



### List of Revised Courses

**Department : *Biotechnology***

**Program Name : *B.Sc., M.Sc., Ph.D. Course work***

**Academic Year : *2017-18***

### List of Revised Courses

Sr. No.	Course Code	Name of the Course
1.	LBTC 402	Paper-2 Biophysical Techniques
2.	LBTC 502	Animal & Plant biotechnology (core)
3.	LBTC 503	Bioinformatics (Core)
4.	LBTC 504	a) Medical Diagnostics (Elective)
5.	LBTC 505	b) Biotechnology in Crop improvement (Elective)
6.	LBTC 506	Laboratory – 1
7.	LBTC 507	Laboratory - 2
8.	LBTC 601	Industrial Biotechnology (core)
9.	LBTC 602	Biosafety, Bioethics & IPR (core)
10.	LBTC 603	a) Fermentation Technology (Elective)
11.	LBTC 604	b) Gene therapy (Elective)
12.	LBTC 605	Laboratory - 1
13.	LBTC 606	Dissertation on electives
14.	LBTC 701	Cell Biology
15.	LBTC 702	Microbiology
16.	LBTC 705	Laboratory - 1
17.	LBTC 801	Molecular Biology
18.	LBTC 802	Immunology
19.	LBTC 803	Bio techniques
20.	LBTC 804	Enzymology and Enzyme Technology



21.	LBTC 805	Laboratory- 1
22.	LBTC 806	Laboratory -2
23.	LBTC 902	Microbial Biotechnology (Core)
24.	LBTC 903	Animal Biotechnology (Core)
25.	LBTC 904	a) Bioprocess Technology (Elective)
26.	LBTC 905	b) Genomics & Proteomics (Elective)
27.	LBTC 906	c) Molecular Diagnostics (Elective)
28.	LBTC 907	d) Food Technology (Elective)
29.	LBTC 908	Laboratory -1
30.	LBTC 909	Laboratory -2
31.	LBTC 1001	Bioinformatics & Statistics (Core)
32.	LBTC 1002	a) Plant metabolic Engineering (Elective)
33.	LBTC 1003	b) Gene Therapy & Nanomedicine (Elective)
34.	LBTC 1004	c) Industrial & Fermentation Technology (Elective)
35.	LBTC 1005	d) Immunotechniques (Elective)
36.	LBTC 1006	e) Entrepreneurship Management in Biotechnology (Elective)
37.	Paper2	Analytical and Separation Techniques



## Minutes of Meetings (MoM) of Board of Studies (BoS)

**Academic Year : 2017-18**

**School : School of Studies of Interdisciplinary Education and Research**

**Department : Biotechnology**

**Date and Time : 13-04-2017 - 12:00 Noon**

**Venue : Room of Head, Department of Biotechnology**

MINUTES OF THE MEETING OF BOARD OF STUDIES IN BIOTECHNOLOGY  
HELD ON 13/04/2017

A Meeting of the BOS was held on 13/04/2017 at 12:00 Noon to discuss the following:

- To discuss and approve the course structure and scheme of examination of Int. UG/PG, M.Sc. and Ph. D courses in Biotechnology and following members were present:
- Any other matter by permission of the Chair.
  - Dr. Renu Bhatt, Head
  - Prof. B.N. Tiwary, Professor
  - Prof. Ragini Gothwal,
  - Ms. Alka Ekka, Assistant Professor

Chairman  
Member  
Expert  
Member

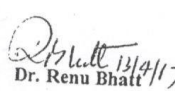
At the very outset the HOD and Chairman of BOS welcomed all the esteemed members and placed the draft prepared to revise course structure and scheme of examination in the light of UGC directives as per CBCS scheme to be implemented from 2017-18. The Syllabus of M.Sc Biotechnology and Pre Ph.D course work was also updated and placed before the committee.

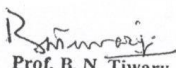
The course structure and scheme of examination was discussed and approved by all the members.

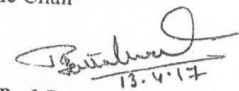
The chairman categorically pointed out that in the UG courses only 03 core subjects have to be defined and the student shall have to opt for honors subject in Ist semester only.

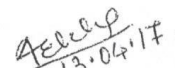
Group A: Biotechnology-Chemistry-Zoology  
Group B: Biotechnology-Chemistry-Botany

The meeting ended with a vote of thanks by the Chair

  
Dr. Renu Bhatt  
Chairman

  
Prof. B. N. Tiwary  
Member

  
Prof. Ragini Gothwal  
Expert

  
Ms. Alka Ekka  
Member



In the meeting of BOS-Biotechnology held on 13-40-2017, the following courses were revised in the of Syllabus of B. Sc. and M.Sc. Ph.D. Course work:

Sr. No.	Course Code	Name of the Course
1.	LBTC 402	Paper-2 Biophysical Techniques
2.	LBTC 502	Animal & Plant biotechnology (core)
3.	LBTC 503	Bioinformatics (Core)
4.	LBTC 504	a) Medical Diagnostics (Elective)
5.	LBTC 505	b) Biotechnology in Crop improvement (Elective)
6.	LBTC 506	Laboratory – 1
7.	LBTC 507	Laboratory - 2
8.	LBTC 601	Industrial Biotechnology (core)
9.	LBTC 602	Biosafety, Bioethics & IPR (core)
10.	LBTC 603	a) Fermentation Technology (Elective)
11.	LBTC 604	b) Gene therapy (Elective)
12.	LBTC 605	Laboratory - 1
13.	LBTC 606	Dissertation on electives
14.	LBTC 701	Cell Biology
15.	LBTC 702	Microbiology
16.	LBTC 705	Laboratory - 1
17.	LBTC 801	Molecular Biology
18.	LBTC 802	Immunology
19.	LBTC 803	Bio techniques
20.	LBTC 804	Enzymology and Enzyme Technology
21.	LBTC 805	Laboratory– 1
22.	LBTC 806	Laboratory -2
23.	LBTC 902	Microbial Biotechnology (Core)
24.	LBTC 903	Animal Biotechnology (Core)



25.	LBTC 904	a) Bioprocess Technology (Elective)
26.	LBTC 905	b) Genomics & Proteomics (Elective)
27.	LBTC 906	c) Molecular Diagnostics (Elective)
28.	LBTC 907	d) Food Technology (Elective)
29.	LBTC 908	Laboratory -1
30.	LBTC 909	Laboratory -2
31.	LBTC 1001	Bioinformatics & Statistics (Core)
32.	LBTC 1002	a) Plant metabolic Engineering (Elective)
33.	LBTC 1003	b) Gene Therapy & Nanomedicine (Elective)
34.	LBTC 1004	c) Industrial & Fermentation Technology (Elective)
35.	LBTC 1005	d) Immunotechniques (Elective)
36.	LBTC 1006	e) Entrepreneurship Management in Biotechnology (Elective)
37.	Paper2	Analytical and Separation Techniques

The following new courses were introduced in the Syllabus of B. Sc. and M.Sc. Ph.D. Course work:

Course Code	Course Name
LBTC 502	Animal & Plant biotechnology (core)
LBTC 601	Industrial Biotechnology (core)
LBTC 602	Biosafety, Bioethics & IPR (core)
LBTC 603	a) Fermentation Technology (Elective)
LBTC 604	b) Gene therapy (Elective)
LBTC 605	Laboratory - 1
LBTC 606	Dissertation on electives
LBTC 701	Cell Biology
LBTC 702	Microbiology
LBTC 705	Laboratory - 1
LBTC 801	Molecular Biology



LBTC 803	Bio techniques
LBTC 902	Microbial Biotechnology (Core)
LBTC 904	a) Bioprocess Technology (Elective)
LBTC 905	b) Genomics & Proteomics (Elective)
LBTC 907	d) Food Technology (Elective)
LBTC 1001	Bioinformatics & Statistics (Core)
LBTC 1002	a) Plant metabolic Engineering (Elective)
LBTC 1004	c) Industrial & Fermentation Technology (Elective)
LBTC 1005	d) Immunotechniques (Elective)

*Ashatt*

Signature & Seal of HoD

**विभागाध्यक्ष, जैव प्रौद्योगिकी विभाग**  
**Head, Department of Biotechnology**  
**गुरु घासीदास विश्वविद्यालय, बिलासपुर (छ.ग.)**  
**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**





## Scheme and Syllabus

Integrated UG/PGSemester - IV					
Code	Course Opted	Subject	Hours/ Semester	Hours/ Week	Credits
LBTC 401	Core-1	Paper-1 Immunology	32	2	2
LBTC 402		Paper-2 Biophysical Techniques	32	2	2
	Core-2	Zoology/Botany Paper-1	32	2	2
		Zoology/Botany Paper-2	32	2	2
	Core-3	Chemistry Paper-1	32	2	2
		Chemistry Paper-2	32	2	2
	Skill Enhancement Course-1				
		Environmental Sciences-II	32	2	2
		Disaster Management (incorporate only if common syllabus or Academic council decision)	32	2	2
LBTC 403	Lab - 1	Laboratory - 1 (Based on Core - 1)	64	4	2
	Lab - 2	Laboratory - 2 (Based on Core - 2)	64	4	2
	Lab - 3	Laboratory - 3 (Based on Core - 3)	64	4	2
		<b>Total</b>	<b>448</b>	<b>32</b>	<b>22</b>

\*Student can opt any one out of the three core papers (Biotechnology, Botany/Zoology and Chemistry) as the honours (Subject to the availability of the seats as approved by the Academic Council)

\*The decision of the Dean of the school and the Head of the respective Department will be final

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Integrated UG/PG V Semester					
Code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 501	Core -1	Genetic Engineering	48	03	03
LBTC 502	Core -2	Animal & Plant biotechnology	48	03	03
LBTC 503	Core -3	Bioinformatics	48	03	03
LBTC 504	Elective	a) Medical Diagnostics	48	03	03
LBTC 505		b) Biotechnology in Crop improvement			
		Laboratory			
LBTC 506	Lab 01	Laboratory - 1 (based on Core -1 & Core -2)	96	06	03
LBTC 507	Lab 02	Laboratory - 2 (based on Core -3 & Elective)	96	06	03
LBTC 508	Seminar	Seminar based on elective	32	02	02
		<b>Total</b>	<b>806</b>	<b>26</b>	<b>20</b>

Integrated UG/PG VI Semester					
Code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 601	Core -1	Industrial Biotechnology	48	03	03
LBTC 602	Core -2	Biosafety, Bioethics & IPR	48	03	03
LBTC 603	Elective	a) Fermentation Technology	48	03	03
LBTC 604		b) Gene therapy			
		Laboratory			
LBTC 605	Lab 01	Laboratory - 1 (based on Core -1 & Core -2)	96	06	03
LBTC 606	Lab 02	Dissertation on electives	192	12	06
		<b>Total</b>	<b>384</b>	<b>27</b>	<b>18</b>

PG I Semester/ Integ. UG/PG VII Semester					
code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 701	Core -1	Cell Biology	48	03	03
LBTC 702	Core -2	Microbiology	48	03	03
LBTC 703	Core -3	Biochemistry (Regulation & Metabolism)	48	03	03
LBTC 704	Core -4	Recombinant DNA Technology	48	03	03
		Laboratory			
LBTC 705	Lab 01	Laboratory - 1 (based on Core -1 & Core -2)	96	06	03
LBTC 706	Lab 02	Laboratory - 2 (based on Core -3 & Core -4)	96	06	03
		<b>Total</b>	<b>384</b>	<b>24</b>	<b>18</b>

*Shruti*  
13.04.17

*Poojashree*  
13.04.17

*Ashish*  
13.04.17

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PG II Semester/ Integ. UG/PG VIII Semester					
Code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 801	Core -1	Molecular Biology	48	03	03
LBTC 802	Core -2	Immunology	48	03	03
LBTC 803	Core -3	Biotechniques	48	03	03
LBTC 804	Core-4	Enzymology and Enzyme Technology	48	03	03
		Laboratory			
LBTC 805	Lab 01	Laboratory -1 (based on Core -1 & Core -2)	96	06	03
LBTC 806	Lab 02	Laboratory -2 (based on Core -3 & Core-4)	96	06	03
		<b>Total</b>	<b>384</b>	<b>24</b>	<b>18</b>

PG III Semester/ Integ. UG/PG IX Semester					
Code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 901	Core -1	Plant Biotechnology	48	03	03
LBTC 902	Core -2	Microbial Biotechnology	48	03	03
LBTC 903	Core -3	Animal Biotechnology	48	03	03
LBTC 904	Elective	a) Bioprocess Technology	48	03	03
LBTC 905		b) Genomics & Proteomics			
LBTC 906		c) Molecular Diagnostics			
LBTC 907		d) Food Technology			
		Laboratory			
LBTC 908	Lab 01	Laboratory -1 (based on Core -1 & Core -2)	96	06	03
LBTC 909	Lab 02	Laboratory -2 (based on Core -3 Elective)	96	06	03
		<b>Total</b>	<b>384</b>	<b>24</b>	<b>18</b>

PG IV Semester/ Integ. UG/PG X Semester					
Code	Course opted	Subjects	Hours/ semester	Hours/ week	Credits
LBTC 1001	Core -1	Bioinformatics & Statistics	48	03	03
		Skill Development Courses			
LBTC 1002	Elective	a) Plant metabolic Engineering	48×2	03×2	03×2
LBTC 1003		b) Gene Therapy & Nanomedicine			
LBTC 1004		c) Industrial & Fermentation Technology			
LBTC 1005		d) Immunotechniques			
LBTC 1006		e) Entrepreneurship Management in Biotechnology			
LBTC 1007		f) Environmental Biotechnology			
LBTC 1008		Dissertation	288	18	06+03
		<b>Total</b>	<b>432</b>	<b>27</b>	<b>18</b>

**Baskets of Electives:** Students in PG IV semester has to select any two subjects from the elective baskets.

The dissertation work for PG IV semester shall be based on the area of electives selected by the students.

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*Potlun* 13.04.17  
*Acharya* 13.04.17



Paper-(I): Analytical and Separation Techniques.

Unit - 1

Introduction and types of chromatography: paper, thin layer, affinity and column chromatography chromatography, Gel permeation, ion-exchange, GLC, HPLC, FPLC and instrumental details of each. Applications of Chromatographic techniques in Biology and research application.

Unit - 2

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, 2-D electrophoresis, Blotting- Southern, Western and Northern blotting, Immunoblotting, Immunoelectrophoresis, DNA finger printing and ELISA

Unit - 3

Electromagnetic spectrum, Beer Lambert's Law, Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy ESR and NMR spectroscopy. Mass spectroscopy (LC-MS, GC-MS). Fluorescent spectroscopy Applications of different Spectroscopic techniques in Biology

Unit - 4

DNA Microarray, Protein Microarray, Microarray analysis, DNA chip, DNA Probes, FTIR, Flow cytometry.

Unit - 5

Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography. Safety measures in handling radioisotopes. RIA, non radiolabelling.

Suggested Readings

1. Nuclear Magnetic Resonance:(2007) Williams
2. Biochemical Techniques theory and practice: (2009) White R
3. Analytical Chemistry: (2000) Christian G. D.
4. A Biologist Guide to Principle and Techniques: (2009) Willson K. and Gounding K.H.
5. An Introduction to Practical Biochemistry:(2008) Plummer D. T.

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Integ. UG/PG IV Semester, Core - 1  
Course: Biophysical Techniques  
Course Code: LBTC 402  
Course Credit: (2-0-0) 2

**Unit - 1**

General biophysical methods – Measurement of pH, buffers, Henderson – Hasselbalch equation, isoelectric point

**Unit - 2**

Separation & identification of biomolecules - concept of chromatography their types and applications, electrophoresis- types and application

**Unit - 3**

Centrifugation – Basic principle of centrifugation, types and application, instrumentation of ultracentrifuge and application

**Unit - 4**

Microscopy – light microscopy, bright & dark field microscopy, fluorescence microscopy, phase contrast microscopy, TEM, SEM

**Unit - 5**

**Spectroscopy:** Principle, types and instrumentation, (colorimeter, UV-Visible spectrophotometer, InfraRed spectrophotometer), Techniques of radioactivity and radioactive labeling, Counting- Scintillation counters, Geiger-Muller counter, autoradiography.

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessment will be taken into consideration.

**Suggested Readings**

1. Biochemical Techniques theory and practice: White R
2. Analytical Chemistry: Christian GD
3. An Introduction to Practical Biochemistry: Plummer DT
4. Undergraduate Instrumental Analysis: Robinsan, JW
5. Essentials of Biophysics: Narayanan, P
6. A Text Book of Biophysics: Roy RN
7. Biophysical chemistry: Upadhy and Nath

*Patel*  
13.6.12

*Ashup*  
13.04.17





Integrated UG/PG V Sem, Elective  
Course: a) Medical Diagnostics  
Course Code: LBTC 504  
Course Credit: (3-0-0) 3

Unit-1

Introduction to medical diagnostics, methods of separation of molecule and cells, Methods of cell counting, Assays for estimation of biomolecules.

Unit-2

Analysis of body fluids, methods of body fluid collection, Process and investigation of basic hematology, blood transfusion, Blood banking, Urine analysis, Feces and sputum analysis,

Unit-3

Diagnostics methods for genetic disorders, chromosomal abnormalities: structural and numerical, karyotyping.

*Dr. K. K. Singh*  
13.4.17

*J. Prasad*  
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*A. K. Singh*  
13.04.17

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Unit-4

Methods of diagnostic imaging: X-Ray, USG, CT, MRI, SPECT, targeted imaging.

Unit-5

Introduction to histopathology, preparation of histological slides and analysis, cytological investigations. Kit-based methods for diagnosis of hepatitis, blood Sugar Level etc.



Integrated UG/PG V Sem, Elective

Course: b) Biotechnology in Crop improvement  
Course Code: LBTC 505  
Course Credit: (3-0-0) 3

**Unit-1**

Basic techniques and tools of plant tissue culture: Establishment of plant tissue culture lab: equipment, culture vessels, Composition of various tissue culture media and their preparation surface sterilization of various explants, pretreatment of explant, subculture and repeated transfer of explants and cultures, Hardening.

**Unit-2**

Culture techniques: Meristem tip culture, anther, embryo and ovule culture, callus culture, suspension cultures, Single cell culture, organogenesis and embryogenesis, Artificial seed (synthetic seed)

**Unit-3**

Tissue culture in crop improvement: Somaclonal variation, Somatic hybridization, Haploids in plant breeding Protoplast culture: Importance, Isolation of protoplasts, method of protoplast culture, culture media, Growth and division of protoplast, regeneration of plants, Production of virus-free plants

**Unit-4**

Transgenic plant: features of Ti and Ri plasmids, mechanisms of transformation, vectors and promoters, genetic markers, reporter genes, transformation, Herbicide and insect resistance transgenic plant, gene silencing

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Parul  
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Abhishek  
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**Unit-5**

Biofertilizers, Plant growth promoting rhizobacteria, Biological control, Biopesticides- types and application, Integrated Pest Management (IPM)





Integrated UG/PG V Sem, Lab - 1

Course: Laboratory -1(Based on Core -1 & Core -2)

Course Code: LBTC 506

Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	15
2	Internal Assessment II	3 hour	15
3	End Semester	6 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken

Integrated UG/PG V Sem, Lab - 2

Course: Laboratory -1(Based on Core -3 & Elective)

Course Code: LBTC 507

Course Credit: (0-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	15
2	Internal Assessment II	3 hour	15
3	End Semester	6 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken

Integrated UG/PG V Sem, Seminar

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*J. S. S. S.*  
13.4.17

*A. S. S. S.*  
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Integrated UG/PG VI Sem, Core-1  
Course: Industrial Biotechnology  
Course Code: LBTC 601  
Course Credit: (3-0-0) 3

**Unit - 1**

Bioreactor / Fermenter – types and working of Fermenters (Stirred tank, bubble columns, airlift, Bioreactors, Static, Submerged and agitated fermentation),

**Unit - 2**

Solid substrate fermentation & submerged fermentations, Raw materials for fermentation, microbial Biomass production, principles of malt and brewing industry

**Unit - 3**

Enzyme technology – nature of enzymes, Industrial applications of enzyme, immobilized enzymes, limitations of microbial cells used as catalysts in fermentation, multi-enzyme reactors, protein engineering of enzymes

**Unit - 4**

Upstream processing (Strain selection, Sterilization), Downstream processing – extraction, separation, concentration, recovery & purification, operations of fermentation products.

**Unit - 5**

Production of recombinant proteins having, therapeutic and diagnostic applications, vaccines. Bioprocess strategies in Plant Cell and Animal Cell culture

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Frontiers in Microbial Technology: Bisen PS
2. Industrial Microbiology: Prescott and Dunn
3. A text of Industrial Microbiology: Crueger W and Crueger A
4. Principles of Fermentation Technology: Stanbury PF, Ehitaker H, Hall SJ
5. Fermentation Biotechnology: Mansi
6. Principle of fermentation technology: Stanbury PF

Integrated UG/PG VI Sem, Core-2

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Course: Biosafety, IPR & Bioethics  
Course Code: LBTC 602  
Course Credit: (3-0-0) 3

**Unit - 1**

Biosafety/Good Lab Practices, Introduction to Biological Safety Cabinets, GMOs and LMOs and their environmental impact, Roles of Institutional Biosafety Committee, RCGM, GEAC etc. Hazardous Materials used in Biotechnology, their Handling and Disposal.

**Unit- 2**

Introduction to Intellectual Property. Concept of Intellectual Property Kinds of Intellectual Property Patents, Copyrights, Designs, Trademarks, Geographical Indication, Infringement of IPR, protection and Remedies, Licensing and its types.

**Unit-3**

Introduction to the leading International instruments concerning intellectual property rights, The Berne Convention, GATT, WTO, Universal Copyright Convention, The Paris Convention, TRIPS, The World Intellectual Property Rights Organization (WIPO), Budapest treaty, Patent Infringement, Biological Patentability, Patenting Living Organisms.

**Unit-4**

Patents: Requirement of patentable novelty, Inventive step, Prior art Classifying products as patentable and non-patentable, Procedure for applying for patent, Indian Patent Act, Traditional Knowledge, Commercial Exploitation, and Protection, Biopiracy and Bioprospecting.

**Unit-5**

Introduction to Bioethics. Legal and Socio-economic impacts of Biotechnology, Ethical, Legal and Social Implications of Human Genome Project, Bioethics in Biodiversity, Resource Management and Genetically Modified Organisms

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Fleming, D.A., Hunt, D.L., (2000). Biotechnology and Safety Assessment (3rd Ed) Academic press. ISBN-1555811804, 9781555811808.
2. Thomas, J.A., Fuch, R.L., (1999). Biotechnology and safety assessment (3rd Ed). CRC press, Washington. ISBN: 1560327219, 9781560327219
3. Law and Strategy of biotechnological patents by Sibley. Butterworth publication.(2007) ISBN: 0750694440, 9780750694445.
4. Intellectual property rights- Ganguli-Tat McGrawhill. (2001) ISBN-10: 0074838602.
5. Intellectual Property Right- Wattal- Oxford Publication House (1997) ISBN: 0195905024
6. Biotechnology - A comprehensive treatise (Vol. 12). Legal economic and ethical dimensions VCH. (2nd ed) ISBN-10 3527304320.
7. Encyclopedia of Bioethics 5 vol set, (2003) ISBN-10: 0029657748.
8. Thomas, J.A., Fuch, R.L. (2002). Biotechnology and safety Assessment (3rd Ed) Academic press.
9. B.D. Singh. Biotechnology expanding horizons.
10. H.K.Das. Text book of biotechnology 3rd edition

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Integrated UG/PG VI Sem, Elective  
Course: a) Fermentation Technology  
Course Code: LBTC 603  
Course Credit: (3-0-0) 3

**Unit - 1**

Introduction to fermentation: aerobic and anaerobic fermentations; Kinetics of growth and product formation - chemically structured models, mass transfer diffusion, membrane transport

**Unit - 2**

Fermenter design - operation, measurement and control in fermentation; Aeration and agitation in fermentation: Oxygen requirement, measurement of adsorption coefficients, bubble aeration, mechanical agitation, correlation between mass-transfer coefficient and operating variables, hollow fibre reactors, immobilized cell reactors

**Unit - 3**

Strain development: General aspects mutation selection of mutants, recombination, regulation gene technology and use of genetic methods, In brief genetic engineering for strain improvements and applications in medicine, agriculture and industry

**Unit - 4**

Microbial Biotransformation: types, methods and processes, analysis and isolation of products; applications in waste management, medicine and agriculture; Biogas production - pathways, regulation/modulation, advanced biomethanation systems and their applications

**Unit - 5**

Microbial & Bioprocess technology: Down stream processing in brief -Methods for vitamins (B<sub>12</sub> & Riboflavin), amino acids (L-glutamic acid & L Lysine), organic acids (Citric acid & Gluconic acid), enzymes (Amylases & pectinases), antibiotics (Beta Lactam antibiotics & amino acid and peptide antibiotics), microbes as biocontrol agents

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken into consideration,

**Suggested Readings**

1. Principles of Fermentation Technology: Whittaker & Stanbury
2. Bioprocess Engineering Principles: Pauline Doran
3. Bioreactor Design & Product Yield, BIOTOL series: Butterworth Heinemann
4. Bioseparation & Bioprocessing: Subramaniam G
5. Product Recovery in Bioprocess Technology: BIOTOL series, Butterworth Heinemann

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Integrated UG/PG VI Sem, Elective  
Course: b) Gene Therapy  
Course Code: LBTC 604  
Course Credit: (3-0-0) 3

**Unit-1**

Gene Therapy: Background, Introduction, Types: Somatic, Germ line, strategies: Gene Augmentation therapy, Targeted killing of specific cells, Targeted inhibition of gene expression. Targeted gene mutation correction, different approaches: Classical and non classical, Methods of gene therapy: Ex-vivo, in-vivo

**Unit-2**

Target site for gene therapy, Vectors in gene therapy: Viruses – Retroviruses, Adenoviruses, Adeno-associated viruses, advantages and disadvantages, other viral vectors: HSV-1, Baculovirus, SV40

**Unit-3**

Non-viral methods – Naked DNA, Oligodeoxynucleotides, Liposome, Electroporation, Hybrid methods: RNA-DNA chimera, Receptor mediated Endocytosis

**Unit 4**

Gene therapy in the treatment of disease: Introduction, SCID, Cancer, Muscular dystrophy, Respiratory disease,

**Unit 5**

Advantages and recent developments in gene therapy, Problems and ethics, challenges and future of gene therapy

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	15
2	Internal Assessment II	1 hour	15
3	End Semester	3 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken into consideration.

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Integrated UG/PG VI Sem, Lab -1





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Integrated UG/PG VISEm, Lab -1  
Course: Laboratory -1(based on Core -1 & Core -2)  
Course Code: LBTC 605

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Course Credit: (3-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	15
2	Internal Assessment II	3 hour	15
3	End Semester	6 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken

Integrated UG/PG VISEm, Dissertation on electives

Course: Dissertation  
Course Code: LBTC 606  
Course Credit: (3-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment	2 hour	60
2	End Semester	3 hours	90



PG I Semester/ Integ. UG/PG VII Semester, Core- 1  
Course: Cell Biology  
Course Code: LBTC 701  
Course Credit: (3-0-0) 3

**Unit - 1**

Structural organization of Biomembrane, Overview of Membrane Transport, Active and passive transport. Facilitated transport of glucose and water, ATP powered pumps, Ion channels, Resting membrane potential, Symporters and antiporters.

**UNIT-2**

Intracellular protein transport, Protein targeting to and across the ER Membrane, Insertion of membrane proteins into the ER, Protein Modifications and folding in the ER. Protein targeting to cell organelles, Molecular Mechanisms of Vesicle mediated protein.

**Unit - 3**

Signalling molecules and cell surface receptor, second messenger, intracellular signal transduction pathway (DAG, Ca<sup>2+</sup>, c-AMP, G-Proteins), MAKK, Notch, TGF-beta, Jak-STAT signaling pathway.

**UNIT-4**

Eukarvotic cell cycle. model organism to study cell cycle. Regulation of cell cycle. Cell death and its regulation.

**Unit - 5**

Tumor Cells and the Onset of Cancer, Oncogenic Mutations in Growth-Promoting Proteins, Mutations Causing Loss of Growth-Inhibiting and Cell-Cycle Controls, Role of Carcinogens and DNA Repair in Cancer.



PG I Semester/ Integ. UG/PG VII Semester, Core- 2

Course: Microbiology  
Course Code: LBTC 702  
Course Credit: (3-0-0) 3

**Unit -1**

History and Scope of Microbiology, Major characteristics used in microbial taxonomy (numerical and molecular), Current methods of microbial identification (16s rRNA, Gene sequencing, House keeping genes).

**Unit -2**

Cultivation and enumeration of microbes from environment, Ultrastructure of bacteria, algae, protozoa and viruses, Ecology of micro-organisms

**Unit -3**

Nutritional requirements of micro-organisms, mode of nutrition, phototrophy, mixotrophy, saparophytic, symbiotic and parasitic organisms

**Unit -4**

Microbial growth and population kinetics, methodology for measuring growth and growth regulation. Physical and chemical control of microbes

**Unit -5**

Mechanism of gene transfer and genetic recombination in bacteria: transformation, transduction, conjugation

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessment will be taken into consideration.  
PG I Semester/ Integ. UG/PG VII Semester, Core- 3

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**SEMESTER -VIII**

PG II Semester/ Integ. UG/PG VIII Semester, Core- 1

Course: Molecular Biology

Course Code: LBTC 801

Course Credit: (3-0-0) 3

**Unit - 1**

DNA replication, Unit of replication, Enzymes involved in DNA replication, replication origin and replication fork, fidelity of replication, Mechanism of DNA replication. Inhibitors of DNA replication.

**Unit-2**

Transcription, formation of initiation complex, transcription activator and repressor, RNA polymerases, capping, elongation, and termination, RNA processing, RNA editing, splicing, and polyadenylation.

**Unit - 3**

Ribosome, Translation, formation of initiation complex, initiation factors and their regulation, elongation and elongation factors, termination, genetic code, Mechanism of translation, translational inhibitors, Post- translational modification of proteins.

**Unit-4**

Control of gene expression at transcription and translation level (regulating the expression of phages, viruses, prokaryotic and eukaryotic genes, Epigenetic regulation, Genomic Imprinting.

**Unit-5**

DNA damage, DNA repair, DNA damage and repair mechanisms, homologous and site-specific recombination,

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.  
Suggested Readings

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PG II Semester/ Integ. UG/PG VIII Semester, Core- 2

Course: Immunology  
Course Code: LBTC 802  
Course Credit: (3-0-0) 3

**Unit - 1**

Introduction and History of Immunology; Organization and structure of lymphoid organs; Cells and molecules of Immune system; Hematopoiesis; Innate and acquired immunity, Clonal nature of immune response, Phylogeny of Immune system.

**Unit - 2**

Nature and Biology of antigens and super antigens, Antigenicity and immunogenicity; Kinetics and antigen and antibody interaction; Antibody structure and function, Immunoglobulin gene and Generation of antibody diversity, antigen and antibody interactions-based assays, Hybridoma Technology and monoclonal antibody, Antibody engineering and SCFVs.

**Unit - 3**

Complement System-Activation and regulation; Structure and function of various cytokines and their receptors; Antigen presenting cells; Structure and functions of MHC and HL-A system; Antigen processing and presentation.

**Unit - 4**

T - cell receptor-CD3 complex; Development and differentiation of T cells; Positive and negative regulation; Development and differentiation of B cells; B Cell receptors; Cell mediated cytotoxicity: T cytotoxic cells, Natural Killer (NK) Cells, Antibody dependent cell Cytotoxicity (ADCC), Macrophage-mediated cytotoxicity. Immunological tolerance, Immunosenescence. Immunodeficiency.

**Unit - 5**

Autoimmunity, Hypersensitivity; Transplantation, Immunity to infectious agents, Tumor Immunology, Vaccination

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings**

1. Essentials of Immunology: Roitt IM
2. Immunology: Kuby
3. Advanced Immunology: Male D, Champion B, Cooke A, and Owen M.
4. Principle and practice of Immunoassay: Christopher P. Price and David J
5. Culture of Animal cell- Ian: Freshney

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PG II Semester/ Integ. UG/PG VIII Semester, Core- 3  
Course: Biotechniques  
Course Code: LBTC 803  
Course Credit: (3-0-0) 3

**Unit - 1**

Microscopy: Principles and applications, simple, compound, phase-contrast and fluorescence microscopes. Electron microscopy: SEM and TEM. X-Ray Crystallography, X-ray diffraction Bragg equation. Application in structural analysis of biomolecules, Centrifugation Technique: Principles, types of centrifuges, density gradient centrifugation in isolation of cells, organelles and biomolecules.

**Unit- 2**

Electromagnetic spectrum, Beer Lambert's Law, Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy, ESR and NMR spectroscopy, Mass spectroscopy (LC-MS, GC-MS, MALDI - TOF), Fluorescent spectroscopy, Applications of different Spectroscopic techniques in Biology.

**Unit- 3**

Introduction and types of chromatography, paper, thin layer, gas, Gel permeation, ion exchange, HPLC, FPLC and affinity chromatography and instrumental details of each. Applications of Chromatographic techniques in Biology.

**Unit- 4**

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, Immunoelectrophoresis, Principle and application of blotting (Southern Western and Northern and South Western blotting), ELISA.

**Unit- 5**

Nature and types of radiations, preparation of labeled biological samples, Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Safety measures in handling radioisotopes, RIA, Non radiolabeling, Role of ionizing and non ionizing radiation in Structural and functional analysis of biological sample.

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1hour	15
2	Internal Assessment II	1hour	15
3	End Semester	3 hour	30
4	Attendance/Assignment/Class performance	Entire semester	5

Note: The best one out of two Internal Assessments will be taken into consideration.

**Suggested Readings:**

1. Nuclear Magnetic Resonance: (2007) Williams
2. Biochemical Techniques theory and practice: (2009) White R
3. Analytical Chemistry: (2000) Christon G. D.
4. A Biologist Guide to Principle and Techniques: (2009) Wilson K, and Gounding K.H.
5. An Introduction to Practical Biochemistry: (2008) Plummer D. T.

PG II Semester/ Integ. UG/PG VIII Semester, Core- 4

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*Bachchan* 13.6.17  
*Arsh* 13.04.17

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Course: Enzymology and Enzyme Technology  
Course Code: LBTC 804  
Course Credit: (3-0-0) 3

**Unit - 1**

Introduction to enzymes, enzyme nomenclature, classification of enzymes and enzyme commission numbers. Concept of active centre, binding sites, stereospecificity and ES complex formation. Isolation and purification of enzymes, preparation of purification chart, Enzyme activity, Specific activity and turn over number, Marker enzymes.

**Unit - 2**

Enzyme Kinetics: Steady state, pre-steady state, equilibrium kinetics, Michaelis and Menten, Lineweaver-burk, Eadie-Hofstee equation and its derivation, Different methods to calculate the  $K_m$  and  $V_{max}$  and their significance.

**Unit - 3**

Factor affecting enzyme activity and catalysis: pH, substrate and enzyme concentration, temperature, coenzyme and cofactor etc, Mechanism of action of enzymes involving two/more substrates. Role of metal ions in enzyme catalysis. Enzyme inhibition, different types of inhibitors and activators.

**Unit - 4**

Structure and function of enzymes: Lysozyme, chymotrypsin, proteases. Enzyme regulation and control of their activity. Introduction to allosteric enzymes and isozymes.

**Unit - 5**

Enzyme Technology: Immobilization of enzymes, whole cell immobilization and their application, commercial production of enzymes, RNA-catalysis, abzymes, Protein and Enzyme engineering: Design and construction of novel enzymes. Enzymes used in drug synthesis, biosensors. Application of enzymes in medicine (therapeutic enzymes, enzymes as analytical reagents)



Integrated UG/PG VIII Sem, Lab -1

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Course: Laboratory -2(Based on Core -1 & Core -2)  
Course Code: LBTC 805  
Course Credit: (3-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	15
2	Internal Assessment II	3 hour	15
3	End Semester	6 hours	30
4	Attendance/Assignment/Class performance	1 hour	5

Note: The best one out of two Internal Assessments will be taken

Integrated UG/PG V Sem, Lab - 2  
Course: Laboratory -2(Based on Core -3 & Core-4)  
Course Code: LBTC 806  
Course Credit: (3-0-6) 3

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	15
2	Internal Assessment II	3 hour	15
3	End Semester	6 hours	30
4	Attendance/Assignment/Class performance	Each semester	5

Note: The best one out of two Internal Assessments will be taken





PG III Semester/ Integ. UG/PG IX Semester, Core-2

Course: **Microbial Biotechnology**

Course Code: **LBTC- 902**

Course Credit: **(3-0-0) 3**

**Unit-1**

Microbial biotechnology, scope and techniques, Bioprospecting of microbial diversity, Isolation and preservation of industrially important microorganisms.

**unit -2**

Genomics, Transcriptomics, Proteomics, Metabolomics, metagenomics and Systems Biology. Definition, methodology and application in Microbial technology. Functional enzymes.

**Unit-3**

Production of proteins and enzymes in bacteria, yeast and fungus, recombinant and synthetic vaccines. Microbial polysaccharides and polymers. Microbial resources for biopolymer production.

**Unit- 4**

Microbes as biocontrolagents microbial insecticides (Baculoviruses, entomopathogenic fungi, *Bacillus thuringiensis*, *Bacillus sphaericus*, *Bacillus popillae*, Microbe derived inhibitors. Entomopathogenic viruses (Baculovirus, Nuclear Polyhedrosis Virus)

**Unit-5**

Microbial biomass production, utilization of plant biomass by microorganisms (lignocellulose biodegradation). Application of lignolytic microorganisms and enzymes in biodegradation of recalcitrant xenobiotics

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PG III Semester/ Integ. UG/PG IX Semester, Core-3

Course: **Animal Biotechnology**

Course Code: **LBTC 903**

Course Credit: **(3-0-0) 3**

**Unit - 1**

Introduction to the balanced salt solutions and simple growth medium. Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Serum & protein free defined media and their applications.

**unit - 2**

Primary and secondary cell culture, Development of cell lines, Biology and characterization of the cultured cells. Basic techniques of mammalian cell cultures in vitro.

**Unit - 3 .**

Maintenance of cell culture, Cell Passaging, Measuring parameters of growth, Measurement of viability and cytotoxicity.

**Unit - 4**

Cell synchronization, Cell transformation, Apoptosis, Cryopreservation, Common cell culture contaminants.

**Unit - 5**

Applications of animal cell culture: cell culture based products, vaccines, Hybridoma technology and monoclonal antibodies, stem cells and their applications, Animal cloning, IVF technology, Organ, organotypic and histotypic cultures.

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

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PG III Semester/ Integ. UG/PG IX Semester, Elective

Course: a) Bioprocess Technology

Course Code: LBTC-904

Course Credit: (3-0-0) 3

Unit 1

Introduction to bioprocess engineering, bioreactors, isolation, preservation and maintenance of industrial microorganisms, kinetics of microbial growth and death, media formulation for industrial fermentation. Designing of a fermenter/Bioreactor, Air and media sterilization.

Unit 2

Types of fermentation process, analysis of batch fed batch and continuous bioreactions, stability of microbial reactors, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.), Measurement and control of bioprocess parameters

Unit - 3

Downstream processing, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization

Unit - 4

Industrial production of chemicals: solvents (acetone, butanol). Microbial production of Bioflavourant and Biocolourant antibiotics (penicillin, streptomycin, tetracycline) amino acids (lysine, glutamic acid)

Unit - 5

Food Biotechnology: Food spoilage and preservation process. Causative organisms and process. Physical and chemical preservation process. Dairy products, wine, beer and other alcoholic Beverages. Mushroom-types, isolation and culture

Evaluation Scheme:

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration.

Suggested Readings

1. General Microbiology: Sullia SB and Shantharam S
  2. Microbial Biotechnology: Glaser AN and Nilaido
  3. Industrial Microbiology: Prescott & Dunn
  4. A text of Industrial Microbiology: Crueger W and Crueger A
  5. Principles of Fermentation Technology: Stanbury PF, Ehitaker H, Hall SJ
  6. The Handbook of Microbial Bioresources by V.K. Gupta, G.D. Sharma
- PG III Semester/ Integ. UG/PG IX Semester, Elective

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Course: Genomics and Proteomics  
Course Code: LBTC 905  
Course Credit: (3-0-0) 3

**Unit-1**

Genomics: Omics and importance, Genome sequencing, Shotgun sequencing, Whole Genome sequencing, Human Genome project.

**Unit-2**

Transcriptomics: DNA Microarray for analysis of gene expression patterns. cDNA based and oligonucleotide based DNA microarray, Application in system biology and disease diagnosis. Single nucleotide polymorphisms, Predictive genomic medicine.

**Unit-3**

Proteomics: Proteome- General Account, Isoelectric focusing, Protein profiling by one Dimensional and 2 Dimensional gel electrophoresis, Detection and quantitation of proteins in gels, Pros and cons of various staining methods, Image analysis of 2D gels, Application of 2D PAGE.

**Unit-4**

Basics of mass spectrometry, Tandem MS/MS spectrometry, MALDI TOF and ESI, and their application in proteomics, Peptide sequencing by tandem mass spectrometry, Protein microarrays, Yeast two hybrid system, Clinical and biomedical application of proteomics

**Unit-5**

Metabolomics: Metabolomics: Definition, History, Tools, Databases and the Applications.

**Evaluation Scheme:**

S.No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

**Suggested Readings**

1. Genome 3: TA Brown,
2. Principles and Techniques of Biochemistry and Molecular Biology: Wilson and Walker
3. Proteomics: R Twyman
4. Metabolomics: M Tomita and T Nishioka

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*A. K. Singh*  
13-04-17





Course: c) Molecular Diagnostics  
Course Code: LBTC 906  
Course Credit: (3-0-0) 3

**Unit - 1**

Southern, northern, dot/slot blot; electrophoresis, nucleic acid probe preparation, DNA sequencing, interpretation, troubleshooting.  
DNA amplification techniques and applications including reverse transcriptase (RT)-PCR, in situ PCR, mutational analysis: PCR, sample preparation, experimental design, primers, controls, product detection

**Unit - 2**

Ligase chain reaction, nucleic acid sequence-based amplification, branched DNA detection, introduction to common approved kits and their applications, RT-PCR, relative RT-PCR, competitive RT-PCR; experimental design, controls, kits, and specialized applications, RACE, RNA fingerprinting

**Unit- 3**

Immunological Diagnostics: agglutination, RIA, ELISA's, immunofluorescence, Western blots – Bioluminescence

**Unit- 4**

PCR-based mutation detection: single-stranded conformational polymorphism analysis, heteroduplex analysis, denaturing gradient gel electrophoresis, chemical cleavage, ribonuclease cleavage; allele-specific and multiplex PCR; competitive oligonucleotide priming, protein truncation

**Unit- 5**

In situ nucleic acid hybridization and amplification: ISH, FISH, ISA. Applications and limitations; DNA chips, automation, gene therapy; applications in diagnosis of genetic disorders, human genome project, ethical considerations

**Evaluation Scheme:**

S.No	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

**Suggested Reading:**

1. Immunology: Kuby
2. Molecular Diagnostics: For the Clinical Laboratorian Hardcover: William B. Coleman, Gregory J. Tsongalis
3. Fundamentals of Molecular/Diagnostics: David E. Bruns, Edward R. Ashwood
4. Molecular Biotechnology: Pasternak
5. Textbook of Clinical Chemistry and Molecular Diagnostics: Carl A. Burtis, Edward R. Ashwood, David E. Bruns
6. Introduction to Molecular Diagnostics (DX-INSIGHTS)
7. Biophysical chemistry: Upadhyay & Nath
8. A Biologist Guide to Principle and Techniques: Wilson K and Gounding KE

*Q. Mittal*  
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*Prashant*  
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*A. K. Singh*  
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PG III Semester/ Integ. UG/PG IX Semester, Elective  
Course: d) Food Technology  
Course Code: LBTC 907  
Course Credit: (3-0-0) 3

**Unit - 1**

Introduction to Food Biotechnology, Application Biotechnology to food stuffs, Food Processing Biotechnology, Unit Operation in Food Processing Unit Operation, Quality factors of Food, food Deterioration and its control.

**Unit - 2**

Application of Molecular methods in food Production, Methods of molecular cloning in food, Techniques for development of new plant varieties, GMO as food.

**Unit - 3**

Microbial Biotechnology in Food Products, Role of microbes in food products, Microbial Food Spoilage; Use of microbes for production of food (Yeast; Bacteria and other microorganism-based process).

**Unit - 4**

Raw material for food and its modification, Bio conversion of food raw material, Conversion of food waste in value added products, (conversion of Whey, molasses, starch and etc.)

**Unit - 5**

Alternative food products- Mushrooms, Single cell protein, Aqua culture, Microbes as food product, etc.  
Social and Regulatory aspects of Food Biotechnology, Regulations for food industries

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

PG III Semester/ Integ. UG/PG IX Semester, Lab - 1  
Course: Laboratory -1(Based on Core -1 & Core -2)  
Course Code: LBTC 908  
Course Credit: (3-0-6) 3

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	30
2	Internal Assessment II	3 hour	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

PG III Semester/ Integ. UG/PG IXSem, Lab -2

*Dr. Anurag Mishra*  
*J. Patil*  
*13.04.17*



PG III Semester/ Integ. UG/PG IX Semester, Lab - 1  
Course: Laboratory -1(Based on Core -1 & Core -2)  
Course Code: LBTC 908  
Course Credit: (3-0-6) 3

Evaluation Scheme:

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	30
2	Internal Assessment II	3 hour	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

PG III Semester/ Integ. UG/PG IXSem, Lab -2

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Course: Laboratory -2(Based on Core -3 & Electives)  
Course Code: LBTC 909  
Course Credit: (3-0-6) 3

Evaluation Scheme:

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	3 hour	30
2	Internal Assessment II	3 hour	30
3	End Semester	6 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration





SEMESTER - X

PG IV Semester/ Integ. UG/PG X Semester, Core-1

Course: Bioinformatics & Statistics

Course Code: LBTC 1001

Course Credit: (3-0-0) 3

**Unit-1**

Introduction to Bioinformatics, Searching database and locating genes, Alignment of gene sequences, Local and Global, Analysis of DNA sequence, Finding and calculating core nucleotide sequence, Predicting ORFs, location of transcription start point and end point, getting polypeptide sequence of the extracted core nucleotide sequence, application of bioinformatics.

**Unit-2**

Designing primers of specific gene, generation of restriction maps, Generating phylogenetic trees based on DNA sequence and evolutionary relationship Analysis of proteins: Protein classification, homology modeling, trading, prediction of protein structure (secondary and .3 dimensional), tools for structure prediction, validation and visualization.

**Unit-3**

Computer assisted drug design- concept, methods and practical approaches, various computational methods applied to design the drugs: QSAR and 3DQSAR methods, CADD software demonstration

**Unit-4**

Diagrammatic, graphical and tabular representations of data; measures of central tendency, dispersion, skewness and kurtosis. Linear regression, Pearson correlation coefficient and Rank correlation

**Unit-5**

Basic concepts of hypothesis testing, two kinds of error, level significance, p value, t- Test for mean and difference between two means, partial t-test., and Chi square test for goodness of fit. Analysis of variance for one way and two way classified data

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class	Each	10

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Akshay  
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PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: Skill Development

PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: a) Plant metabolic Engineering  
Course Code: LBTC 1002  
Course Credit: (3-0-0) 3

**Unit-1**

The concept of secondary metabolites, Historical and current views, Importance of secondary metabolites in medicine and agriculture, Introduction to various pathways

**Unit-2**

Flavanoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

**Unit-3**

Terpenoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

**Unit-4**

Polyketoid pathway: The basic structure, Stereochemistry, Chemical synthesis of different intermediates, The biochemical pathway, Different regulatory points, Intermediate pools and their significance in horticulture, agriculture and medicine, Regulatory genes, Regulation of gene expression

**Unit-5**

Production of secondary metabolites from plant cell cultures; Processes for enhancing the production of secondary metabolites. Technology of plant cell culture for production of chemicals; Bioreactors systems and models for mass cultivation of plant cells, Plant Therapeutic proteins, Edible vaccine, Bioplastic.

Evaluation Scheme:

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B. Prasad  
13.4.17

A. K. Singh  
13.04.17

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PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: b) Gene Therapy & Nanomedicine  
Course Code: LBTC 1003  
Course Credit: (3-0-0) 3

**Unit -1**

Clinical management and Metabolic manipulation – Diabetes, Phenylketouria, Familial Hypercholesterolemia, Rickets, ADA, Congenital hypo-thyroidism

**Unit - 2**

Gene therapy – Molecular basis of disease and disease model, Ex-vivo, In-vivo, In-situ gene therapy, Strategies of gene therapy: gene augmentation, Vectors used in gene therapy - retrovirus, adenoviruses, Herpes, Synthetic vectors liposomes, receptor mediated gene transfer, Gene therapy trials, HLA typing, Graft rejection,

**Unit - 3**

Stem cell and tissue engineering: plastic surgery, Embryonic and adult stem cell, Potential use of stem cells - Cell based therapies

**Unit - 4**

Types of nanoparticles and their development, uses in Nanomedicine and therapeutically applications in medical biotechnology

**Unit - 5**

Health and Environmental impact of Nanotechnology: Special emphasis to risk assessment and risk management of nanomaterials, ethical and legal aspects of nanotechnology, and nano-industry and nano-entrepreneurship.

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

**Suggested Reading:**

*Q. Bhatt*  
13-4-17

*Pratibha*  
13-4-17

*A. S. S. S.*  
13-04-17

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PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: c) Industrial & Fermentation Technology  
Course Code: LBTC 1004  
Course Credit: (3-0-0) 3

**Unit-1**

History and scope of microbial biotechnology, the bioreactor/fermenter-types and parts, scale-up, media design for fermentation processes, Economic aspects of fermentation

**Unit-2**

Biotechnological application of microorganisms, Production of chemicals and pharmaceuticals (bioconversion), Production of microbial enzymes and their applications, Microbes in mining-Bioleaching, oil recovery, Application of microbes in pharmaceutical industry

**UNIT-3**

Role of microorganisms in the production and transformation of food and beverages, Food fermentation - Bread leavening by yeast and other micro-organisms, chemical leavening, brewing: Manufacture of Beer- microbiological aspects, Wine - Kinds of wines, manufacture, microbial spoilage, Distilled liquors, Vinegar -methods of manufacture

**Unit-4**

Fermented vegetables - Pickles - Fermented dairy products — Fermented milk, cheese, butter and other milk products - spoilage of milk - preservation of milk,

**Unit-5**

Biofertilizers- manufacture, formulation and utilization, Microbes as Biofertilizers -Chemically fixed Nitrogen versus biologically fixed Nitrogen, biopesticides.

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

**Suggested Readings**

1. Microbial Biotechnology: Alexandern, Glazer Hiroshi Nikaido
2. Molecular Biotechnology: Principles and Applications of Recombinant DNA: Bernaral R Glick and Jack J. Pasternak
3. Principles of Fermentation Technology: Whittaker & Stan bury.

*Q. S. Mitt*  
13.4.17

*Patil*  
13.4.17

*A. K. S. S.*  
13.04.17

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PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: d) Immunotechniques  
Course Code: LBTC 1005  
Course Credit: (3-0-0) 3

**Unit - 1**

Introduction to antigen and antibody interaction; Methods for generation of antibody; Monoclonal antibody and Hybridoma technology; Antibody engineering and ScFvs, Abzymes, Immunoprecipitation based methods; Agglutination based techniques; Immunological assays based on molecular binding on solid support (RIA, ELISA, ELISPOT, Western blotting) Methodological options and considerations. Methods for determination of Antigen antibody affinity. Equilibrium dialysis; SPR;

**Unit- 2**

Microscopic methods based on antigen antibody interactions: Immunocytochemistry, Immunohistochemistry, immunoelectronmicroscopy, Imaging techniques based on immunofluorescence: immunofluorescence microscopy; Confocal microscopy, Intravital imaging methods. Isolation and enrichment of specific immune cells, Flow-cytometer and FACS for quantitative/qualitative analysis and sorting of different immune cell subsets, Magnetic Activated Cell Sorting, Techniques for cell cycle analysis, Assays for apoptosis and cell death, Cell functional assays-lymphoproliferation, Cell-mediated cytotoxicity, mixed lymphocyte reaction, Detection of apoptosis

**Unit - 3**

Immune response and bacterial, parasitic and viral infections, Immunization, strategies: Vaccination; Recombinant DNA and protein based vaccines, Peptide vaccines, conjugate vaccines; Passive Immunization: Antibody, Transfusion of immuno-competent cells, Stem cell therapy, Cell based vaccines, edible vaccines; Immunoinformatics and vaccine design

**Unit - 4**

Manipulation of the immune response: Regulation of unwanted immune responses and immunomodulation against autoimmunity, transplantation rejections, cancer therapy, congenital and acquired immunodeficiency; tolerance and autoimmune diseases, Transplantation and Tumor Immunology, diagnosis and therapeutic approaches. Cytokine related diseases: diagnosis and therapeutic application of cytokines

**Unit- 5**

Adoptive cell transfer therapy; Animal models: Transgenic mice and gene knockout by targeted disruption, in vivo cell tracking techniques, Cell imaging techniques-in vitro and in vivo. Molecular diagnosis of immunological disorders: ex. DiGeorge syndrome, humoral immunodeficiency, cellular immunodeficiency (due to defects in IFN $\gamma$  receptor  $\alpha$  and  $\beta$  chain, MHC Class I)

Evaluation Scheme:

*Abhinit*  
13.4.17

*J. Prasad*  
13.4.17

*Abhinit*  
13.04.17





PG IV Semester/ Integ. UG/PG X Semester, Elective  
Course: e) Entrepreneurship Management in Biotechnology  
Course Code: LBTC1006  
Course Credit: (3-0-0) 3

**Unit - 1**

Concept of entrepreneur, nature of entrepreneur, entrepreneurial characteristics, function of an entrepreneur, role of entrepreneurship in developing economy

**Unit - 2**

Nature and characteristics of Management, Scope and Functional areas of management, Management V/s Administration, Roles of Management, Levels of Management, Basic managerial functions, management as profession.

**Unit - 3**

Business opportunity: Business opportunity identification process, project cycle and its management, project identification, project appraisal, project closure report.

**Unit - 4**

Structure of a Biotechnology Company, Start-up of Biotechnology Company, New Product Development, Market Research, Sales & Marketing Principles, Institutional support system for small scale sector, SIDO, NSIC, SIDBI, SIBRI, BCIL

**Unit - 5**

Intellectual Property Principles in Biotechnology, Health Care Overview and Role of Government in Biotechnology, Ethical and Other Legal Issues in Biotechnology, national and international policies on Biotechnology

**Evaluation Scheme:**

S. No.	Examination	Duration	% of Marks
1	Internal Assessment I	1 hour	30
2	Internal Assessment II	1 hour	30
3	End Semester	3 hours	60
4	Attendance/Assignment/Class performance	Each semester	10

Note: The best one out of two Internal Assessments will be taken into consideration

**Suggested Readings**

*Q. Shett*  
13.4.17

*P. S. Chandra*  
13.4.17

*A. K. Singh*  
13.04.17

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Paper-11: Analytical and Separation Techniques

**Unit - 1**

Introduction and types of chromatography, paper, thin layer, affinity and column chromatography chromatography, Gel permeation, ion-exchange, GLC, HPLC, FPLC and instrumental details of each. Applications of Chromatographic techniques in Biology and research application.

**Unit - 2**

Paper and gel electrophoresis, Polyacrylamide gel electrophoresis (native and SDS), Agarose gel electrophoresis, 2-D electrophoresis. Blotting- Southern, Western and Northern blotting, Immunoblotting, Immunoelectrophoresis, DNA finger printing and ELISA

**Unit - 3**

Electromagnetic spectrum, Beer Lambert's Law, Photometry, UV/VIS Spectrophotometry, Infrared spectroscopy, Atomic absorption spectroscopy ESR and NMR spectroscopy, Mass spectroscopy (LC-MS, GC-MS), Fluorescent spectroscopy Applications of different Spectroscopic techniques in Biology

**Unit - 4**

DNA Microarray, Protein Microarray, Microarray analysis, DNA chip, DNA Probes, FTIR, Flow cytometry.

**Unit - 5**

Detection and measurement of radioactivity, GM counter, Scintillation counter, Autoradiography, Safety measures in handling radioisotopes, RIA, non radiolabelling.

**Suggested Readings**

1. Nuclear Magnetic Resonance:(2007) Williams
2. Biochemical Techniques theory and practice: (2009) White R
3. Analytical Chemistry: (2000) Christian G. D.
4. A Biologist Guide to Principle and Techniques: (2009) Willson K. and Gounding K.H.
5. An Introduction to Practical Biochemistry:(2008) Plummer D. T.

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13-4-17

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13-04-17

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