

SCHEME OF STUDIES FOR BS (4 YEAR) BIOTECHNOLOGY

YEAR ONE / SEMESTER FIRST

(Page No. 01-05)

Course Code	Name of Subject	Credits
Eng.101	English-I	3+0
Pak101	Pakistan Studies	2+0
Math.101	Mathematics-I	3+0
Chem.101	Physical Chemistry (General)	2+1
Bot.101	Plant Diversity (General)	2+1
CB.101	Cell Biology (Foundation)	2+1
	Total	17

YEAR ONE / SEMESTER SECOND

(Page No. 06-12)

Course Code	Name of Subject	Credits
Eng.102	English-II	3+0
Isl.101	Islamic Studies/Ethics	2+0
Math.102	Mathematics-II	3+0
Chem.102	Inorganic Chemistry (General)	2+1
Zoo1.101	Animal Diversity (General)	2+1
Gen.101	Genetics (Foundation)	2+1
	Total	17

YEAR TWO/SEMESTER THIRD

(Page No. 13-17)

Course Code	Name of Subject	Credits
Eng.201	English-III	3+0
Comp.101	Introduction to Computer	3+0
Chem.103	Organic Chemistry (General)	2+1
Soc.101	Any subject from social sciences (General)	3+0
Biochem.101	Biochemistry-I (Foundation)	2+1
Mic.101	Microbiology (Foundation)	2+1
	Total	18

YEAR TWO /SEMESTER FOURTH

(Page No. 18-22)

Course Code	Name of Subject	Credits
Eng.202	English-IV/International Language	3+0
Env.101	Ecosystem & Environment (General)	2+1
Jour.101	Any subject from social sciences (General)	3+0
Chem.201	Analytical Chemistry & Instrumentation (Foundation)	2+1
Biochem.201	Biochemistry-II (Foundation)	2+1
MB.101	Molecular Biology-I (Foundation)	2+1
	Total	18

YEAR THREE /SEMESTER FIFTH

(Page No. 23-26)

Course Code	Name of Subject	Credits
Stat.101	Statistics (Foundation)	3+0
Imun.101	Immunology (Foundation)	2+1
MB.201	Molecular Biology II (Foundation)	2+1
IBBBt.301	Principles of Biochemical Engineering (Major)	2+1
Bot.201	Cell and Tissue Culture (Major)	2+1
IBBBt.302	Elements of Biotechnology (Major)	2+0
	Total	17

YEAR THREE/SEMESTER SIXTH (Page No. 27-31)

Course Code	Name of Subject	Credits
Gen. 201	Genetic Resources & Conservation (Foundation)	2+1
IBBbt.303	Microbial Biotechnology	2+1
IBBbt.304	Agriculture Biotechnology (Major)	2+1
IBBbt.305	Food Biotechnology (Major)	2+1
IBBbt.306	Bioinformatics (Major)	0+2
IBBbt.307	Health Biotechnology (Major)	3+0
	Total	17

YEAR FOUR /SEMESTER SEVENTH (Page No. 32-35)

Course Code	Name of Subject	Credits
IBBbt.401	Recombinant DNA Technology (Major)	2+1
IBBbt.402	Skills Enhancement (Major)	0+1
IBBbt.403	Metabolomics, Proteomics and Genomics (Major)	2+0
IBBbt.420	Elective-I	2+1
IBBbt.422	Elective-II	2+1
IBBbt.440	Research Dissertation, Research Project, Internship, Special Paper	3+0
	Total	15

YEAR FOUR /SEMESTER EIGHTH (Page No. 36-39)

Course Code	Name of Subject	Credits
IBBbt.423	Elective-III	2+1
IBBbt.406	Environment Biotechnology (Major)	2+1
IBBbt.407	Downstream Technology (Major)	1+0
IBBbt.408	Biosafety & Bioethics (Major)	1+0
IBBbt.434	Elective-IV	2+1
IBBbt.440	Research Dissertation, Research Project, Internship, Special Paper	3+0
	Total	14

LIST OF ELECTIVE COURSES

Course Code	Name of Subject	Credits
IBBbt.420	Industrial Biotechnology	2+1
IBBbt.421	Pharmaceutical Biotechnology	2+1
IBBbt.422	Plant Biotechnology	2+1
IBBbt.423	Animal Biotechnology	2+1
IBBbt.424	Fungal Biotechnology	2+1
IBBbt.425	Waste Management	2+1
IBBbt.426	Water and Waste water treatment	2+1
IBBbt.427	Bioremediation	2+1
IBBbt.428	Biofuel and Biorefinery	3+0
IBBbt.429	Diagnostics	1+2
IBBbt.430	Bioelectronics & Biosensor	3+0
IBBbt.431	Radiobiology	2+1
IBBbt.432	Biomaterial	2+1
IBBbt.433	Marine Biotechnology	2+1
IBBbt.434	Nanobiotechnology	3+0

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SEMESTER-I

Course No.: Eng.101
Course Title: English-I
Credit Hours: 3+0

Course Objectives

The objective of this course is to upgrade the students' abilities of reading, writing and understanding the English language and grammar.

Course Contents

- Prose
- Translation Urdu to English
- Report Letter writing
- Vocabulary building

Recommended Books

1. A selection of English Prose for B. Sc. Students compiled & edited by Nosheen Khan.
2. A selection of short stories and One-Act Plays for (B.A students) compiled & edited by Dr. Nasim Riaz Butt.
3. A new Anthology of English verse compiled & Edited by Kameez Aslam, Shuaib Bin Hassan.
4. English in Context Idioms, by Betty Kirk Patrick.
5. English for Undergraduate by D.H. Howe, T.A. Kirkpatrick, D.L. Kirkpatrick.
6. Oxford Practice Grammar by Jhon Eastwood.
7. Polymer English Grammar and Composition for B.A students by B.A. Chisty, R.A. Khan and S.A. Hamid.
8. Challenging English Vocabulary, High School English Grammar & Composition by Wren and Martin.

Course No.: Pak.101
Course Title: Pakistan Studies
Credit Hours: 2+0

Course Objectives

The objective of this course is to let the students know about the dimensions of Pakistan movement and role of Muslim leaders in this context. The students will also get the opportunity to know the relations of Pakistan with neighboring countries.

Course Contents

Ideology of Pakistan

Definition of ideology, ideology of Pakistan, Two Nation Theory
Aims and objectives of the creation of Pakistan
Quaid-i-Azam Muhammad Ali Jinnah and ideology of Pakistan
Allama Muhammad Iqbal and ideology of Pakistan

Historical Background of Pakistan's Ideology

Impact of Islam
National Services of Mujaddad Alif Sani
Milli Services of Hazrat Shah Waliullah
Syed Ahmad Shahced – 1757 to 1857 Era of East India Company

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Educational and religious Movements

Aligarh Movement, Darul Aloom Dauband,
Nadwat-ul-Ulma, Hamait-i-Islam etc. & Hindu Revivalist Movements

Era of Political Awareness

Urdu Hindi controversy – Separate Electorate, Division of Bengal 1905
Shimla Deputation 1906–Formation of Muslim League 1906, Minto-Morley Reforms (1909)

Politics of Compromise and Conflict

Lucknow Pact 1916 – Reforms 1919 – Khilafat Movement, 1922
Nehro Report 1928 – Fourteen Points of Jinnah 1929 etc.

Final Struggle for Pakistan

Allama Iqbal address 1930, Roundtable conference 1930-31,32
Government of India Act of 1935, Congress Ministries – Dark Period for Muslims 1937-39
Pakistan resolution 1940 Major Events from 1940 to 1946 Cabinet Mission Plan 1946

Establishment of Pakistan

Emergence of Pakistan & Initial Problems after the creation of Pakistan
Quaid-i-Azam Services as a Governor General Important Events 1947 to 1956

Islamization in Pakistan

Objective Resolution, Islamic Provision of 1956, 1962, 1973 Constitutions
Zia-ul-Haq Steps for Islamization & Other steps taken by ruler till 2007

Land of Pakistan Physical Feature

Location of Pakistan & its importance
Natural Resources of Pakistan

Economy, Population and Education of Pakistan

Economic Development (Agricultural Industry Trade)
Education System of Pakistan – Population of Pakistan
Pakistan & the World of Islam, Saudi Arabia, Iran, Afghanistan

Organization of the Islamic World and Role of Pakistan

OIC, RCD Rabta Alim Islami,
Motamir Alim Islami, ECO

Recommended Books

1. A text book of Pakistan Studies by Dr. Muhammad Sarwar
2. Pakistan Studies by Ikram Rubani

Reference Material

1. Towards of Pakistan by Dr. Waheed uz Zamman United Publisher
2. Ideological Orientation of Pakistan by Sharif ul Mujahid 1976.
3. Struggle for Pakistan by Ishtiaq Hussain Qureshi 1965.
4. History of Pakistan Prof. Rafiullah Shehab Sang e Meel Publications.
5. Pakistan History and Politics by Dr. Safdar Mehmood Sh. Ghulam Ali & Sons.

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Course No.: Math.101
Course Title: Mathematics-I
Credit Hours: 3+0

Course Objectives

In this course, students will understand properly as to how bases of mathematics relate to biological sciences.

Course Contents

Real Number and Real Line, sets, subsets, function and their graphs, types of function Concept of limit, limit of functions, rules for finding limits, rate of change, rate of change by definition, differentiation techniques, derivatives of trigonometric functions, implicit & explicit differentiation, chain rules, applications of derivatives, extreme values functions by 1st derivations from 2nd derivations.

Recommended Books

1. Thomas, calculus, 11th Edition Addison Wesley publishing company, 2005.
2. H.Anton, I.Bevers, S.Davis, Calculus, 8th edition, John Wiley & Sons Inc.
3. Frank A. Jr.Elliott Meldelson, Calculus, Schaum's outline series, 4th edition 1999.
4. C.H Edward and E.D Pemey, Calculus and Analytic Geometry Prentice Hall, Inc. 1988.

Course No.: Chem. 101
Course Title: Physical Chemistry (General)
Credit Hours: 2+1

Course Objectives

Aim of this course is to assist and guide the students to understand physico-chemical principles that will help them in better understanding of different biochemical processes in the living systems.

Course Contents

Physical States of Matter: Ideal and real gases, equations of state. Molecules in motion: collision diameter and mean free path. Physical properties of liquids and their applications. Unit cells and crystal systems, crystal structure analysis. Superconductors and semi-conductors. Chemical Thermodynamics: Laws of thermodynamics. Thermodynamic functions, Van't Hoff's equation. Heat capacities, entropy and probability. Chemical kinetics: Rate of reaction. Rate law, order and molecularity of the reactions. Zero, first and second order reactions. Determination of reaction order and its rate constant. Law of mass action, Le-Chatelier principle and its applications. Elementary concepts underlying complex and fast reactions. Collision theory, Transition state theory. Solution Chemistry: Ideal and non ideal solutions. Raoult's law and its applications. Colligative properties. Distillation and concept of azeotropic mixture. Phase rule and its applications. Surface Chemistry: Concept of interfaces. Adsorption and adsorption isotherms: Freundlich and Langmuir adsorption isotherms. Catalysis, colloids, emulsions and their industrial applications.

Practicals

Determination of viscosity and Redwood values of the liquids; percentage composition of liquid solution viscometrically; surface tension measurement parachor values of the liquids; percentage composition of liquid solution; refractive index, molar refractivity and specific refractivity; percentage composition of liquids by refractive index measurements. Determination of molecular weight of compounds by elevation of boiling (ebullioscopic method) and by lowering the freezing

point (cryoscopic method); Determination of transition temperature; determination of heat of solution by solubility method and heat of neutralization of an acid and with a base, Kinetic study of acid catalyzed hydrolysis by ethyl acetate. Determination of partition coefficient of a substance in two immiscible liquids. Determination of optical activity of sucrose.

Recommended Books

1. Physical Chemistry, R. Alberty, 17th edition (1987), John Wiley and Sons.
2. Physical Chemistry, P.W. Atkins, 6th edition (1998), W.H. Freeman and Co.
3. The World of Physical Chemistry, K.J. Laidler (1993), Oxford University Press.
4. Physical Chemistry, K.J. Laidler, H.M. John and C.S. Bryan, 4th edition (2003), Houghton Mifflin Publishing Company Inc.
5. Chemical Thermodynamics, P.A. Peter (1983), Oxford University Press.
6. Basic Chemical Thermodynamics, S.E. Brain, 4th edition (1990), E.L.B.S. Publishers.
6. Physical Chemistry, M.G. Barrow, 5th edition (1992), McGraw Hill.
7. Experimental Physical Chemistry, M. Jaffar, (1989) University Grants Commission.
8. Findlay's Practical Physical Chemistry, B.N.P. Levitt, 9th edition, Longman Group Limited.
9. Experiments in Physical Chemistry, D. Shoemaker, 5th edition (1989), McGraw Hill Publishing Company Limited.

Course No.	Bot.101
Course Title:	Plant Diversity (General)
Credit Hours:	2 + 1

Course Objectives

This course aims to cover the various aspects of plant diversity, starting from structure, growth and reproduction of plants to the origin of eukaryotic diversity.

Course Contents

Introduction, diversity of life, prokaryotes and origin of metabolic diversity, the origin of eukaryotic diversity, plant and colonization of land, plant structure and growth, methods of plant reproduction, over view of developmental mechanism and control systems of plants.

Practical

To study different parts of microscope, study of specimens like volvox, spirogyra, rhizopus, yeast, lichens, marchantia, funaria, adiantum, equisetum, cycas, pinus and few seasonal representatives of monocot and dicot angiosperms.

Observation of prepared slides; transverse section of stem, leaf and roots of monocots and dicots. To perform Gram-staining of bacteria.

Recommended Books

1. Botany, R.Moore, W.D.Clark, P.Stern, 2nd Edition (1997), W.C.Brown.
2. Plant Physiology, L. Taiz, E. Zeiger, (1991), Benjamin Cummings Publishing Co. Inc.
3. Plant Diversity and Evolution, R.T. Henry (2005), CABI publishing Co.
4. A Lab Manual of Plant Biotechnology, S.S. Purohit, 2nd edition (2006), Agrobios Publishers.

Course No. CB.101
Course Title: Cell Biology (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint students with cell structure, function and visualization of cell and its components.

Course Contents

Introduction to cell theory, structure, chemical constituents of cell and cell organelles and their functions, separation of cell organelles, Cell membrane, its molecular organization and functional role, The concept of the unit membrane, the fluid mosaic model, membrane receptors and transport mechanisms. Endoplasmic Reticulum. Lysosome, Micro-bodies, Mitochondrial ultra structure and function, Chloroplast ultra structure and the mechanism of photosynthesis, Cell movements, structure and function of cytoskeleton, centriole, cilia and flagella, the mitotic apparatus, The nucleus, structure and function of chromosomes, the cell cycle, mitosis, meiosis.

Practical

Microscopy and staining techniques, Study of prokaryotic and eukaryotic cells. Study of plant and animals cell. Cell structure in the staminal hair of *Tradescantia*, Study of different types of plastids, Cellular reproduction, Mitosis: smear/squash preparation of onion roots.

Recommended Books

1. Molecular Biology of the Cell, Bruce Alberts, Alexander Johnson, 4th Edition, 2006. Garland Sciences. Published by Academic Internet Publishers.
2. Molecular Cell Biology. Lodish, Berk, Zipursky, 4th Edition. 2000. W.J.I. Freeman. Cell and Molecular Biology, Karp, 3rd Edition. 2002. John Wiley and Sons.

SEMESTER-II

Course No.: Eng.102
Course Title: English-II
Credit Hours: 3+0

Course Objectives

Objective of this course is to upgrade the students' abilities of reading, writing and understanding the English language and grammar.

Course Contents

- Prose
- Translation Urdu to English
- Essay writing
- Comprehension

Recommended Books

1. A selection of English Prose for B. Sc. Students compiled & edited by Nosheen Khan.
2. A selection of short stories and One-Act Plays for (B.A students) compiled & edited by Dr. Nasim Riaz Butt.
3. A new Anthology of English verse compiled & Edited by Kameez Aslam, Shuaib Bin Hassan.
4. English in Context Idioms, by Betty Kisk Patrick.
5. English for Undergraduate by D.H. Howe, T.A. Kirkpatrick, D.L. Kirkpatrick.
6. Oxford Practice Grammar by Jhon Eastwood.
7. Polymer English Grammar and Composition for B.A students by B.A. Chisty, R.A. Khan and S.A. Hamid.
8. Challenging English Vocabulary, High School English Grammar & Composition by Wren and Martin.

Course No.: Isl.101
Course Title: Islamic Studies / Ethics
Credit Hours: 2+0

Course Objectives

The objective of this course is to develop better understanding of the Islamic Ideology. The students will also get opportunity to learn the teachings of Islam relating to moral, social, political and judicial systems.

Course Contents

احکام شریعت کے مآخذ

کتاب و سنت

(الف) قرآن مجید

استعارات و افعال - دیگر مذاہب کی کتاب (یسروریت، سنی سائیت، اجدہمت، ہندومت و سکھو دھرم)

۳۔ سورۃ الحجرات (ترجمہ و تشریح) سورۃ الفرقان و مہر دارالسلام ۴۔ یحیون لڑا (آیت ۶۳ تا ۷۷) ترجمہ و تشریح

(ب) سنت

استعارات و افعال

۴۔ قرآن کتاب اسراریت (ترجمہ و تشریح)

(۱) احقر عبد اللہ بن عمر بن الخطاب رضی اللہ عنہما قال سمعت رسول اللہ صلی اللہ علیہ وسلم یقول ان الاسلام

سکون سبیل شہادت ان لا اله الا اللہ ان یحسدوا غلبہ و رسولہ و اقام العتدہ و ابناء الزکوة و خلق النیب و سونہ

و عسل - (مشکوٰۃ علیہ)

(٢) عَنْ أَبِي هُرَيْرَةَ رَضِيَ اللَّهُ عَنْهُ قَالَ سَمِعْتُ رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ يَقُولُ: مَا أَهْلُكُمْ عَنْهُ فَأَجْتَبَوْهُ رَسُلًا أَرْسَلَكُمْ بِهِ فَأَتَوْا بَنِي نَاسٍ اسْتَطَعْتُمْ فَإِنَّمَا أَهْلَكَ الَّذِينَ بَيْنَ قُلُوبِكُمْ كَثْرَةُ مَسَائِلِهِمْ وَاجْتِلَاءُ قُلُوبِهِمْ عَلَى أَنْبِيَائِهِمْ. (مُتَّفَقٌ عَلَيْهِ)

(٣) عَنْ الْحُسَيْنِ بْنِ عَلِيٍّ رَضِيَ اللَّهُ عَنْهُمَا قَالَتْ خُوفْتُ مِنْ رَسُولِ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ دَخَلَ مَائِرِئِيلَ إِلَى مَالَا يَرِيئِكَ. (رَوَاهُ التِّرْمِذِيُّ وَغَيْرُهُ)

(٤) عَنْ أَبِي هُرَيْرَةَ رَضِيَ اللَّهُ عَنْهُ قَالَ: قَالَ رَسُولُ اللَّهِ ﷺ: مِنْ حُسْنِ إِسْلَامِ الْمَرْءِ تَرْكُهُ مَالًا يَنْبِيئُهُ. (رَوَاهُ التِّرْمِذِيُّ وَغَيْرُهُ)

(٥) عَنْ أَنَسِ بْنِ مَالِكٍ رَضِيَ اللَّهُ عَنْهُ أَنَّ النَّبِيَّ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قَالَ: لَا يُؤْمِنُ أَحَدُكُمْ حَتَّى يُجِبَ لِأَخِيهِ مَا يَجِبُ لِنَفْسِهِ. (مُتَّفَقٌ عَلَيْهِ)

(٦) عَنْ أَبِي هُرَيْرَةَ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ ﷺ قَالَ: مَنْ كَانَ يُؤْمِنُ بِاللَّهِ وَالْيَوْمِ الْآخِرِ فَلْيُكْرِمْ خَيْرًا أَوْلَيْتُكُمْ وَمَنْ كَانَ يُؤْمِنُ بِاللَّهِ وَالْيَوْمِ الْآخِرِ فَلْيُكْرِمْ جَارَهُ وَمَنْ كَانَ يُؤْمِنُ بِاللَّهِ وَالْيَوْمِ الْآخِرِ فَلْيُكْرِمْ صَيفَهُ. (مُتَّفَقٌ عَلَيْهِ)

(٧) عَنْ أَبِي هُرَيْرَةَ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَجُلًا قَالَ لِلنَّبِيِّ ﷺ: أَوْصِنِي. قَالَ: لَا تَغْضَبَ فَرْدٌ ذِي سِرٍّ أَوْ قَالَ لَا تَغْضَبَ. (رَوَاهُ التَّحَارِيُّ)

(٨) عَنْ أَبِي دَرٍّ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ ﷺ قَالَ: إِنِّي اللَّهُ خَلَقْتُكُمْ وَأَتَمَّ السَّمِيتَةَ الْحَسَنَةَ تَمَحَّهَا وَخَالَقِي النَّاسَ بِخَلْقِي حَسَنٍ. (رَوَاهُ التَّحَارِيُّ)

(٩) عَنْ أَبِي سَعْدٍ غَفَقَةَ بْنِ عَمْرِو بْنِ الْأَنْصَارِيِّ الْبَدْرِيِّ رَضِيَ اللَّهُ عَنْهُ قَالَ: قَالَ رَسُولُ اللَّهِ ﷺ: إِنْ مِثْلًا أَدْرَكَ النَّاسَ مِنْ كَلَامِ النَّبِيِّ الْأَوَّلَى إِذَا لَمْ تَسْمَعْ فَاصْنَعْ شَيْئًا. (رَوَاهُ التَّحَارِيُّ)

(١٠) عَنْ سُلَيْمَانَ بْنِ عَبْدِ اللَّهِ رَضِيَ اللَّهُ عَنْهُ قَالَ قُلْتُ يَا رَسُولَ اللَّهِ صَلَّى اللَّهُ عَلَيْهِ وَسَلَّمَ قُلْ لِي فِي الْإِسْلَامِ قَوْلًا لَا أَشْأَلُ عَنْهُ أَحَدًا غَيْرَكَ قَالَ: قُلْ (أَسَمْتُ بِاللَّهِ ثُمَّ أَسْتَقِيمُ). (رَوَاهُ مُسْلِمٌ)

(١١) عَنْ حَبِيبِ بْنِ عَبْدِ اللَّهِ الْأَنْصَارِيِّ رَضِيَ اللَّهُ عَنْهُمَا أَنَّ رَجُلًا سَأَلَ رَسُولَ اللَّهِ ﷺ فَقَالَ: إِذَا صَلَّيْتُ الْمَكْتُوبَاتِ وَصَلَّيْتُ رَمَضَانَ وَخَلَّيْتُ الْخَلَالَ وَحَرَمْتُ الْخَرَامَ وَلَمْ أَرِدْ عَلَى ذَلِكَ شَيْئًا أَدْخُلُ الْجَنَّةَ؟ قَالَ نَعَمْ. (رَوَاهُ مُسْلِمٌ)

(١٢) عَنْ خَالِدِ بْنِ عَمْرِو بْنِ الْقُرَيْشِيِّ عَنْ أَبِي حَارِمٍ عَنْ سَهْلِ بْنِ أَبِي هُرَيْرَةَ عَنْ النَّبِيِّ ﷺ وَعِظَ رَجُلًا إِذَا هَدَى فِي الدُّنْيَا يُجِئِكَ اللَّهُ وَإِذَا هَدَى فِيهَا أَيْدِي النَّاسِ يُجِئُكَ النَّاسُ. (رَوَاهُ ابْنُ مَاجَةَ)

(١٣) عَنْ أَبِي سَعِيدٍ الْخُدْرِيِّ رَضِيَ اللَّهُ عَنْهُ أَنَّ رَسُولَ اللَّهِ ﷺ قَالَ: لَا ضَرَرَ وَلَا ضِرَارَ. (رَوَاهُ ابْنُ مَاجَةَ)

(١٤) عَنْ أَنَسِ بْنِ مَالِكٍ رَضِيَ اللَّهُ عَنْهُمَا أَنَّ رَسُولَ اللَّهِ ﷺ قَالَ: لَوْ يُعْطَى النَّاسُ بِدَعْوَاهُمْ لَا دَعَى رَجُلٌ أَسْوَالَ قَوْمٍ وَدِينَهُ هُمْ لَكِنِ النَّبِيَّةُ عَلَى الْمُذْعَبِ وَالْيَمِينُ عَلَى مَنْ أَنْكَرَ. (رَوَاهُ التَّيْهَقِيُّ)

(١٥) عَنْ أَبِي سَعِيدٍ الْخُدْرِيِّ رَضِيَ اللَّهُ عَنْهُ قَالَ سَمِعْتُ رَسُولَ اللَّهِ ﷺ يَقُولُ: مَنْ رَأَى مِنْكُمْ مُنْكَرًا فَلْيُغَيِّرْهُ بِيَدِهِ فَإِنْ لَمْ يَسْتَطِعْ فَبِلسَانِهِ فَإِنْ لَمْ يَسْتَطِعْ فَبِقَلْبِهِ وَذَلِكَ أَضْعَفُ الْإِيمَانِ. (رَوَاهُ مُسْلِمٌ)

(۱۶) عن أبي غسان رضي الله عنه: أن رسول الله ﷺ قال: إن الله تجاوزني عن أمتي الخطأ والنسيان وما استكرهوا عليه. (رواه ابن ماجه)

(۱۷) عن ابن عمر رضي الله عنهما قال: أخذ رسول الله ﷺ ينسجى فقال: كن في الدنيا كأنك غريب أو عابر سبيل. (رواه البخاري)

(۱۸) عن عبد الله بن عمرو بن العاص رضي الله عنهما قال: قال رسول الله ﷺ: لا يؤمن أحدكم حتى يكون هواه تبعاً لما حلت به. (أربعين نوري)

(۱۹) عن عبد الله بن عمرو رضي الله عنه قال: قال رسول الله ﷺ: المسلم من سلم المسلمون من لسانه ويده والمهاجر من هجرناه. (رواه البخاري)

(۲۰) عن أنس رضي الله عنه قال: قال رسول الله ﷺ: لا يؤمن أحدكم حتى أكون أحب إليه من والده وولده والناس أجمعين. (متفق عليه)

عقائد وعبادات

آیات قرآنی اور احادیث کی روشنی میں

۱۔ توحید، ۲۔ رسالت، ۳۔ آخرت، ۴۔ نماز، ۵۔ روزہ، ۶۔ زکوٰۃ، ۷۔ حج، ۸۔ جہاد

اسوۂ حسنہ: حضور ﷺ کی سیرت خیرہ کا مطالعہ بطور ۱۔ معلم، ۲۔ سربراہ خاندان

تعمیر کردار: اسلام میں صحیح کردار کی اہمیت

اخلاقی حسنہ: اتنی صدق، توکل، مدد، انصاف، ایثار، عہد، سادگی، رواداری، والدین اور بزرگوں کا احترام، سب حلال۔

Course No.: Math.102
Course Title: Mathematics-II
Credit Hours: 3+0

Course Objectives

The objective of this course is to develop a better understanding of basic mathematics concepts in those students who have not studied mathematics at F.Sc. level.

Course Contents

Introduction to indefinite integral, integration of simple algebraic function, Integration of trigonometric function, integration of trigonometric, exponential functions etc. integration by substitution, applications of integration, problems concerning area beneath the curves, problems concerning arc lengths, introduction to definite integral, techniques of definite integral.

Recommended Books

1. Thomas, calculus, 11th Edition Addison Wesley publishing company, 2005.
2. H.Anton, I.Bevens, S.Davis, Calculus, 8th edition, John Wiley & Sons Inc.
3. Frank A. Jr.Elliott Meldelson, Calculus, Schaum's outline series, 4th edition 1999.
4. C.H Edward and E.D Pemcy, Calculus and Analytic Geometry Prentice Hall, Inc. 1988.

Course No.: Chem.102
Course Title: Inorganic Chemistry (General)
Credit Hours: 2+1

Course Objectives

To reinforce concepts, essential to the biochemists and to develop further understanding of chemical bonding, acid base equilibria, hybridization and redox processes are main objective of this course. Students will also be able to know that how hydrogen bonding, hydrophilic and hydrophobic forces play major role in stabilization of different biomolecules like proteins and nucleic acids. In this course, students will also learn the role of inorganic metals in different physiological processes.

Course Contents

The Periodic Law and Periodicity: classification of elements based on *s*, *p*, *d* and *f* orbitals, group trends and periodic properties. Electron affinities, electronegativities and redox potential. Chemical Bonding in Main Block Elements: Nature and types of chemical bonding, Lewis concepts, ionic, covalent coordinate covalent bond, valence bond theory (VBT) Molecular Orbital Theory (MOT). Valence shell electron pair repulsion (VSEPR) theory and hybridization. Acids and Bases: Concepts and relative strengths of acids and bases, pH, pK_a , pK_b and buffers solutions, indicators (acid base, redox adsorption). Solubility, solubility product, common ion effect and their industrial applications. Chemistry of the p-block Elements. Boron and Aluminum: Group anomalies; boron and aluminium hydrides; structures, properties and industrial applications. Carbon and Silicon: Group anomalies. Allotropic forms of carbon, silicates and silicones and industrial applications. Nitrogen and Phosphorus: Group anomalies, Preparation, structures, properties and the environmental role of oxides of nitrogen industrial preparation of nitric acid, urea and superphosphate fertilizers. Oxygen and Sulfur: Group anomalies. Preparation, structures, properties and environmental role of oxides and oxyacids of sulphur. manufacturing of sulphuric acid and its reactions. Thionic acids and use of hypo in industry. The Halogens: Anomalous behaviour of fluorine; Industrial preparation of chlorine. Preparation, structures, properties and uses of oxides, oxyacids of chlorine, interhalogens and pseudohalogens. Noble Gases: Preparation, properties, structures and uses of xenon fluorides; commercial uses of noble gases.

Practicals

Laboratory ethics and safety measures: Awareness about the toxic nature of chemicals and their handling, cleaning of glassware, safe laboratory operations. Qualitative analysis: analysis of four ions (two cations and two anions) from mixture of salts; Preparation and standardization of normal and molar solutions of HCl, NaOH and KMnO_4 . Quantitative analysis: Determination of total hardness of water using EDTA; Estimation of magnesium using EDTA and copper (iodometrically). Determination of ferricyanide using KI solution and chloride by Volhard and Mohr methods. Estimation of chloride/bromide ions using adsorption (fluorescein) indicator. Percentage determination of ferric ions in ferric alum using KMnO_4 solution and barium in barium nitrate by gravimetric method. Determination of purity of commercial potassium oxalate using KMnO_4 solution. Estimation of ferrous/ferric ions using $\text{K}_2\text{Cr}_2\text{O}_7$ solution. Gravimetric determination of nickel.

Recommended Books

1. Basic Inorganic Chemistry, F.A. Cotton, G. Wilkinson, C.A. Murillo, and M. Bochmann, 2nd Edition (1987), John Wiley & Sons, Inc.
2. Concepts and Models of inorganic Chemistry, B. Douglas, D. McDaniel and J. Alexander, 3rd Edition (1994), John Wiley & Sons, Inc.
3. General Chemistry, J.W. Hill and R.H. Petrucci, (1996) Prentice Hall Inc.
4. Concise Inorganic Chemistry, J.D. Lee, 5th Edition (1996), Chapman and Hall.
5. Inorganic Chemistry, G.L. Miessler and D.A. Tarr (1991), Prentice Hall International edition.
6. Comparative Inorganic Chemistry, B. Moody, 3rd Edition (1991), Chapman and Hall Inc.
7. Inorganic Chemistry, D.F. Shriver, P.W. Atkins, C.H. Langford, 2nd Edition (1994), Oxford University Press.
8. Inorganic Chemicals Analysis, M.M. Baig (1974) Kifayat Academy.
9. Vogel's Textbook of Quantitative Inorganic Analysis including Elementary Instrumental Analysis, J. Bassette, C. Denney, G.H. Jeffery and J. Mendham, 4th edition (1978), English language Book Society.
10. An Introduction to Chemical Analysis, W.E. Harris, B. Kratochvil (1981), Saunders College Publishing.
11. A Text Book of Micro and Semimicro Qualitative Inorganic Analysis, A.I. Vogel (1995), Longman Green & Co.

Course No: Zool. 101
Course Title: Animal Diversity (General)
Credit Hours: 2+1

Course Objectives

This course aims to cover the various aspects of animal diversity starting from their origin, to their growth and reproduction.

Course Contents

Classification of organisms; evolutionary relationships and tree diagrams; patterns of organization. Biodiversity. Animal-like Protists: the Protozoa: evolutionary perspective. Pseudopodia and amoeboid locomotion; cilia and other pellicular structures; nutrition; genetic control and reproduction. Multicellular and tissue levels of organization: evolutionary perspective; origins of multicellularity; animal origins; Phylum porifera. Phylum cnidaria (coelenterate) the body wall and nematocysts; alternation of generations; maintenance functions; reproduction and classification up to class. Phylum ctenophore; further phylogenetic consideration. The pseudocoelomate body plan: ascheiminths: evolutionary perspective; general characteristics; classification up to phyla with external features. Some important nematode parasites of humans, further phylogenetic considerations. Molluscan success; evolutionary perspective relationships to

other animals origin of the coelom molluscan characteristics classifications up to class. Annelida: The metameric body form: evolutionary perspective, relationship to other animals, metamerism and tagmatization; classification up to class. External structure and locomotion, feeding and the digestive system, gas exchange and circulation, nervous and sensory functions, excretion, regeneration, reproduction and development, in polychaeta and hirudinea; further phylogenetic consideration. The hexapods and myriapods: evolutionary perspective; classification up to class. Echinoderms: Evolutionary perspective: Maintenance functions, regeneration, reproduction, and development in asterodia, ophiuroidea, echinoidea, holothuroidea and crinoidea; further phylogenetic considerations, some lesser-known invertebrates. Invertebrates, Hemichordates & Chordates: Evolutionary perspective: classification up to subphylum or class where applicable. Fishes Vertebrate success in water. Amphibians: The first terrestrial vertebrates: survey of order caudate, gymnophiona, and anura. Evolutionary pressures: adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, temperature regulation, nervous and sensory functions, excretion and osmoregulation, reproduction, development, and metamorphosis. Reptiles: The first amniotes: cladistic interpretation of the amniotic lineage; survey of order testudines or chelonian, rhynchocephalia, squamata, and crocodilian. Birds: Feathers, Flight and Endothermy: Evolutionary perspective: phylogenetic relationships; ancient birds and the evolution of flight; diversity of modern birds. Mammals: Specialized Teeth, Endothermy, Hair and viviparity: Evolutionary perspective; diversity of mammals; evolutionary pressures; adaptations in external structure and locomotion, nutrition and the digestive system, circulation, gas exchange, and temperature regulation, nervous and sensory functions, excretion and osmoregulation, behavior reproduction and development.

Practical

Study of euglena, amoeba, entamoeba, plasmodium, trypanosoma, paramecium as representative of animal like protests (prepared slides). Study of sponges and their various body forms. Study of principal representative classes of phylum coelentrata. Study of principal representative classes of phylum platyhelminthes. Study of representative of phylum Rotifera, phylum Nematoda. Study of principal representative classes of phylum Mollusca. Study of principal representative classes of phylum Annelida. Study of principal representative classes of groups of phylum Arthropoda. Brief notes on medical /economic importance of the following: Silkworm, Citrus butterfly. Preparation of permanent stained slides of the following: Obelia, Daphnia, Cestode, Parapodia of Nereis. Study of a representative of hemichordate and invertebrate chordate. Study of representative groups of class fishes. Study of representative groups of class Amphibia. Study of representative groups of class Reptilia. Study of representative groups of class Aves. Study of representative groups of class Mammalia. Field trips to study animal diversity in an ecosystem.

Recommended Books

1. Miller, S.A. and Harley, J.B. 1999 & 2002. Zoology, 4th & 5th Edition (International). Singapore; McGraw Hill.
2. Hickman, C.P. Roberts, L.S. and Larson, A. 2004. Integrated Principles of Zoology, 11th Edition (International) Singapore: McGraw Hill.
3. Pechenik, J.A. 2000. Biology of Invertebrates, 4th Edition (International) Singapore: McGraw Hill.
4. Kent, G.C. and Miller, S. 2001, Comparative Anatomy of Vertebrates. New York: McGraw Hill.
5. Campbell, N.A. 2002. Biology 6th Ed. Menlo Park. California: Benjamin/Cummings Publishing Company, Inc.
6. Miller, S.A. 2002. General Zoology Laboratory Manual 5th Edition (International) Singapore: McGraw Hill.
7. Hickman, C.P. and Kats, H.L. 2000. Laboratory Studies in Integrated Principles of Zoology. Singapore: McGraw Hill.

Course No: Gen. 101
Course Title: Genetics (Foundation)
Credit Hours: 2+1

Course Objectives

To acquaint the student with the Mendelian inheritance, gene interaction and gene mapping.

Course Contents

Mendelian Genetics, principle of segregation, symbols and Terminology, Monohybrid crosses, Dominance, Recessiveness, codominance, Semidominance, Principle of independent Assortment, Dihybrid Ratios, Trihybrid Ratios, Gene interaction, Epistasis, Multiple Alleles, ABO blood Type Alleles in Humans, Rh factor Alleles in humans, Probability in Mendelian inheritance, chi-square, structure of chromosomes and Genes, Function of DNA and RNA, classes of RNA, Nucleotide units of DNA and RNA, DNA as storage of Genetic information, Friedrich Miescher Experiment, Avery, Macleod and McCarty Experiment, Hershey and chase experiment, Watson and crick DNA model, physical and chemical structure of DNA, Difference between Prokaryotic and Eukaryotic Genetic material, sex determination, identification of sex chromosomes, Environmental factors and sex determination, Linkage and crossing over.

Practicals

Introduction to Fast plants and Drosophila. Set up a Drosophila opened-ended cross. Pollinate Fast Plants, ABO blood group, Isolation of DNA from Drosophila.

Recommended Books

1. Principal of Genetics by D.Peter Snustad and Michael J. Simons
2. Principles of Genetics by Eldon John Gardner, Michael J. Simons, and D. Peter Snustad

SEMESTER-III

Course No.: Eng.201
Course Title: English-III
Credit Hours: 3+0

Course Objectives

The objective of this course is to upgrade the students' abilities of reading, writing and understanding the English language and grammar.

Course Contents

- Prose
- Direct Indirect, Change of Voice
- Essay writing
- Precis

Recommended Books

1. A selection of English Prose for B. Sc. Students compiled & edited by Nosheen Khan.
2. A selection of short stories and One-Act Plays for (B.A students) compiled & edited by Dr. Nasim Riaz Butt.
3. A new Anthology of English verse compiled & Edited by Kameez Aslam, Shuaib Bin Hassan.
4. English in Context Idioms, by Betty Kisk Patrick.
5. English for Undergraduate by D.H. Howe, T.A. Kirkpatrick. D.L. Kirkpatrick.
6. Oxford Practice Grammar by Jhon Eastwood.
7. Polymer English Grammar and Composition for B.A students by B.A. Chisty, R.A. Khan and S.A. Hamid.
8. Challenging English Vocabulary, High School English Grammar & Composition by Wren and Martin.

Course No.: Comp.101
Course Title: Introduction to Computer
Credit Hours: 3+0

Course Objectives

Knowing the importance of information technology, this course is designed to let the students know about working and applications of computer in biological sciences. In this course, students will understand the basic principles on which computer works and will familiarize themselves with some of the important software components found on a PC. Another main objective of this course is to familiarize the students with word processing, spreadsheet analysis and use of computer to retrieve and communicate information.

Course Contents

Introduction to computer software, hardware and window 98/2000. Word processing. (Microsoft word), spreadsheet analysis (Microsoft excel) and other related software package (at least two). Internet access and different databases available on the Internet.

Recommended Books

1. Microsoft Office 2000 for windows for Dummies by Doug Lowe revised by Bjoern-Erik Hartsfvang.
2. Discovering Computers 2009 by Shelly Vermaat.
3. Microsoft Office 2003 by Beskeen, Cram, Duffy, Friedrichsen, Reding.

Course No.: Chem. 103
 Course Title: Organic Chemistry (General)
 Credit Hours: 2+1

Course Objectives

Objective of this course is to comprehend the basics of organic chemistry in a precise and compact way. This course shall include the topics relating to stereochemistry and reaction of organic compounds.

Course Contents

Basic Concepts in chemical bonding: Localized and delocalized bonding, concept of hybridization, bond energies and geometry of simple organic molecules, dipole moment, inductive effect, resonance and rules of resonance, hyperconjugation, tautomerism, hydrogen bonding. Nomenclature of organic compounds: systematic nomenclature of mono and bi-functional organic compounds by IUPAC rules. Hydrocarbons preparation, properties and reactions of open chain (alkanes, alkenes and alkynes) and closed chain (cycloalkanes). Aromatic compounds: Structure of benzene, aromaticity and electrophilic substitution reactions, preparation and reactivity of naphthalene. Isomerism geometrical, optical and conformational isomerism. Alkyl halides: Preparation and reactions of alkyl halides with special reference to nucleophilic substitution and eliminations reactions. Grignard's reagent; preparation, structure and applications in the synthesis of alcohols and carboxylic acids. Chemistry of the hydroxyl group and ethers: Brief review of the physical properties, preparation and reactions of alcohols, phenols and ethers. Chemistry of carbonyl compounds: Structure and reactivity of the carbonyl group, preparation and reactions of aldehydes and ketones. Chemistry of carboxylic acids and their derivatives: Physical properties of carboxylic acids, effect of substitution on acidity of carboxylic acids. Preparation, properties and reactions of carboxylic acids and their derivatives i.e. esters, amides acid halides and acid anhydrides. Chemistry of amino group: structure, physical and chemical properties of aliphatic and aromatic primary, secondary and tertiary amines, basicity and nucleophilicity of amines. Diazonium salts. Preparation and their synthetic applications.

Practicals

Experiments shall be conducted based on the following: Melting and boiling point determination; Distillation, solvent extraction, crystallization; Systematic identification of organic compounds (10 compounds); Preparation of simple organic compounds like iodoform, aspirin, acetanilide etc (10 preparations).

Recommended Books

1. A Text Book of Organic Chemistry, R.K. Bansal, 2nd edition (1990), Wiley Eastern Ltd.
2. Organic Chemistry, F.A. Carey, 4th edition (2000) The McGraw Hill Companies Inc.
3. Organic Chemistry, I.L. Finer, Vol.1 and 2 (1992), Longman, U.K.
4. Advanced Organic Chemistry Reactions, Mechanisms and Structure, J. March, John Wiley & Sons.
5. Organic Chemistry, J. McMurry, 5th edition (2000), Thomson Asia Ltd.
6. Organic Chemistry, R.T. Morrison, R.N. Boyd, 6th edition (1992), Prentice Hall Inc.

7. Organic Chemistry, S.H. Pine, J.B. Hendrickson, G.S. Hammond, 4th edition (1992), McGraw Hill, Inc.
8. Vogel's Text book of practical organic chemistry including qualitative organic analysis, B.S. Furniss, A.J. Hannaford, V. Rogers, P.W.G. Smith, A.R. Tatchell, 4th edition (1986), Longman group Ltd.
9. Practical Organic Chemistry I, J.T.S. Gosney, A.G. Rowley, (1990) Chapman and Hall.
10. Practical Organic Chemistry, F.G. Mann, B.C. Saunders (1975), Lowe and Brydone (Printers) Ltd.
11. The systematic identification of organic compounds (a laboratory manual), R.L. Shriner, R.C. Fuson, D.Y. Curtin and T.C. Morrill, 6th edition (1980), John Wiley & Sons. Inc.
12. Practical Organic Chemistry, A.I. Vogel, (1995) Longman Green & Co.

Course No.: Soc. 101
Course Titles: General Sociology (General)
Credit Hours: 3+0

Course Objectives

The objectives of this elective course is to help the student understand man's place, as an individual, in relationship to the powerful conditioning forces of the culture, and to encourage the student to discover the problematic character of everyday life and to learn and see the value conflict as a natural process in the evolution of human society.

Course Contents

An overview of sociology-the science of society; scope, fields and significance of sociology: the nature and basis of social interactions. Social structure; status, role, power and authority. Role allocation. Forms of social changes; conflicts and problems. Resistance to social changes. Ecological processes; ecological problems of Pakistan and European countries.

Recommended Books

1. Sociology in a Changing World, 5th Edition, William Kornblum, Harcourt Brace College Publishers, 2000.
2. Telecourse Guide for the Sociology Imagination, 4th Edition, Glenn Currier and Jane Penney, Harcourt Brace College Publishers, 1999.

Course No. Biochem.101
Course Title: Biochemistry-I (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint the student with the chemistry and biology of biomolecules.

Course Contents

Introduction to biochemistry, amino acids and proteins, general functions, classification, primary, secondary, tertiary and quaternary structure, Fibrous and globular proteins. Protein stability, Protein folding. Enzyme nomenclature and classification, co-factors and co-enzymes. general characteristics of enzymatic reactions. Enzyme kinetics. Classification of carbohydrates. structure and functions of mono, oligo and polysaccharides, sugar derivatives, Structural polysaccharides, storage polysaccharides, Structure and function of bacterial cell-walls. Classification, structure, properties and functions of different types of lipids, fatty acids, triglycerides, glycerophospholipids, sphingolipids, cholesterol, Micelles, bilayers and liposomes. Properties and functions of lipoproteins, Fat and water soluble vitamins, Structural and functional aspects of nucleic acids, Chemical structures of nucleotides, nucleosides and bases.

Practicals

Qualitative tests for amino acids, Amino acid titration, Hydrolysis of proteins and chromatographic separation of amino acids, Isolation and solubilization of proteins from plant and animal tissues, Estimation of proteins using different methods, Estimation of glucose in a mixture of monosaccharides, estimation of sucrose by polarimeter, chromatographic separation of sugars. Estimation of acid, saponification and iodine values of fat, Enzymes assay, effect of pH, temperature and substrate concentration on the properties of enzymes, Kinetic analysis of enzymes. Isolation of nucleic acids.

Recommended Books

1. Principles of Biochemistry, A. L. Lehninger, D.L. Nelson, 3rd edition (2000), Worth Publishers.
2. Biochemistry, L. Stryer, 6th Edition (2006), W.H. Freeman and Co.
3. Biochemistry, D. Voet, T. G. Voet, 3rd edition (2004), John Wiley and Sons, New York.
4. Harper's Illustrated Biochemistry, 27th edition (2006), McGraw-Hill Medical.
5. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 4th edition (2008), J.B. Lippincott Company.
6. An Introduction to Practical Biochemistry, D. T. Plummer, 3rd edition (1987), McGraw-Hill.
7. Handbook of Molecular and Cellular Methods in Biology and Medicines, P.B. Kaufmann, W.Wu, L.J. Creke (1995), CRC Press.
8. Modern Experimental Biochemistry, R.F. Boyer, 2nd edition (1993), Benjamin/Cummings Publishing.
9. The Basic Protein & Peptide Protocols, J.M. Walker (1994), Humana Press.

Course No.	Mic. 101
Course Title:	Microbiology (Foundation)
Credit Hours:	2 + 1

Course Objectives

To acquaint student with the knowledge of Microbiology and its applications.

Course Contents

Introduction and scope of Microbiology, Historical foundations of Microbiology, General characteristics of Microbes, methods of Microbiology, bacterial forms and ultrastructure, microbial nutrition, cultivation, reproduction and growth, Metabolic characteristics, symbiotic relationships, taxonomy, classification, nomenclature of microorganism/bacteria. Physical and chemical control of microbes. Role of microbes in industry, agriculture, health, basic research and environment.

Practicals

Sterilization techniques, culturing, staining (Gram, simple, negative, capsule and spore), colony and cell morphology, bacterial cell count and growth curve, biochemical tests [oxidation fermentation (OF), urease, oxidase and catalase] of bacteria.

Recommended Books

1. Lalaro, K. P., 2006. Foundations in Microbiology: Basic Principles. McGraw Hill. Publisher.
2. Black, J. G., 2005. Microbiology: principles and explorations, by 6th Edition, J. Wiley & Sons, USA.

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3. Cappuccino, J. G. and Sherman, N. 2004, Microbiology: a laboratory manual. Pearson Education, USA.
4. Pollack, R. A. Findlay, L., Mondschein, W. Modesto R. R., 2004. Laboratory Exercises in Microbiology by 2nd Edition, J. Wiley and Sons, USA.
5. Tortora, G. J., Funke, B. R. and Case, C. L. 2008. Microbiology: an introduction 9th Edition, Pearson Education, USA.
6. Kathleen P. T., and Arthur, T. 2001. Foundations in Microbiology: Basic Principles McGraw-Hill Companies/
7. Tortora, G. J., Funke, B. R., Case, C. L. 2000. Microbiology: An Introduction, Study Guide. Benjamin-Cummings Publishing Company.
8. Tortora, G. J., Christine, L. Case, C. L., Funke, B. R., Funke, B., Case, C. 2006. Microbiology: An Introduction, Publisher: Pearson Education.
9. Alcamo, I. E., 2001. Fundamentals of Microbiology published by Jones and Bartlett Publishers, USA.
10. Baker, S., Khan, N., Nicklin, J. and Killington, R., 2006. Instant Notes in Microbiology, 3rd Ed edition, Taylor and Francis.
11. Madigan, M. T. and Martinko, J., 2005. Brock Biology of Microorganisms 11 International Ed edition Prentice Hall.

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SEMESTER-IV

Course No.: Eng.202
Course Title: English Composition IV
Credit Hours: 3+0

Course Objectives

Objective of this course is to upgrade the students' abilities of reading, writing and understanding the English language and grammar.

Course Contents

- Poetry
- Skill Enhancement / CV Making
- Application Writing
- Close Text

Recommended Books

1. A selection of English Prose for B. Sc. Students compiled & edited by Nosheen Khan.
2. A selection of short stories and One-Act Plays for (B.A students) compiled & edited by Dr. Nasim Riaz Butt.
3. A new Anthology of English verse compiled & Edited by Kameez Aslam, Shuaib Bin Hassan.
4. English in Context Idioms, by Betty Kisk Patrick.
5. English for Undergraduate by D.H. Howe, T.A. Kirkpatrick, D.L. Kirkpatrick.
6. Oxford Practice Grammar by Jhon Eastwood.
7. Polymer English Grammar and Composition for B.A students by B.A. Chisty, R.A. Khan and S.A. Hamid.
8. Challenging English Vocabulary, High School English Grammar & Composition by Wren and Martin.

Course No. Env.101
Course Title: Ecosystem and Environment (General)
Credit Hours: 2 + 1

Course Objectives

To acquaint the students with the knowledge of ecosystems and the environment.

Course Contents

Concept, overall structure and components of Ecosystem, Energy flow and Biogeochemical cycling, Energy transfer (Food chain, Food webs, Food cycle, Trophic levels), Ecological pyramids, Productivity of ecosystems, Factors influencing environments and habitats, Impact of man on ecosystem, Fundamental of population ecology and community ecology, Human impacts on ecosystems, The Atmosphere (Composition, Minor and major gases, Water in atmosphere, Aerosols, Global circulation pattern), Pollution (Air, Water, Land, Thermal, Radiation and Noise), Climate Change (Green House Effect and Global Warming), Ozone Depletion (Ozone-structure, Properties/Significances, Ozone destroying catalysts, Natural, Anthropogenic, Antarctic zone hole, Changing ozone Level, Impact on biosphere), Waste Type, Disposal and Management, Environmental Ethics.

Practicals

Study of pond freshwater ecosystem, Study of vegetation profile, Study of grassland, rangeland and forest, Study of some biotic and abiotic factors of grassland, rangeland and aquatic ecosystem, methods of sampling. Measurements and description of plant communities by different methods. Study of decomposition of leaf litter by organisms.

Recommended Books

1. Davet, P. 2004. Microbial ecology of soil and plant growth. Science Publishers.
2. Nico, M., Straalen, V., and Roelofs, D., 2006. An Introduction to Ecological Genomics. Oxford University Press.
3. Aston, A., Harris, S., Lowe, A., 2004. Ecological Genetics: Planning and Application. Blackwell Science (UK).
4. Costa, L. G., and Eaton, D. L., 2006. Gene-Environment Interactions: Fundamentals of Ecogenetics. John-Wiley and Son Limited.
5. Freeland, J. R., 2005. Molecular Ecology. John-Wiley and Son Limited.
6. Light, A and Rolston III.H. 2003. Environmental Ethics. Blackwell Publishers Ltd. U.S.A.
7. Wenz, P. S., 2001. Environmental Ethics Today, Oxford University Press.
8. Louis P. and Pojman, L. P., 2004. Environmental Ethics: Readings in Theory and Application, 4 edition. Wadsworth Publishing.
9. Light, A., and Rolston, III. H., 2005. Environmental Ethics. Blackwell Publishing Incorporated.
10. Raven, P. H., and Berg, L. R., 2005. Environment, 5 Edition John-Wiley and Son Limited

Course No.: Jour. 101

Course Titles: Basic Concepts of Journalism (General)

Credit Hours: 3+0

Course Objectives

The objective of this course is to expose the students to various means of mass communications, media organizations, and the processes by which mass communications are produced.

Course Contents

Introduction to journalism and broadcast media; importance and ingredients of communications; communicative and social importance of language; Note taking and note making; Reading, writing, speaking and listening skills; organization and sequencing of ideas; issues of ethics in journalism and press councils; Propaganda and psychological warfare; misinformation/disinformation, slanted and distorted news; Role of media and communication in 21st century.

Recommended Books

1. McQuail's Mass Communication Theory by Denis McQuail, Sage publications, 2005.
2. Theories of Mass Communication by Melvin Lawrence Deffleur. Sandra Ball-Rokeach. Longman publishers, USA, 1982.
3. Media Effects and Society by Elizabeth M. Perse, published by Lawrence Erlbaum Associates, 2001.
4. The Media and Modernity: A social theory of the media by John B. Thompson Stanford University Press, 1995.
5. Social Communication in Advertising: persons, products & images of well-being by William Leiss, Stephen Kline, Sut Jhally, published by Routledge, 1990.
6. Controversies in Contemporary Advertising by Kim Bartel Sheehan Sage publications, 2003.

7. Handbook of Public Communication: Principles and Practices by Andrew D. Wolvin, Roy M. Berko, Darlyn R. Wolvin, Jaico Publishing House, Mumbai, 2007.
8. Professional Communication by Aruna Koneri. The McGraw-Hill Publishing Company Ltd., New Delhi, 2008.
9. Scientific Papers and Presentations by Martha Davis. Elsevier Academic Press, 2005.
10. Television and politics (Classics in communication and mass culture series) by Kurt Lang Transaction Publishers, 2002.

Course No.: Chem. 201
Course Title: Analytic Chemistry & Instrumentation (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint the student with key analytical concepts of identification and analysis at molecular levels.

Course Contents

General methods of fractionation and characterization of proteins and nucleic acids, dialysis, ultrafiltration, lyophilisation, principles and application of visible, UV, IR, mass spectroscopy, Nuclear Magnetic Resonance spectroscopy (NMR), flame photometry, atomic absorption, fluorescence spectroscopy, Chromatographic techniques (thin layer, adsorption, partition, ion-exchange, hydrophobic and affinity), Chromatofocusing, native and SDS-PAGE, isoelectric focusing, agarose gel electrophoresis, immunoelectrophoresis. Radioisotopes and their applications in molecular and biomedical sciences, Amino acid analyzer, thermal cycler (PCR), DNA sequencer, Protein/DNA microarray.

Practicals

Experiments in chromatography (TLC, column and paper), Dialysis, ultrafiltration, fractionation of proteins using gel filtration, ion-exchange chromatography, chromatofocussing and other chromatographic techniques. Fractionation of proteins using native and SDS gel electrophoresis, Molecular weight determination of proteins using UVP gel based computer software program, Isoelectric focusing, Preservation of biological samples by lyophilization.

Recommended Books

1. Methods for protein analysis, R.A. Copeland, (1994), Chapman and Hall.
2. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.
3. A Biological Guide to Principles and Techniques of Practical Biochemistry, K.Wilson, K.H. Goulding, 3rd edition (1991), ELBS.
4. Protein Methods, D.M. Bollag, M.D. Rozycki, S.J. Edelstein, 2nd Edition (1996), Wiley- Liss.
5. A Biological Guide to Principles and Techniques of Practical Biochemistry, K.Wilson, K.H. Goulding, 3rd edition (1991), ELBS.
6. Methods for Protein Analysis, R.A. Copeland, (1994), Chapman and Hall.
7. Protein Methods, D.M. Bollag, M. D. Rozycki, S.J. Edelstein, 2nd Edition (1996), Wiley- Liss.
8. Analytical Chemistry, A. Skoog, M. Donald (2000), Saunder Publishers

Course No.: Biochem.201
Course Title: Biochemistry-II (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint the student with the key concepts of intermediary metabolism of proteins, nucleic acids, carbohydrates and lipids.

Course Contents

Amino acid deamination mechanisms, urea cycle and its regulation, biosynthesis and degradation of essential and non-essential amino acids, RNAs and their role in protein synthesis, transcription and translational processes. Chemical nature, synthesis and degradation of purine and pyrimidine nucleotides, Glycolytic pathway and its significance, fermentation, Glycogen breakdown and synthesis pathways. Citric acid cycle, mechanism of electron transport chain, oxidative phosphorylation and regulation of ATP production, gluconeogenesis, pentose phosphate pathway, Properties and functions of lipoproteins, fatty acid oxidation, fatty acid and triglyceride synthesis, Ketone bodies, utilization of cholesterol, Prostaglandins, prostacyclins, thromboxanes and leukotrienes.

Practicals

Iodine test for polysaccharides, Formation of sugar derivatives, 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 wheat grain, Lipid separation from brain tissue and fractionation by TLC. Effect of UV light on vitamin A. Preparation of mitochondrial fraction from heart muscles and measurement of enzyme activities like malate dehydrogenase and monoamine oxidase.

Recommended Books

1. Biochemistry, D. Voet, J.G. Voet, 3rd (2004), John Wiley and Sons Inc.
2. Principles of Biochemistry, A.L. Lehninger, D.L. Nelson, 3rd edition (2000), Worth Publishers.
3. Lippincott's Biochemistry, P.C. Champe, R.A. Harvey, D.R. Ferrier, 4th edition (2008), J.B. Lippincott Company.
4. An Introduction to Practical Biochemistry, D. T. Plummer, 3rd edition (1987), McGraw-Hill.
5. Modern Experimental Biochemistry, R.F. Boyer, 3rd edition (2000), Pearson Education Inc.

Course No. MB.101
Course Title: Molecular Biology-I (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint the student with the chemistry and biology of macromolecules.

Course Contents

Overview of Molecular Biology, Logic of Molecular Biology, Prokaryotes and Eukaryotes, bacteria, Bacteriophage, yeasts, Animal cell, Animal & plant viruses, Genetic Analysis of Molecular Biology, Macromolecules, chemical structures of the major classes of Macromolecules: Proteins, Nucleic Acids, Polysaccharides, Nucleic Acids, DNA Helix, Form of DNA Helix, Factor that determine structure of DNA, properties of Genetic Material (storage and Transmission of Genetic information by DNA). Transmission of information from parent to progeny, chemical stability of DNA, Ability of DNA to change, DNA Replication, Enzymology

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of DNA Replication. Events in the Replication Fork, Initiation of synthesis of Leading and lagging strands, Okazaki fragments, importance of $3 \rightarrow 5$ and $5 \rightarrow 3$ Exonuclease activities of DNA polymerase, Rolling circular Replication, Loop Rolling circular Replication, Difference between Prokaryotic and Eukaryotic Replication, DNA Repair.

Practicals

Isolation & purification of DNA, determination of DNA concentration using spectrophotometer. Hypochromicity determination of DNA.

Recommended Books

1. Molecular Biology by David Freifelder. Jones & Barlet Publisher, Boston
2. Molecular Biology of the cell by B. Alberts, D. Brag, J. Lewis, M. Raff, K. Roberts and J. D. Watson, Garland Publishers. Jones & Barlet Publisher, Boston

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SEMESTER-V

Course No. Stat.101
Course Title: Statistics (Foundation)
Credit Hours: 3 + 0

Course Objectives

To acquaint the student with experimental design, data collection and analysis.

Course Contents

Definition of statistics, characteristics, importance and limitations, population and samples. Frequency distribution and probabilities, formation of frequency table from raw data, histograms. Applications of probabilities to simple events, Measures of central tendencies and dispersion. Arithmetic mean, median, mode, range, variance and standard deviation, standard error of the mean, mean deviation, semi interquartiles range. Standard distribution (Binomial, poison and normal distributions, properties and application, Normality). Test of significance (t-test, χ^2 -test. F-test. L.S.D. test, multiple range test), Design of experiment: Brief account of correlation and regression. Computer based statistical software applications.

Recommended Books

1. Sullivan, L.S., 2008. Essentials of biostatistics. Jones and Bartlett press.
2. Daniel, W.W., 2008. Biostatistics: A Foundation for Analysis in the Health Sciences John Wiley & Sons
3. Gertmsn, B. B., 2007. Basic biostatistics: statistics for public health practice. Jones and Bartlett press.
4. Essex-Sorlie, D. 1995. Medical Biostatistics & Epidemiology, International Edition, Appleton & Lange 2nd. Edition.
5. Marzillier, L.F., 1990. Elementary statistics, Wm.C.Brown Publisher
6. Stanton, A.G., 2001. Primer of Biostatistics. McGraw Hill
7. Beth, D.D., Robert, G.T 2000. Basic and clinical biostatistics. Appleton & Lange
8. Streiner, N., Norman, G.R., 2000. Biostatistics: The bare essentials B.C. Decker, Inc.
9. Rosner, B., 2000. Fundamentals of biostatistics. Cole Pub. Co.
10. Quinn, G., 2002. Experimental Design and Data Analysis for Biologists. Cambridge University Press.
11. Bailey, N.T.J., 1994. Statistical Methods in Biology, Cambridge University Press.
12. Barnett, V., 2003. Environmental Statistics: Methods and Applications. John-Wiley and Son Limited.

Course No. Immun.101
Course Title: Immunology (Foundation)
Credit Hours: 2 + 1

Course Objectives

To acquaint the student with the basic principles of defense mechanism and immune system.

Course Contents

Body defense mechanisms, the immune system, elements of innate and acquired immunity, antibody structure and function, antigen-antibody interactions, cells of the immune system, monoclonal antibodies, Genetics of antibody structure and diversity, Activation and function of T and B cells and their receptors, Major histocompatibility complex, Complement system.

Hypersensitivity, cytokines, Autoimmunity, resistance and immunity to infectious diseases, Immunochemical techniques.

Practicals

Radioimmunoassay of hormones (thyroid, growth, adrenal and others), Enzyme-linked immunosorbent assay (ELISA), Blood group determination (ABO and Rh), Western blot, Ouchterlony analysis.

Recommended Books

1. Immunology, J. Kuby, 6th edition (2007), W.H. Freeman and Co.
2. Immunobiology - The immune system in health and disease, C.A. Janeway, P.Travers, 3rd edition (1997), Garland Publication Inc. New York.
3. Roitt's Essential Immunology, Ivan Roitt, 11th edn (2007), Blackwell Scientific Publication.
4. Harlow ED, David L., Antibodies - A laboratory Manual, (1988), Cold Spring Harbor laboratory Press.
5. Methods for protein analysis, R.A. Copeland, (1994), Chapman and Hall.
6. The Basic Protein and Peptide Protocols, J.M. Walker (1994), Humana Press.
7. The Protein Protocols Handbook, J.M. Walker (1996), Humana Press.
8. Basic Biochemical Methods, R.R. Alexander, J. M. Griffiths, 2nd edition (1993), Wiley Liss.

Course No. MB.201
Course Title: Molecular Biology-II (Foundation)
Credit Hours: 2 +1

Course Objectives

To acquaint the student with the chemistry and biology of macromolecules.

Course Contents

Mutations. Types of Mutations, Biochemical basis of Mutagenesis, Base-Analogue Mutagens, chemical Mutagens, Intercalating Agents, Reversion, Transcription, Basic Features of RNA synthesis, Enzymology of RNA synthesis, RNA chain synthesis Initiation, elongation and Termination, Transcription in Eukaryotes, Post-transcriptional Modifications, Translation, Genetic code, codons, Decoding system, Role of mRNA, Role of tRNA, chemical composition of Ribosomes, initiation of protein synthesis, Elongation of polypeptide chain, Termination of polypeptide chain, Difference between protein synthesis in prokaryotes and Eukaryotes, Post-translational Modifications, Regulation of Genes and gene products in prokaryotes, Regulation in Eukaryotes, Protein sorting and transport. DNA repair mechanisms.

Practicals

Restriction digestion of DNA and preparation of restriction maps, Gel Electrophoresis, PCR, Blotting Techniques, RNA isolation and RT-PCR.

Recommended Books

1. Molecular Biology by Daved Freifelder. Jones & Barlet Publisher, Boston
2. Molecular Biology of the cell by B. Alberts. D. Brag, J. Lewis. M. Raff, K. Roberts and J. D. Watson, Garland Publishers. Jones & Barlet Publisher, Boston

Course No.	IBBbt.301
Course Title:	Principles of Biochemical Engineering (Major)
Credit Hours:	2 +1

Course Objectives

To acquaint the student with biological and engineering sciences.

Course Contents

Introduction to microorganisms and biological molecules, Principles of enzyme catalysis. Methods of enzyme and cell immobilization enzyme kinetics. Internal mass transfer effect on immobilized growth. Stoichiometry models of microbial growth, Structured model. of microbial growth. Continuous Stirred tank bioreactor, Plug-flow and packed bed bioreactors imperfect mixing, Fed batch bioreactors, Gas liquid mass transfer in bioreactors, Power requirement for bioreactor, Sterilization, Heat transfer in bioreactors, Introduction to bioproduct recovery. Manufacture of biological products, Economic analysis of bioprocesses, Case study Penicillin.

Practical

Unstructured Microbial growth with application of Monod Model, Inhibition kinetics and nutrient uptake rate, Methods of immobilization by binding and physical retention, Yield coefficient and Stoichiometry, Production of enzymes by structured model, segregated model. 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 Books

1. Biochemical Engineering by Harvey W. Blanch, S. Douglas and Clark.
2. Biochemical Engineering Fundamentals, J. E. Bailey and D. F. Ollis.
3. Biochemical Engineering, S. Aiba, A. G. Humphrey and N. F. Millis 2nd Edition (1973) Academic Press Inc. N.Y.

Course No.	Bot.201
Course Title:	Cell and Tissue Culture (Major)
Credit Hours:	2 +1

Course Objectives

To acquaint the student with the techniques to produce disease free plant material.

Course Contents

Cell and Plant Tissue culture, Introduction, history and importance, Methods of cell and tissue culture, callus culture, organogenesis, somatic embryogenesis, protoplast isolation and fusion, anther and pollen culture Micropropagation, improvement of Plants via Plant cell culture, production of variant plants from selected cells, selection for stress tolerance, production of disease resistant plant material.

Practicals

Preparation of stock and working solutions, preparation of culture media (liquid) semi-liquid and semi-solid) Explants preparation, callus culture and organogenesis. Preparation and fusion of protoplasts.

Recommended Books

1. Plant Tissue culture manual. K. Lindeseg Kluwer. Academic Publisher, The Netherlands
2. Principles of Tissue Engineering, R.P. Lanza, R. Langer and J. Vacantuy. Academic press, california, USA.

Course No. IBBbt.302
Course Title: Elements of Biotechnology (Major)
Credit Hours: 2 +0

Course Objectives

To acquaint the student with the importance and basic concepts of biotechnology.

Course Contents

The cell its organelles and their functions, growth requirements, Characteristics and Industrial importance of algae, fungi and bacteria, Glycolytic pathway and enzymes, fermentative ethanol production, High-energy compounds and coenzymes, TCA cycle and its metabolic and industrial importance, Protein structure, synthesis and function, Nucleic acids and microbial strain selection techniques, Cell growth parameters, fermentor assembly and systems, cultivation conditions, sterilization and inoculation procedures, Biomass and Single-Cell Protein production. Aerobic and anaerobic yeast fermentations: products & processes.

Recommended Books

1. Principles of Plant Biotechnology. An Introduction to Genetic Engineering in Plants. S. H. Mantel, J. A. Mathews, R. A. Mecee, Blackwell Scientific Publication Oxford, London, Boston.
2. Biotechnology in 21st century. Ayyana, C. McGraw Hill.
3. Shuler, M.L. and F. Kargi. 1992. Bioprocess Engineering, Prentice-Hall, Englewood Cliffs, NJ.
4. Bailey, J.E. and D.F. Ollis. 1986. Biochemical Engineering Fundamentals, 2nd ed. McGraw - Hill, New York .

SEMESTER-VI

Course No.	Gen. 201
Course Title:	Genetic Resources and Conservation (Foundation)
Credit Hours:	2+1

Course Objectives

To accustom students with bioresources of the country and conservation.

Course Contents

Introduction to genetic resources and its importance, Evolution of Terrestrial and Marine biodiversity, An overview of Wild and Domesticated Genetic Resources of Pakistan, Extent of genetic diversity, Low genetic diversity in threatened species, Genotype and environment interaction, Mutation selection balance, Genetic drift, Population bottle necks, Inbreeding, Migration and gene flow, Introduction to extinctions and its causes, Threatened Animal and Plant Species, Conservation of Genetic Resources through Mapping of Existing Biological Diversity, Assessing Conservation Status, Management Strategies, Laws and Treatises of conservation, Introduction to wildlife and forest Acts, Biodiversity action plan of Pakistan, Quarantine regulations, Future Prospects of Conservation.

Practicals

Experiments on Diversity studies, standard methods of sample collection and preservation, Analysis of wild organisms and fossil Samples, Visits to National Parks, Visits to Plant and Animal Genetic Resources Conservation Centers.

Recommended Books

1. Bush, M.B. 1997. Ecology of a changing planet. Prentice Hall.
2. Cunningham, A.B. 2001. Applied Ethnobotany: People, wild plant use and conservation. Earthspan Publications.
3. Cotton, C.M. 1996. Ethnobotany Principals and Application. Jhon Willy and Sons, hichester, UK.
4. De Klemm, C. 1990. Wild Plant Conservation, IUCN, Gland.
5. Dyke, F.V. 2003 Conservation Biology. Mc Graw Hill, New York.
6. Krupnick, G.A. 2005. Plant Conservation. The University of Chicago Press.
7. Mc Neely, J.A., Mc Carthy, T.M., Smith, A., Whittaker, L.O. and Wikramanayake. 2006. onservation biology in Asia. Resources Himalaya Foundation.
8. Given, D.R. 1994. Principals and practices of plant conservation Timber Press.

Course No.	IBBbt. 303
Course Title:	Microbial Biotechnology (Major)
Credit Hours:	2 + 1

Course Objectives

To acquaint the students with biotechnological potentials of microbes in food, pharmaceuticals, industries, mining, disease control and as a biofertilizer.

Course Contents

Issues and scope of microbial biotechnology, genetically modified microorganisms, microbes as tools for microbiological research, Biotechnological potential of microbes, significance of

microorganisms in food production and fermentation, pharmaceutical and other industrial products, Vaccine development and production, biofertilizers, composting, microbiological mining, biofuels, use of microbes in petroleum industry, Microbial role in regulatory mechanism of plant, Significance of microbial biotechnology in economic development of Pakistan.

Practicals

Isolation and screening of potential microbes from different environmental sources, Lab scale production of bacterial enzymes, lab scale production of alcohol by yeast, use of microbes in bioleaching, use of microbes in microbial enhanced oil recovery.

Recommended Books

1. Olguin, E., Sanchez, G., and Elizabeth Hernandez, E., 1999. Environmental Biotechnology and Cleaner Bioprocesses. CRC Press.
2. Agathos, S.N.N. and Reineke, W., 2002. Biotechnology for the Environment: Soil Remediation. Springer-Verlag New York, LLC.
3. Stevens, C., Verhe, R., Verhé, R., 2004. Renewable Bioresources: Scope and Modification for Non-Food Applications. Wiley, John and Sons, Incorporation
4. Groves, M. J., 2005. Pharmaceutical Biotechnology. CRC Press.
5. Glick, B. R., and Pasternak, J., 2002. Molecular Biotechnology: Principles and Applications of Recombinant DNA. ASM Press.
6. Klefenz, H., 2002. Industrial Pharmaceutical Biotechnology, Wiley-VCH Verlag GmbH.
7. Mukhopadhyay, S. N., 2004. Process Biotechnology Fundamentals, 2nd Edition Viva Books Pvt. Limited, New Delhi.
8. Goodsell, D. S., 2004. Bionanotechnology: Lessons from Nature . John Wiley and Sons Limited.
9. Purohit, S. S., 2002, Biotechnology: Fundamentals and Applications, Agrobios publishers.
10. Prave, P., Faust, U., Sittig, W., and Sukatsch, D. A., 2002. Fundamentals of Biotechnology, John Wiley and Sons.
11. Thauer, R., and Wagner, F., 1991. Biotechnology Focus: Fundamentals - Applications – Information, Helen Cooper-SchluterCarl Hanser, Verlag GmbH and Co.
12. Ray, R. C., 2005. Microbial Biotechnology in Agriculture and Aquaculture. NBN International.
13. Kreuzer, H. and Massey, A., 2005. Biology and Biotechnology Science, Applications, and Issues American Society for Microbiology.
14. Harding, S. E., 2004. Biotechnology and Genetic Engineering Reviews: Volume 21 Intercept Ltd.
15. Parekh, R., 2004. The GMO Handbook: Genetically Modified Animals, Microbes and Plants in Biotechnology Humana Press

Course No.	1BBbt. 304
Course Title:	Agricultural Biotechnology (Major)
Credit Hours:	2+1

Course Objectives

To acquaint the students with the techniques to develop skills to produce Transgenic Crops.

Course Contents

The concepts of Plant Molecular Markers, Historical Back ground of Tissue Culture, Requirements for in-vitro cultures, Role of Phyto-hormones in somatic embryogenesis, Types of

Cultures: Tissue culture and regeneration, Cell culture. Haploid Culture. Protoplast culture. Somaclonal variations as breeding tool. Somatic Hybridization, Commercial application and Issues related to tissue culture, Plant Transformation: Gene Gun Method of Transformation. *Agrobacterium*-Mediated transformation, Chloroplast Transformation, PEG mediated transformation etc, Field Evaluation and Commercialization. Transgenic crops for Herbicide, Biotic and Abiotic stress resistance, Introduction to Biofertilizers. Biosafety Concerns and Bioethics on GM crops.

Practical

Selection of ex-plant, Medium Preparation and Callus Induction, Culturing *Agrobacterium* and Infection to plant callus. Selection of Transformants. Regeneration of Plantlets and acclimatization, Plant DNA extraction and PCR for Transgene.

Recommended Books

1. Jitendra Prakash, R.L.M. Pierik, 1993. Plant Biotechnology: Commercial Prospects and Problems, Intercept
2. Peter M. Gresshoff, 1992. Plant Biotechnology and Development. CRC Press
3. Adrian Slater, Nigel W. Scott, Mark R. Fowler, 2008. Plant Biotechnology: The
4. Genetic Manipulation of Plants, Oxford University Press
5. Sheela Srivastava, Alka Narula, S. S. Bhojwani, Inc NetLibrary, 2004 "Plant
6. Biotechnology and Molecular Markers" publishers Springer link
7. H.S. Chawla, 2002 "Introduction to Plant Biotechnology" Second Edition, ISBN 978-1-57808-228-5;; 562 Pages, Science publishers, USA
8. S Harding, 2007. Biotechnology and Genetic Engineering Reviews: V. 24, Nottingham University Press
9. Jane K Setlow, 2003. Genetic Engineering: Principles and Methods. Springer
10. National Biosafety Guidelines Biosafety rules 2005
11. Clarice Swisher, Carol Wekesser, 1996. Genetic Engineering. Lucent Books

Course No.	IBBbt. 305
Course Title:	Food Biotechnology (Major)
Credit Hours:	2 +1

Course Objectives

To acquaint the student with the role of microorganisms in food and food industry, and also with the principles of enzymology, and food engineering.

Course Contents

Food composition, proximate analysis. Probiotics. Fermented foods, Food enzymes, colors and additives, Microbial Food spoilage and food born disease. Food preservation methods. Food engineering principles, Modified atmospheric packaging, Food marketing principles. Mathematical Modeling in food technology .Microbial biotechnology of food flavors production, oil and fats, dairy products, meat and cereal foods, Food Safety and quality control.

Practicals

Estimation of moisture, ash, carbohydrates, protein, fat, crude fiber in food, Detection of proteases, amylases in milk. Determination of iodine number of fats. Determination of specific gravity of sugar. Separation of gluten from wheat flour. Detection of *E.coli* in drinking water. Detection of yeast and mould in dairy and bakery products. Production of cheese.

Recommended Books

1. Food Biotechnology by Ulf Stahl, Ute E.B. Donalies and Elke Nevogit, 2008.
2. Food colors, flavors and additives technology by NIIR, National Institute of industrial research, Dehli, India .2007
3. Biotechnology and food processing by Meenakshi Paul, 2007
4. Food Biotechnology, edited by K. Shetty et al , 2nd edition, 2006.
5. Fundamentals of food Biotechnology, Dyong H.Lee, 1996 Food Chemistry, lab. Manual by Dennis D. Miller, Willey Inter science. , 1998
6. Food analysis Manual by Javid Aziz Awan.2000.
7. Biotechnology and our Food by Joan Nordquist, Mass Market paper back, 2000

Course No. IBBbt. 306
Course Title: Bioinformatics
Credit Hours: 0 + 2

Course Objectives

To acquaint the students with bioinformatics tools, databases, algorithms and applications.

Course Contents

Introduction to computer hardware and software, computer applications for biotechnologists, Spreadsheet work, Word processing; Graphical and Statistical analysis packages.

Biocomputing (Introduction to String Matching Algorithms, Database Search Techniques, Sequence Comparison and Alignment Techniques, Use of Biochemical Scoring Matrices, Introduction to Graph Matching Algorithms, Genome Comparison, Prediction and its Implication).

Introduction to Bioinformatics, its Definition and History, Introduction to Data Mining and its Application, Database Hierarchies, Genomic and Proteomic Sequence Database and their Interpretation (UCSC Genome Database, NCBI, PDB, EcoCyc, DDBJ, SWISS-PROT, TIGR, KEGG etc)

Bioinformatics Tools: Repeatmasker, PHRED, PHRAP, BLAST, Prosite/BLOCKS/PFAM, CLUSTALW, Emotif, RasMol, Oligo, Primer3, Molscript, Treeview, Alscript, Genetic Analysis Software, Phylip

Recommended Books

1. Claverie, J.M. and Notredame C. 2003 Bioinformatics for Dummies. Wiley Editor.
2. Letovsky, S.I. 1999 Bioinformatics. Kluwer Academic Publishers.
3. Baldi, P. and Brunak, S. 1998 Bioinformatics. The MIT Press.
4. Setubal, J. and Meidanis, J. 1996 Introduction to Computational Molecular Biology. PWS Publishing Co., Boston.
5. Lesk, A.M. 2002 Introduction to Bioinformatics. Oxford University Press.
6. Rastogi, S.C., Mendiratta, N. and Rastogi, P. 2004 Bioinformatics: Concepts, Skills & Applications. CBS Publishers & Distributors, New Delhi.
7. Fogel, G.B. and Corne, D.W., Evolutionary Computation in Bioinformatics.
8. Mont, D.W., Bioinformatics: Sequence and Genome Analysis.
9. Evens, W.J. and Grant, G.R., Statistical Methods in Bioinformatics: An Introduction.
10. Pierre Baldi and Soren Brunak, Bioinformatics: The Machine Learning Approach.
11. Jae K. Lee, Statistical Bioinformatics, John Wiley & Sons Inc.
12. Introduction to Bioinformatics. (A Theoretical and Practical Approach). A. Krawetz and D. Womble. 2002. Humana Press.

Course No. IBBbt. 307
Course Title: Health Biotechnology (Major)
Credit Hours: 3 + 0

Course Objectives

To acquaint the student with diagnostic tools, immunization and therapeutics.

Course Contents

Introduction to Health biotechnology, Social acceptance of medical biotechnology, The molecular basis of disease, Molecular and genetic markers, Detection of mutations, Detection of infectious agents, Active and passive immunization, vaccines (live, killed, recombinant DNA vaccines, subunit vaccines, DNA vaccines, edible vaccines), Organ transplantation, transplant rejection. Applications of transgenic animals (animal models of diseases, pharming, farm animals improvement), Drug delivery systems, Blood transfusion, Grafting techniques, Pharmacogenetics, Strategies of gene therapy, gene delivery vehicles, genetic disorders and gene therapy, Biopharmaceuticals from plants, Uses of stem cell technology.

Recommended Books

1. "Medical Biotechnology" by Judit Pongracz, Mary Keen "(2009).Published by Elsevier Health Sciences.
2. "Biotechnology and Your Health: Pharmaceutical Applications" by Bernice Zeldin Schacter, Bernice Schacter (2005). Published by Chelsea House Publishers.
3. "Health and Pharmaceutical Biotechnology" by D.M. Chetan, K.P. Dinesh, D.M. Chetan (2006). Published by Firewall Media.

SEMESTER-VII

Course No.	IBBbt. 401
Course Title:	Recombinant DNA Techniques (Major)
Credit Hours:	2 + 1

Course Objectives

To acquaint the students with Basic techniques and tools used in gene manipulation and its practical uses.

Course Contents

Introduction and History of Recombinant DNA technology, Basic techniques, gel electrophoresis, Blotting techniques, restriction endonucleases, restriction mapping, vectors and their types, cloning vectors, transformations, Polymerase Chain reaction, Cloning strategies, Site-directed mutagenesis. Sequencing strategies, Application of recombinant DNA Technology (agriculture, health, industry, environment and basic research).

Practicals

DNA and plasmid isolation and agarose gel electrophoresis, conjugation, transformation, role of mutagenic agents in mutation, Blotting techniques.

Recommended Books

1. Robert F.W., 2005. Molecular Biology. McGraw-Hill.
2. Dale, J.W. and von Schantz, M. 2002. From Genes to Genomes: Concepts and Applications of DNA Technology. John-Wiley and Son Limited.
3. Meyers, R.A., 2006. Genomics and Genetics. John-Wiley and Son Limited.
4. Primrose, S.B., and Twyman, R.M. 2006. Gene Manipulation and Genomics 6th edition. Blackwell Publishing
5. Watson, J.M., Caudy, A.A., Meyers, R.A., and Witkowski, J.A., 2007. Recombinant DNA. Gene and genomes. 3rd Edition. W.H. Freeman and Company, New York.

Course No.	IBBbt. 402
Course Title:	Skills Enhancement (Major)
Credit Hours:	0+1

Course Objectives

This course is designed to equip the student with latest trends in the field of Biotechnology. It also aims to develop skills for comprehending scientific literature, preparing scientific manuscript and designing the research project.

Course Contents

It shall include activities like writing an abstract, preparing posters, making oral scientific presentations, project writing and preparing scientific reviews.

Recommended Books

1. Preparing Scientific Illustrations –A guide to better poster presentations and publications, M.H. Briscoe, 2nd edition (1996), Springer, New York.
2. Resource – Based Learning, S.Boowa, B. Smith, (1996) Kogan page, London.

Course No. IBBbt. 403
Course Title: Metabolomics, Proteomics and Genomics (Major)
Credit Hours: 2+0

Course Objectives

To acquaint the students with structural and functional genomics, proteomics and metabolomics

Course Contents

Structural genomics, Organization and Structure of the Genomes, Genetic Mapping, Transcript Mapping, Structural Variation in the Genomes, Genomics and proteomics, Molecular Biology of Proteins, Posttranslational modifications, Molecular mechanisms of cellular communication/signaling pathways, Protein-Protein Interactions, receptor identification and characterization, Integral Membrane Proteins and Ion Channels, Advance techniques used in proteomics (MS, LCMS/MS, ICAT, iTRAQ). Introduction to Metabolomics, detection, profiling, analysis and engineering. Microarray and RNA interference.

Recommended Books

1. Handbook of comparative genomics: principles and methodology by Cecilia Saccone, Graziano Pesole (2003). Published by Wiley-Liss.
2. Functional genomics by Chris Town (2002). Published by Springer.
3. Human Molecular Genetics-3 by T. Strachan, Andrew P. Read Published by Garland Science, 2004
4. Genes IX by Benjamin Lewin . Published by Jones and Bartlett Publishers, 2007
5. Systems Biology by Mohamed Al-Rubeai (2006), Martin Fussenegger Published by Springer

Course No.: IBBbt.420
Course Title: Industrial Biotechnology (Elective)
Credit Hours: 2+1

Course Objectives

Biotechnology being an expanded new version of the classical fermentation technology utilizes the synthetic abilities of living systems to produce the products needed by the society. The course aims to cover the strains selection methods, their improvement and commercial production of valuable macromolecules ranging from fuels to food supplements via biotechnological processes.

Course Contents

Biotechnology, the golden wave in biology. Industrial applications of biotechnology. Isolation of suitable microorganisms from the environment, industrial strains. Classical and modern molecular genetics tools for the strain improvement and stability. Cell harvesting, sedimentation, Industrial centrifuges. Filtration, rotary vacuum filters, membrane filtration. Mechanical and non-mechanical cell disruption methods.

Overview of health care products and antibiotics. Commercial production of penicillin, recombinant therapeutics, peptides and proteins. Food, dairy and plant products and beverage fermentation, beer brewing, malt and malting. Food preservation and flavoring agents. Food packaging technology.

Existing scenario of pesticide industry. Fate and effects of pesticides, Pollution prevention and control, Genomic insights into the biodegradation of pesticides. Characterization of waste effluents. Sources of heavy metals, commonly encountered toxic heavy metals. Physicochemical process for the removal of heavy metals, Bioremediation of heavy metals.

Prospects of biotechnology in utilization of pollutants from thermal power plants. Industrial enzymes and biocatalysts. Engineering enzymes for clinical diagnosis.

Practical

Experiments relating to physical and nutritional requirements for bacterial, fungal and yeast fermentation. Cultivation of aerobic and anaerobic microorganisms, batch and continuous cultures, product recovery etc., plant and animal cell cultures. The course will include the production of various macromolecules on laboratory and pilot scale by using different fermentation techniques.

Recommended Books

1. Industrial Biotechnology, M.P. Arora (2007), AITBS Publishers and Distributors.
2. Industrial Biotechnology, I. S. Thakur (2006), I. K. International Pvt. Ltd.
3. Industrial Biotechnology, editors V.S. (1992), Oxford and IBH publishing Co.
4. Environmental Microbiology, Raina M. Maier, Ian L. Pepper, Charles P. Gerba, (2000) Academic Press.
5. Biotechnology of Antibiotics, alkaloids and steroids of medicinal importance, R. Vlahov (1991), VCH Publishing.
6. Plant tissue culture techniques and laboratory exercises, Trigiano R.N and D. J. Gray (2000) CRC press text book
7. Physical Biochemistry, Principles and Applications, David Sheehan (2000), John Wiley and Sons.
8. Antibodies-A laboratory Manual, E.D. Harlow and L. David (1988), Cold Spring Harbor laboratory Press.

Course No.	IBBbt. 422
Course Title:	Plant Biotechnology (Elective)
Credit Hours:	2 +1

Course Objectives

To acquaint the student with the molecular techniques for the yield and quality improvements of crops.

Course Contents

Importance of Biotechnology in Plant improvement, Biotechnology as a tool to supplement conventional systems of Plant improvement, tools of Biotechnology for plant improvement. In Vitro Technology, Micro propagation, Embryo Rescue, Haploid Development. Viral Free Plant material, Somaclonal variation, Recombinant DNA Technology and Genetic Engineering, Gene cloning, GMOs, Incorporation of Novel genes for tolerance against Biotic and Abiotic stresses. Genes for yield and quality improvement, Genes for Insect and disease Resistance. BT crops, herbicide Resistant crops. Ethical issues and public concerns regarding GMOs.

Practicals

Plant tissue culture, DNA isolation from plants, Agrobacterium mediated transformation of plant cells.

Recommended Books

1. Plant biotechnology by M. W. fowler, G. S. Warren and M. Moo-young, Elsevier Science
2. Plant Biotechnology, S. H. Mantell, Springer-Verlag, New York

Course No.	IBBbt. 440
Course Title:	Research Dissertation, Research Project, Internship, Special Paper (Major)
Credit Hours:	3 + 0

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SEMESTER-VIII

Course No. IBBbt. 423
Course Title: Animal Biotechnology (Elective)
Credit Hours: 2 + 1

Course Objectives

To acquaint the students with techniques to produce transgenic animal and embryonic micromanipulations.

Course Contents

Introduction and history of transgenic animals, Role of synthetic peptides/protein in animal health. Use of monoclonal antibodies as a diagnostic/therapeutic agents, Cytokines and their potential therapeutic value, Application to diagnosis of microbial infection and to genotype analysis, The micromanipulations of farm animal embryos, The incorporation of biotechnological techniques in animal breeding strategies, Gene transfer through embryo microinjection, Ethical and social issues in animal biotechnology.

Practicals

Aquaculture techniques, various DNA recombinant techniques useful for animal biotechnologies.

Recommended Books

1. Freshney, H., 2000. Culture of animal cells: A manual of basic techniques Wiley, John and Sons
2. Masters, J. R., 2000. Animal cell culture. Oxford University Press.
3. Lanza, R.P., Lanza, B., Atala, A., 2001. Methods of tissue engineering Academic Press Inc.
4. Doyle, A., Griffiths, J. B., 1998. Cells and tissue culture: Laboratory. procedures in biotechnology. Wiley, John and Sons.
5. Barnum, S., 2004. Biotechnology: An Introduction (with Infotrac) Brooks /Cole.
6. Tourte, Y., and Catherine, T. C., 2005. Genetic Engineering and Biotechnology: Concepts, Methods, and Agronomic Applications. Science Publishers.
7. Houdebine, L-M., 2003. Animal Transgenesis and Cloning. John Wiley and Sons Limited.

Course No. IBBbt. 406
Course Title: Environmental Biotechnology (Major)
Credit Hours: 2 + 1

Course Objectives

To acquaint the students with conservation and reclamation of environment through biotechnology.

Course Contents

Introduction to Environmental biotechnology, Fundamentals of Biological Intervention, Genetic manipulation strategies in environmental biotechnology, Pollution indicators, Pollution control strategies, Biology of Waste water and its treatment, Sludge treatment, Contaminated land and bioremediation, Aerobes and Effluents, Phytotechnology (Terrestrial Phyto-systems, Metal Phytoremediation, Rhizofiltration etc) Hyper accumulation, Solid Waste treatments, Concept of integrated Environmental biotechnology, Detoxification of hazardous chemicals: biodegradation, Biotransformation. Products of environmental biotechnology.

Practical

Biodegradation of environmental pollutants by microorganisms, Bacteriology of Drinking water, Microscopic studies of water specimens collected from various locations, Field survey of polluted areas, Field study for pollution indicators (Plants, Microorganisms).

Recommended Books

1. Christon Hurst, Ronald Crawford, Jay Garland, David Lipson, Aaron Mills and Linda Stetzenbach (2007) Manual of Environmental Microbiology. 3rd Ed. Blackwell Publishers
2. Christopher F. Easter and D. A John Wase, John Wase (2004) Environmental Biotechnology. John Wiley & Sons.
3. Derek R. Lovley (2000) Environmental Microb-Metal Interactions. ASM Press.
4. Environmental Biotechnology by Bhattacharyya and Rintu Banerjee (Paperback - Mar 1, 2007) OUP India.
5. Environmental Biotechnology by Bruce E. Rittmann and Perry L. McCarty (Paperback - Jan 1, 2001). McGraw-Hill Publishing Co.
6. Environmental Biotechnology Theory and application, 2003. Gareth M Evans and Judith C. Furlong. Wiley Publishers.
7. Environmental Biotechnology, 2008. T. Srinivas New Age international Publishers.
8. Environmental Microbiology: Methods and Protocols (Methods in Biotechnology) by John F. T. Spencer and Alicia L. Ragout de Spencer (Hardcover - Jul 15, 2004) Humana Press; 1 edition.
9. Lawrence P. Wackett (2001) Biocatalysis and Biodegradations: Microbial Transformation of Organic Compounds. ASM Press

Course No.	IBBbt. 407
Course Title:	Downstream Technology (Major)
Credit Hours:	1 + 0

Course Objectives

To acquaint the student with knowledge of potential techniques for bioseparation and purification.

Course Contents

Mechanical operations, Filtration, centrifugation, Flocculation, evaporation crystallization, drying. Membrane processes, Solvent extraction, Electrophoresis and electro dialysis, Operations and applications of Chromatography techniques in biotechnology). Planer, Gas, Column, Ion exchange, Gel exclusion, Affinity Perfusion chromatography, Fast performance Liquid Chromatography (FPLC). Biosensors, protein chips.

Recommended Books

1. Modern experimental biochemistry, 3rd Edition by Rodeny Boyer, 2009. Published by Dorling Kindersley (India) PVT. LTD. India.
2. Bioseparation science and engineering by Roger .G. Harrison., Paul Todd ., Scott R. Rudge and Demeteri P. Petrides. 2003, Oxford University press. New York.
3. Protein purification protocols, 2nd Edition by Paul Culter(2004), Humana Press, Totowa. New Jersey.

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Course No. IBBbt. 408
Course Title: Biosafety and Bioethics (Major)
Credit Hours: 1+0

Course Objectives

To acquaint students with principles of biosafety and ethical perspectives of Biotechnological systems.

Course Contents

Introduction to Biosafety (Definition, Concept, Uses and abuses of genetic information, Biohazards), Good Laboratory Practices, Risks Related to GMOs, International Rules & regulations for Biosafety & GMOs. Introduction to Bioethics, Ethical issues regarding GMOs, Euthanasia, Issues related to Reproductive & Cloning technologies, Issues to transplants and Eugenies, Patenting, Commercialization and Benefits Sharing, role of National Bioethic committees.

Recommended Books

1. WHO. 2006. Laboratory Biosafety manual third edition. AITBS publishers and distributors, India. (Available online free of cost).
2. Lewis RJ. Sax dangerous properties of Industrial materials, 10th edition. Toronto, John Wiley and sons, 1999.
3. Lenga RE. 1988. The Sigma-Aldrich Library of chemical safety data, 2nd ed. Milwaukee, WI, Aldrich chemical company.
4. Furr AK. 2000. CRC handbook of laboratory safety 5th edition. Boca Raton, FL, CRC press.
5. United states Department Health and Human services. 1999. Biosafety in Microbiological and biomedical laboratories. 4th edition. Centers for disease control and prevention/National institutes of Health, Washington DC.
6. Biosafety in the Laboratory: Prudent Practices for Handling and Disposal of Infectious Materials Committee on Hazardous Biological Substances in the Laboratory, National Research Council ISBN: 0-309-55920-0, (1989) available from the National Academies Press at: <http://www.nap.edu/catalog/1197.html>
7. Genes Technology and Policy. Jose Maria A. Ochave 2003 <http://www.apdip.net/publications/iespprimers/eprimer-genes.pdf>
8. Bioethics & Biosafety in Biotechnology by V Sree Krishna.

Course No. IBBbt. 434
Course Title: Nanobiotechnology (Elective)
Credit Hours: 3 + 0

Course Objectives

To acquaint the students with key integrative technologies and use of nanoparticles in biological systems.

Course Contents

A brief introduction to Nanotechnology, Interface between Nanotechnology and Bionanotechnology, Manipulating molecules, Carbon Fullerene, Carbon Nanotubes, Non-Carbon Nanotubes and Fullerene like materials, Quantum Dots and other Nano-particles, Nano-wires, Nano rods and other Nanomaterials, Magnetic Nanoparticles. Natural Biological assembly at Nano-Scale, Nanometric biological assemblies (complexes), Nanobionics and Bio-Inspired Nanotechnology, Applications of biological assemblies in Nanotechnology, Medical, Cosmetics,

Agriculture, water and other applications of Nanobionanotechnology, Future prospect of Nanobiotechnology.

Recommended Books

1. Plenty of room for biology at the bottom: an introduction to Bionanotechnology by Ehud Gazit (2007). Published by Imperial College Press.
2. Bionanotechnology: proteins to nanodevices by Vencatesan Renugopalakrishnan, Randolph V. Lewis (2006). Published by Springer.
3. Nanoscale technology in biological systems by Ralph S. Greco, F. B. Prinz, Robert Lane Smith (2004). Published by CRC Press.
4. Nanobiotechnology II: More Concepts and Applications by Chad A. Mirkin, Christof M. Niemeyer (2007). Published by John Wiley & Sons.

Course No.

IBBbt. 440

Course Title:

**Research Dissertation, Research Project, Internship,
Special Paper (Major)**

Credit Hours:

3 + 0