotechnology course is an interdisciplinary course that describes an emerging discipline dedicated to the generation of products, devices for biotechnology and bioengineering applications through integration of biology, chemistry, engineering and state-of-the-art nanotechnology, starting at the molecular level. The goal of this course is to ignite student's interests in this field by exposing them to diverse amazing projects. Students will gain abilities to integrate their multidisciplinary knowledge and skills into the interdisciplinary research project designs. This course aim to acquaint students with key integrative technologies and use of nanoparticles in biological systems. This course will introduce the students to the nanoparticles which can be used in medical, agriculture and industrial applications, quantum dots, nano tubes, nano rods. They will also explore the natural biological assembly at nanoscale and nanometric biological assemblies and their applications, nanobionics and applications of nano-biotechnology in cosmetics, agriculture and waste treatment. Moreover, the issues related to the nano-biotechnology and future prospective will also be discussed.

Contents

1. Introduction; interface between nanotechnology and nano-biotechnology
2. Manipulating molecules
3. Types, shapes and characteristic features of nanoparticles
4. Demonstrate various techniques used for the synthesis of nanomaterials.
5. Various techniques used for the characterization of nanomaterials.
6. Natural bionanomachinery in living cells,
7. How cells use these "soft machines" for generating energy, motion, synthesizing biomolecules, and how these principles can be applied to design new biomolecules and bionanodevices.
8. Medical, cosmetics, agriculture, water and other applications of nano-biotechnology
9. Use of nano-biotechnology for diagnosing and curing disease.
10. Future prospects of nano-biotechnology (some recent articles)

Recommended Texts

1. Gazit, E. (2007). *Plenty of Room for Biology at the Bottom: An Introduction to Bionanotechnology*. (1st Edition). London, United Kingdom: Imperial College Press.
2. Renugopalakrishnan, V. and Lewis, R.V. (2006). *Bionanotechnology: Proteins to Nanodevices*. New York, USA: Springer.

Suggested Readings

1. Prinz, F.B., Smith, R.L., Greco R.S. (2004). Nanoscale Technology In Biological Systems. Boca Raton, USA: CRC Press.
2. Mirkin, C.A. and Niemeyer, C.M. (2007). *Nanobiotechnology II: More Concepts and Applications*. Hoboken, USA: John Wiley & Sons.
3. Niemeyer C.M. and Mirkin, C.A. (2004). *Nanobiotechnology*. (1st Edition). Hoboken, USA: Wiley-VCH.

DETAILED DESCRIPTION OF INTERDISCIPLINARY COURSES

CHEM-6103 Analytical Chemistry 3(2+1)

This course gives an introduction to analytical chemistry and an overview of important analytical methods and their range of application within detection of inorganic and organic compounds. Analytical chemistry studies and uses instruments and methods used to separate, identify, and quantify matter. In practice, separation, identification or quantification may constitute the entire analysis or be combined with another method. Separation isolates analysts. Important analytical quantitative techniques from classical methods, electrochemical methods, spectrochemical / spectrophotometric methods, and separation techniques are reviewed. The course also includes risk assessment of chemical experiments, important steps and procedures in analytical chemistry, and evaluation/interpretation of results. The course gives an overview of important use of selected classical and instrumental chemical quantitative analytical methods and a short introduction to their basic theory. As a part of this course, a project work is also to be carried out; relevant topics will be announced at semester start. There will be an excursion at the end of the semester.

Contents

1. Introduction to various analytical techniques;
2. Principles and applications of various types of chromatography including paper, thin layer, gel filtration, ion-exchange, affinity, high performance liquid chromatography (HPLC), gas chromatography,
3. GC-MS and LC–MS; Spectroscopy types including nuclear magnetic resonance (NMR),
4. Visible, ultraviolet, luminescence, flame, atomic absorption, fluorescence, emission and inductively coupled plasma emission spectroscopy (ICPMS);
5. Principles and applications of flow cytometry; Introduction to X-ray diffraction;
6. General analytical instrumentations and methods of fractionation and characterization of proteins and nucleic acids including dialysis, ultra-filtration, lyophilisation, ultracentrifuge and amino acid analyzer.

Practicals

Separation of biomolecules by paper, column and thin layer chromatography; determination of molecular weight of proteins by gel filtration; identification of sugars, proteins, electrolytes etc. by UV/Visible spectrophotometer; determination of sodium and potassium content in blood serum by flame photometer and mineral analysis of plant tissues using atomic absorption spectrophotometer.

Recommended Texts

1. Boyer, R.F. (2016). *Biochemistry laboratory: Modern theory and techniques.* (2nd Ed.). New Dehli: Prentice Hall, .
2. Wilson, K. (2016). *Principles and techniques of biochemistry and molecular biology.* (7th Edition). UK: Cambridge University Press.

Suggested Readings

1. Chung, C., et al. (2005). *Analytical methods validation and instrument performance verification.* (1st Ed.). New York: John Wiley & Sons
2. Sharma, B.K. (2005). *Instrumental method of chemical analysis.* (1st Ed.). India: Meerut Goel Publishing House

MATH-5101 **Calculus-I** **3 (3+0)**

Calculus is the mathematical study of continuous change. If quantities are continually changing, we need calculus to study what is going on. Calculus is concerned with comparing quantities which vary in a non-linear way. It is used extensively in science & engineering, since many of the things we are studying (like velocity, acceleration, current in a circuit) do not behave in a simple, linear fashion. Calculus has two major branches, differential calculus (Calculus – I) & integral calculus (Calculus – II); the former concerns instantaneous rates of change, & the slopes of curves, while integral calculus concerns accumulation of quantities, & areas under or between curves. This is the first course of the sequence, Calculus-I, II & III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts & skills needed for mathematical manipulation. Itfocuses on the study of functions of a single variable. Calculus-I is an introduction to differential & integral calculus: the study of change.

Contents

1 Functions & their graphs, Rates of change & tangents to curves
2 Limit of a function & limit laws, the precise definition of a limit
3 One-sided limits, continuity, Limits involving infinity; asymptotes of graphs
4 Differentiation: tangents & derivative at a point, the derivative as a function
5 Differentiation rules, the derivative as a rate of change
6 Derivatives of trigonometric functions, Chain rule, implicit differentiation
7 Related rates, linearization & differentials, higher derivatives
8 Applications of derivatives: extreme values of functions
9 Rolls' theorem, the mean value theorem, Monotonic functions & the first derivative test
10 Convexity, point of inflection & second derivative test, Concavity & curve sketching
11 Applied optimization, Antiderivatives, integration: area & estimating with finite sums
12 Sigma notation & limits of finite sums, definite integral, the fundamental theorem of calculus
13 Indefinite integrals & the substitution method, Substitution & area between curves
14 Applications of definite integrals: volumes using cross-sections
15 Volumes using cylindrical shells, arc length, Areas of surfaces of revolution
16 Transcendental functions: inverse functions & their derivatives
17 Natural logarithms, exponential functions, Indeterminate forms & L'Hôpital's rule
18 Inverse trigonometric functions, hyperbolic functions

Recommended Texts

1. Thomas, G.B., Weir, M. D.,& Hass J. R. (2014).*Thomas'calculus: single variable*(13th ed.). London: Pearson.
2. Stewart, J. (2015).*Calculus*(8th ed.). Boston: Cengage Learning.

Suggested Readings

1. Anton, H., Bivens I. C.,& Davis, S. (2016).*Calculus*(11th ed.). New York: Wiley.
2. Goldstein, L. J., Lay, D. C., Schneider, D. I.,& Asmar, N. H. (2017).*Calculus & its applications*(14th ed.). London: Pearson.
3. Larson, R.,& Edwards, B. H. (2013).*Calculus*(10th ed.).New York: Brooks Cole.

STAT-6228 **Bio-Statistics** **3(3+0)**

The subject covers basic statistical knowledge and its application in biotechnology. Statistics and experimental design are important tools for the plant biotechnologist and should be used when planning and conducting experiments as well as during the analysis and interpretation of results. This chapter provides some basic concepts important to the statistical analysis of data obtained from plant tissue culture or biotechnological experiments, and illustrates the application of common statistical procedures to analyze binomial, count, and continuous data for experiments with different treatment factors as well as identifying trends of dosage treatment factors. For example: A drug is given to animals or humans to see whether the changes produced are due to the drug or by chance or to compare the action of two different drugs. And to find the relative potency of new drug with respect to a standard drug. To test usefulness of sera and vaccine in the field.

Contents

1. Frequency distribution
2. exercise frequency distribution,
3. Measures of central tendency and measures of location,
4. Measures of dispersion,
5. Statistical hypothesis and significance
6. Null and alternative hypothesis, confidence interval,
7. Tests involving normal distribution
8. Tests involving student's t-distribution
9. F-distribution, Analysis of Variance (ANOVA)
10. Chi-square test, tests of independence and contingency tables
11. LSD test, experimental designs
12. Complete Randomized Design (CRD)
13. Randomized Complete Block Design, sequence Analysis
14. Latin Square Design, Markov chains and Models and their application, Profile HMMs, Probabilistic approaches to phylogeny

Recommended Texts

1. Chernick, M.R., & Friis, R.H. (2003). *Introductory biostatistics for the health sciences: Modern applications including bootstrap.* (1st Ed.). USA: Wiley Interscience.
2. Chaudhry, S.M. (2005). *Introduction to statistical theory.* (6th Ed.). Lahore, Pakistan: Markazi Kutub Khana

Suggested Readings

1. Mann, P.S. (2010). *Introductory Statistics.* (7th Ed.). New Jersey: John Wiley & Sons.
2. Freund, J. E., & Perles, M.B. (2005). *Modern elementary statistics.* (12th Ed.). USA: Pearson Publishers

CMEC-6101 **Programming Fundamentals** **3(2+1))**

In this course the student will gain a broad understanding of modern computer programming. Students will acquire introductory skills in problem analysis, solution design, and program construction. Through practical programming activities, the student will gain an appreciation of the nature and history of computer programming. Student will also gain hands on practical skill of problem solving by using computer programming languages. Upon successful completion of this course, students will able to understand how data are represented, manipulated, and stored in a computer. In this course we will Categorize different programming languages and their uses. Use, implement, and evaluate fundamental data structures and associated algorithms; create, implement, debug, and evaluate algorithms for solving substantial problems, including recursive, using divide-and-conquer and via decomposition; select and implement an abstract data type for a given problem. Students will also Develop, understand, test, and evolve substantial programs using a modern IDE, and associated configuration tools.

Contents

1. Overview of Computer Programming
2. Principles of Structured and Modular Programming: Algorithms, Pseudo code, flowcharts.
3. Unary and Binary (arithmetic, relational, arithmetic assignment) operators.
4. Decision Statements: if statement, if-else statement, Multi if-else-if statement. Nested if-else statements, Switch Statement.
5. Decision Statements: Conditional operator, Logical Operators. Program Control.
6. Loops: while loop, do while loop.
7. Nested loop structures, Control Statements, break and continue Statements, Logical Operators.
8. Arrays, Searching techniques, Sorting Arrays: selection sort, bubble sort.
9. Strings: String Library Functions Characters and Strings: Fundamentals of Strings and Characters.
10. Function declaration, definition, Passing Arguments to functions, Returning values.
11. Functions: Passing arrays and strings to functions. Inline functions, Default arguments, Local and global variables.
12. Pointers and their purpose. Pointer expressions. Pointers and arrays, Pointers in functions.
13. Static and dynamic memory allocation, Memory Management using Pointers. Problems with pointers
14. Defining structures, Initializing Structures, Accessing Structure Members. Passing Structures to functions, Structures using pointers.
15. File Processing: Files and Streams, creating a Sequential-Access File, Reading Data from a file.

Recommended Texts

1. Deitel, P. J., & Deitel, H. M. (2008). *C++ how to program*. New York: PearsonPrentice Hall.
2. Kochan, S. G. (2011). *Programming in objective-C*. Boston: Addison-Wesley Professional.

Suggested Readings

1. Nickols, F., & Lin, Y. J. (2019). *Precision programming of roving robots*. New York: ASME.