



KARNATAK UNIVERSITY, DHARWAD
ACADEMIC (S&T) SECTION
ಕರ್ನಾಟಕ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಧಾರವಾಡ
ವಿದ್ಯಾಮಂಡಳ (ಎಸ್&ಟಿ) ವಿಭಾಗ



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NAAC Accredited
'A' Grade 2014

website: kud.ac.in

No. KU/Aca(S&T)/SVB-12/AD-HOC /Biotech. (UG) /20-21/ ೨೮೬

Date:

16 OCT 2020

NOTIFICATION

Sub: Regarding introduction of the syllabus of Bio-technology UG under C.B.C.S. w.e.f. the academic year 2020-21 & onwards.

- Ref: 1. UGC Letter DO No. 1-1/2016(SECY), dt. 10.08.2016.
2. Special BOS Res. No. 02, dt. 08.07.2020
3. Special Faculty Res. No. 02, dt. 11.08.2020.
3. Special Academic Council Res. No. 46, dt. 21.08.2020.
4. Vice-Chancellor's order dated - ೦೭-೧೦-೨೦೨೦

Adverting to the above, it is hereby notified to the Principals of all constituent and affiliated degree colleges coming under the jurisdiction of Karnatak University, Dharwad that the Bio-technology UG syllabus for I to VI Semester which is annexed herewith in Annexure-A is introduced under C.B.C.S. from the academic year 2020-21 & onwards.

Hence, the contents of this notification may please be brought to the notice of the students and all the concerned. The prescribed C.B.C.S. syllabus may also be obtained through K.U.website (www.kud.ac.in).

Hanumanthappa K.T.
(Dr. Hanumantappa K.T)
REGISTRAR

To,

1. The Chairman, BOS Bio-technology (UG), Dept. of Bio-technology, K.U.Dharwad.
2. The Chairman, Dept. of Bio-technology, K.U.Dharwad.
3. The Principals of all the constituted and affiliated degree colleges under the jurisdiction of Karnatak University, Dharwad. (The same may be sent through e-mail)
4. The Registrar (Evaluation), K.U.Dharwad.

Copy fives to:

1. Dr. Ch.Ramesh, Dean, Faculty of Science & Tech., Dept. of Botany, K.U.Dharwad.
2. The Director, IT Section, Examination Section, K.U.Dharwad for information and to upload on K.U.Website (www.kud.ac.in).

Copy to:

1. PS to Vice-Chancellor, K.U.Dharwad.
2. S.A. to Registrar, K.U.Dharwad.
3. O.S., Exam UG / Confl / QP / GAD Section, K.U.Dharwad.
4. The System Analyst, Computer Unit Exam Section, K.U.Dharwad.



KARNATAK UNIVERSITY, DHARWAD

Syllabus and Structure

For

B. Sc. BIOTECHNOLOGY

Under

CHOICE BASED CREDIT SYSTEM (CBCS)

w.e.f. 2020 - 2021 onwards

Karnatak University, Dharwad
CBCS syllabus for Under Graduate Programme in Biotechnology (opt.)
**DISCIPLINE SPECIFIC COURSE (DSC) and DISCIPLINE SPECIFIC
ELECTIVE (DSE)**
Effective from 2020-21

Sem ester	Theory/ Practical	Paper	Subject Code	Instruction hour per week	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
I	Theory	DSC	BT-1.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	BT-1.1	04 hrs	03 hrs	10	40	50	02
II	Theory	DSC	BT-2.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	BT-2.1	04 hrs	03 hrs	10	40	50	02
III	Theory	DSC	BT-3.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	BT-3.1	04 hrs	03 hrs	10	40	50	02
IV	Theory	DSC	BT-4.1	04 hrs	03 hrs	20	80	100	04
	Practical	DSC	BT-4.1	04 hrs	03 hrs	10	40	50	02
V	*Theory P-I /P- II	DSE	BT-5.1 and BT-5.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	BT-5.1 and BT-5.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
VI	*Theory P-I /P- II	DSE	BT-6.1 and BT-6.2	04 hrs / 04 hrs	03 hrs	20	80	100	04
	Practical	DSE	BT-6.1 and BT-6.2	04 hrs / 04 hrs	03 hrs	10	40	50	02
Total						180	720	900	36

*Candidate shall choose either paper –I or P-II but not both in DSE Papers.

SKILL ENHANCEMENT COURSE (SEC) for Biotechnology

Sem ester	Theory	Subject Code	Instruction hour per week	Total hours of Syllabus / Sem	Duration of Exam.	Internal Assessment Marks	Sem final Exam. Marks	Total Marks	Credits
V	Theory	(SEC-1.1)	02 hrs	30	1.5 hrs	10	40	50	02
V	Theory	(SEC-1.2)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.1)	02 hrs	30	1.5 hrs	10	40	50	02
VI	Theory	(SEC-2.2)	02 hrs	30	1.5 hrs	10	40	50	02
Total						40	160	200	08

B.Sc. Biotechnology
Proposed Semester-wise distribution of the course structure
Effective from 2020-21

Sl. No.	Code No.	Type of the Paper	Title of the Paper	Credit Pattern in L:T:P	Credit Value	Hours /Week L:T:P
Semester – I						
1	BT-1.1	DSC	Cell biology and Genetics	4:0:2	6	4:0:4
Semester – II						
1	BT-2.1	DSC	Biomolecules and Biochemical Techniques	4:0:2	6	4:0:4
Semester – III						
1	BT-3.1	DSC	Microbiology and immunology	4:0:2	6	4:0:4
Semester – IV						
1	BT-4.1	DSC	Molecular biology	4:0:2	6	4:0:4
Semester – V						
Any one of following						
1	BT-5.1	DSE 1.1	Agriculture & Plant Biotechnology	4:0:2	6	4:0:4
2	BT-5.2	DSE 1.2	Animal Biotechnology	4:0:2	6	4:0:4
Any one of following						
1	SEC-1.1	Discipline specialization	Biophysical And Biochemical Techniques	2:0:0	2	2:0:0
2	SEC-1.2	Discipline specialization	Molecular Biology Tools	2:0:0	2	2:0:0
Semester – VI						
Any one of following						
1	BT-6.1	DSE 1.1	Industrial and Environmental Biotechnology	4:0:2	6	4:0:4
2	BT-6.2	DSE 1.2	Medical Biotechnology	4:0:2	6	4:0:4
Any one of following						
1	SEC-2.1	Discipline specialization	Pharmaceutical Biotechnology	2:0:0	2	2:0:0
2	SEC-2.2	Discipline specialization	Genetic Engineering	2:0:0	2	2:0:0

- DISCIPLINE SPECIFIC COURSE- DSC
- DISCIPLINE SPECIFIC ELECTIVE-DSE
- SKILL ENHANCEMENT COURSE –SEC

- L=Lecture, T-Tutorial, P-Practical

SEMESTER I
CORE COURSE: BIOTECHNOLOGY
PAPER BT-1.1 CELL BIOLOGY AND GENETICS
(Credits: Theory-4, Practicals-2)
THEORY
TOTAL HOURS ALLOTTED -60

- 1. General Introduction of cell biology:** Historical perspectives, the Cell Theory, Ultra structure of plant and Animal cell. Different types of cells (plant and Animal). Bone, Muscle and nerve cell structures and functions in brief. **(7hrs)**
- 2. Ultra structure of cell organelles:** Cell wall, Plasma membrane, Mitochondria, Chloroplast, Ribosomes, Golgi complex, Endoplasmic reticulum. Nucleus, Lysosomes. Peroxisomes, Vacuole. Cytosol and Cytoskeletal structures. **(8hrs)**
- 3. Chromosomes:** Discovery Morphology and structural organization: number, size and types, Chromosomal morphology and classification, fine structure and models, heterochromatin and euchromatin, giant chromosomes (Salivary gland and Lampbrush) **(4 hrs)**
- 4. Cell Division & Motility:** Cell cycle, mitosis and meiosis, mitotic apparatus, centrioles, spindles, cell plate formation, cell synchrony and significance. Amoeboid, flagella and ciliary motility, Spermatogenesis and Oogenesis. **(7 hrs)**
- 5. Cell senescence and cell-Recognition & programmed cell death:** Special characteristics of vision cells (Rods and cone), Cell-Cell interaction, cancerous cells, cell-recognition and cell-rejection. **(4 hrs)**
- 6. General Introduction of Genetics:** History and scope of genetics, Mendel's Laws of heredity, Mono and di-hybrid crosses, Test-cross, Incomplete dominance and Simple problems. **(5 hrs)**
- 7. Interaction of Genes**
 - Supplementary factor: Comb pattern in fowls
 - Complementary genes: Flower colour in sweet peas.
 - Multiple factor: Skin colour in human beings.
 - Epistasis: Plumage colour in poultry
 - Multiple allelism: Blood groups in human beings **(6hrs)**
- 8. Sex Determination in Plants and Animals:** Concept of allosomes and autosomes, XX-XY, XX-XO, ZW-ZZ. ZO-ZZ types Environmental factors affecting sex determination. **Extra Chromosomal Inheritance**-Plastid inheritance in *Mirabilis*, Petite characters in yeast and Kappa particles in paramecium. **(6hrs)**
- 9. Linkage and crossing over:** Coupling and repulsion hypothesis, Linkage in maize and *Drosophila*, Mechanism of crossing over and its importance. Mutations-Spontaneous and induced, physical and chemical mutagens, Induced mutations in plants, animals and microbes for economic benefit. evolutionary significance **(8hrs)**

- 10. Chromosomal Variations:** Structural and numerical aberrations, Autosomal and allosomal disorders. Chromosomal evolution in wheat and drosophila (5hrs)

PRACTICAL- BT-1.2 CELL BIOLOGY AND GENETICS

1. Study of fixatives and stains: Preparation of formaldehyde (4-10%), Alcohol (70%), Bouin's fixatives, Carnoy's solution, Borox carmine (alcoholic), Eosin (alcoholic), Iron (Haemotoxylin). Leishman's Stain, Ringer's Solution, PAS stain, Acetocarmine, Aceto-orcein, Schiff's reagent (Feulgen), Giemsa's stain.
2. Squash preparation of onion root tips to study stages of mitosis.
3. Squash preparation of grasshopper testes and flower buds to study stages of meiosis.
4. Squash preparation to study salivary gland chromosomes (chironomous larvae)
5. Cell counting methods: Heamocytometer and other aids.
6. Micrometry
7. Buccal epithelial smear and Barr body.
8. Mitochondrial staining
9. Extraction of cellular materials in saline buffers, solvents and precipitation.
10. Demonstration of laws of inheritance by using colour beads
 - a. Laws of segregation
 - b. Laws of independent assortment.
 - c. Solve genetic problems
11. Study of different types cells using slides
12. Spotters based on theory paper

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4. J. Daniel H and Lodish D 1995, molecular Cell Biology. Baltimore Scientific American Book
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20. John Ringo 2004: Fundamental genetics. Cambridge University Press
21. Winter, P.C, Hickey, G.I and Fletchear, H. 1 (1999): Instant notes in Genetics Viva books private limited, New Delhi.
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SEMESTER II
CORE COURSE: BIOTECHNOLOGY
PAPER BT-2.1 BIOMOLECULES AND BIOCHEMICAL
TECHNIQUES
(Credits: Theory-4, Practicals-2)
THEORY
TOTAL HOURS ALLOTTED-60

1. **Introduction:** Structure and properties of water, pH, biological buffer system, Henderson Hassel Balch equation. Indicators and Isotopes **(4hrs)**
2. **Carbohydrates:** Classification, Physicochemical properties of important Monosaccharide's. Disaccharides and polysaccharides chemical reactions of carbohydrates. Derivatives of carbohydrates **(8hrs)**
3. **Proteins:** Classification. Structure. Properties of amino acids. Biological functions of proteins. Primary, secondary. Tertiary and quaternary structures. .Structural importance of Glycoprotein, Myoglobin, hemoglobin. **(8hrs)**
4. **Lipids:** Classification, Properties and Functions of fatty acids. Important Properties and Functions of Neutral, Glyco, Phospholipids, and Cholesterol. **(7hrs)**
5. **Enzymes:** Classification, Properties, purification of enzymes, factors influencing enzyme-catalyzed reactions, induced fit theory and Lock & Key enzyme mechanism, Industrial applications of enzymes. **(8hrs)**
6. **Vitamins:** Dietary sources and functions of water soluble and fat-soluble vitamins. **(4hrs)**
7. **Hormones:** Chemistry and functions of pituitary and gonadal hormones. **(5hrs)**
8. **Bioenergetics:** Concept of free energy transformations. Redox potentials. Regulation of Glycolysis, Krebs cycle and Electron Transport system. **(6hrs)**
9. **Analytical techniques (Principles & Applications):**
 - a) Microscopy- Compound, phase contrast and electron microscope SEM and TEM.
 - b) Colorimeter and UV- visible spectrophotometer
 - c) Centrifugation (Ultra and Density Gradient)
 - d) Electrophoresis (Agarose and SDS-PAGE)
 - e) Chromatography (Paper, TLC, HPLC). **(10 hrs)**

PRACTICAL BT 2.2–BIOMOLECULES AND BIOCHEMICAL TECHNIQUES

1. Preparation of solutions (percent, Molarity, Molality and Normality). Measurement of pH and Buffers.
2. Qualitative analysis of carbohydrate, amino acids, proteins, and lipids.
3. Paper chromatography of amino acids and sugars.
4. Qualitative analysis of body fluids such as blood and urine.
5. Assay of amylase activity. Effect of pH and temperature
6. Estimation of protein using colorimeter
7. Colorimetric estimation of blood sugar
8. Estimation of total and reducing sugar
9. Osmotic haemolysis in blood cells
10. Estimation of amino acids
11. Estimation of creatinine in urine sample.
12. Testing of acid phosphatase (potato) and alkaline phosphatase (milk) activity.
13. Demonstration of catalase activity.
14. Study of analytical instruments.

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SEMESTER III
CORE COURSE: BIOTECHNOLOGY
PAPER BT-3.1 MICROBIOLOGY AND IMMUNOLOGY
(Credits: Theory-4, Practicals-2)
THEORY
TOTAL HOURS ALLOTTED-60

1. **Introduction and Scope of Microbiology:** Historical perspectives. Importance and scope of microbiology as a modern science. Branches of microbiology. **(3hrs)**
2. **Microbial techniques: Sterilization-**Physical, chemical and radiation methods of sterilization. Principles and Applications. **Stains and staining techniques.** Principles of staining, Types of stains - Simple, Differential and Structural staining. Capsule, cell wall, flagella & endospore staining. **(6hrs)**
3. **Microbial taxonomy:** Concept of microbial species and strains, Taxonomical characteristics of microorganisms, Classification of bacteria based on –morphology, Molecular identification of microbe, numerical taxonomy, Bergey’s manual **(6 hrs)**
4. **Ultra structure of bacteria and virus:** Typical bacteria, cell wall structure, flagella structure, plasmid, tobacco mosaic virus(TMV), Bacteriophage- λ phage **(4hrs)**
5. **Culture of microorganisms:** Culture media, Types of culture media, Isolation of microorganisms by different methods, Preservation and maintenance of culture. **(4hrs)**
6. **Microbial growth:** Nutritional requirements of microorganisms. Bacterial growth curve. Factors affecting growth, Counting of Bacteria. **(4hrs)**
7. **Pathogenic microorganisms:** Bacterial diseases of man - Tetanus, Tuberculosis and Cholera, Viral diseases –HIV (AIDS), Ebola virus & Covid-19. **(3 hrs)**
8. **Introduction to Immunology:** History and Scope of Immunology, Types of Immunity- Innate, active, passive and acquired immunity. Humoral and cell - mediated immunity **(4 hrs)**
9. **Cells of the Immune system:** Agranulocytes- Lymphoid cells, B and T-lymphocytes, NK cells. Mono-nuclear cells -Phagocytosis, antimicrobial and cytotoxic activities. Antigen processing cells. Granulocytic cells-Neutrophils, Eosinophils, Basophils, Mast cells and Dendritic cells **(6hrs)**
10. **Organs of the Immune system:** Bone marrow. Thymus, lymph node and spleen. **(4hrs)**
11. **Antigens:** Types of antigens, Super antigens, haptens, epitopes, paratope, Role of Adjuvant in immunogenicity (Fraud’s Complete Adjuvant and Fraud’s Incomplete Adjuvant) Blood group antigens, **(3 hrs)**
12. **Antibodies (Immunoglobulin’s):** Structures, types, properties and functions of

immunoglobulins. **Antigen-Antibody reactions:** Mechanism of precipitation, Agglutination, Complement fixation, Mechanism of immuno-toxin reaction, Immuno-blotting, Immuno-Fluorescence. **(8hrs)**

13. **Hypersensitivity:** Types of hypersensitivity - IgE mediated (type - I). Antibody mediated cyto-toxic (type-II), Immuno complex mediated (type-III) and T-mediated (type-IV) hypersensitivity reactions. **(5hrs)**

PRACTICAL BT 3.2 – MICROBIOLOGY AND IMMUNOLOGY

1. Safety measures in microbiology laboratory
2. Cleaning and sterilization of glass wares
3. Study of instruments: Compound microscope, Autoclave, Hot air oven, pH meter, Laminar airflow, centrifuge, colony counter etc
4. Media preparation : Nutrients agar, Nutrient broth and potato dextrose agar
5. Inoculation technique: Stab, point, Streak, pour plate and spread plate
6. Isolation of bacteria and fungi from soil, air, and water – dilution and pour plate methods and study of colony characters
7. Bacterial staining techniques -simple and differential (Gram's)
8. Counting of micro-organisms – Total count (Haemocytometer)
9. Biochemical tests – Starch hydrolysis, catalase, Gelatin liquification
10. Preparation of bacterial and fungal antigens
11. Total RBC and WBC count
12. Estimation of haemoglobin in blood
13. Demonstration of ELISA and RIA
14. Study of Rocket electrophoresis

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2. Aneja K R 2017: Experimental in Microbiology Plant Pathology and Biotechnology. 5th Edition, New age International. New Delhi
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SEMESTER IV
CORE COURSE: BIOTECHNOLOGY
PAPER BT-4.1 MOLECULAR BIOLOGY
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted 60

1. **Molecular basis of life:** An Introduction, Experimental proof of DNA and RNA as Genetic material and central dogma of molecular biology **(3 hrs)**
2. **Nucleic acids:** History of nucleic acids, Structural elucidation, Structure and types of DNA (Watson & Crick model) and RNA (mRNA, rRNA & tRNA) and their functions. **(5 hrs)**
3. **DNA replication:** Prokaryotic and Eukaryotic - Enzymes and proteins involved in replication. Theta model and Rolling circle model, Origin of replication (*ori*). **(6hrs)**
4. **Transcription:** Process of transcription, transcription factors, post transcription modification. Reverses transcription.

- (7 hrs)**
5. **Translation:** Initiation, elongation and termination of protein synthesis, translational factors. Role of promoter and operator, Aminoacyl tRNA synthase. **(7 hrs)**
 6. **DNA damage and repair:** Causes and mechanisms - Photo reactivation. Excision repair. Mismatch repair and SOS repair. **(6hrs)**
 7. **Recombination in prokaryotes:** Transformation, Conjugation and Transduction. **(4 hrs)**
 8. **Structure of prokaryotic and Eukaryotic gene:** Discovery of genetic codon, Genetic code, properties and deciphering codon. Capping and poly A addition of mRNA in Eukaryotes, Gene organization and expression in mitochondria and chloroplasts. **(8hrs)**
 9. **Regulation of gene expression:** Regulation of gene, expression in Prokaryotes - Operon concept (Lac Operon). Regulation of gene expression in Eukaryotes - Transcriptional activation, galactose metabolism in yeast. **(9hrs)**
 10. **Jumping Genes:** Insertional elements and transposons elements in Maize and Drosophila **(5 hrs)**

PRACTICAL 4.2 - MOLECULAR BIOLOGY

1. Preparation of DNA model.
2. Estimation of RNA by Orcinol method.
3. Estimation of DNA by DPA method and
4. Determination of melting temperature (T_m) of DNA/oligos by UV spectrophotometer
5. Demonstration of detergent lysis and osmotic lysis of RBC/Cells.
6. Extraction and estimation of protein from animal goat liver / muscle source by salt precipitation and organic solvent method.
7. Extraction and estimation of protein from plant source (Green gram/pea) by salt precipitation and organic solvent method.
8. Separation of DNA by Agarose gel electrophoresis
9. Protein separation by polyacrylamide gel electrophoresis.
10. Demonstration of conjugation, transformation and transduction by charts.

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16. Watson J.D. Hopkins, N.H. Roberts J.W. Steitz. J.A and weiner A.M 1987: Molecular Biology of Gene 4th Edn Benzamin Publ. Co. New York

SEMESTER V
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER BT 5.1-DSE 1.1: AGRICULTURE & PLANT BIOTECHNOLOGY
(Credits: Theory-4, Practicals-2)
Theory
Total hours allotted 60

1. History of Human habitat as Agriculture and development of plant biotechnology. (2 hrs)
2. *In vitro* culture methods and laboratory facilities and its management, aseptic condition maintenance in Laboratory. (3hrs)
3. **Growth medium composition:** Use of growth regulators and their effect on cell growth, differentiations and organogenesis. Study of M.S., B₅ and Nitsch media. (4 hrs)
4. **Tissue culture:** Callus, Cell suspension and embryo culture. Regeneration of shoots and roots, ovary and endosperm culture. Plant tissue culture applications in agriculture, horticulture and cryopreservation (5 hrs)
5. **Micro propagation:** Clonal propagation of elite species, auxiliary bud. Shoot tip and meristem culture. Applications of micro propagation. (3 hrs)
6. *In vitro* haploids and their applications. (3 hrs)
7. Single cell suspension cultures and their applications, Agronomic importance and secondary metabolites. (4 hrs)
8. **Protoplast culture and fusion:** Principles, isolation, culture protocol, action of enzymes, protoplast fusion, somatic cell hybridization and its applications. Regeneration of plants. (4hrs)
9. Somaclonal variation and their significance. (2hrs)
10. **Crop improvement:** hybridization and plant breeding techniques, by applications of medialian genetics, polypoid and molecular breeding techniques (6hrs)
11. Study of biopesticides used in agriculture (Neem as example). Integrated pest management. (3hrs)
12. Mechanism of biological nitrogen fixation process, study of nitrogen fixing nods and nif genes and Hup genes in nitrogen fixation process. (5 hrs)

13. **Biofertilizers:** Mechanism of growth promotion by microbial inoculants- *Rhizobium*, *Bradyrhizobium*, *Azospirillum*, *Azotobacter* and *Mycorrhizae*. *Trichoderma sps*, *Pseudomonas sps*, *Bacillus sps*
(6 hrs)
14. Use of plant growth regulators and plant Hormones in Agriculture and Horticulture.
(4 hrs)
15. **Transgenic plants:** Techniques and application (BT cotton), development of Transgenic plants by Ti plasmids
(4 hrs)
16. Vermi-compost and its production methods
(2hrs)

PRACTICALS:

AGRICULTURE & PLANT BIOTECHNOLOGY

1. Preparation of plant tissue culture media.
 - a) MS.
 - b) B₅
 - c) LS
2. Callus induction using plant explants (Carrot, Nicotine, and Sugarcane).
3. Seed Culture.
4. Demonstration of organ cultures, micro propagation. Organogenesis and anther culture and meristem culture.
5. Protoplast isolation from mesophyll cells.
6. Suspension cultures: Initiation of suspension culture from callus.
7. Preparation of synthetic seeds.
8. Isolation of soil microorganisms - *Rhizobium*, *Azotobacter* and *Mycorrhizae*.
9. Estimation of soil alkalinity and soil organic matter
10. Effect of bio-pesticides on the growth of microorganisms.
11. Isolation of rhizobium from root nodules.
12. Study of R: S ratio (Rhizosphere: Nonrhizosphere samples).
13. Culturing microorganisms from vermi compost.
14. Seed inoculation with rhizobium culture and observation for root nodulation.
15. Photographic demonstration of transgenic crop plants / animals and agricultural biotechnology innovations.
16. Preparation of Biocontrol formulations.
17. Biofertilizers formulations.

REFERENCES:

AGRICULTURE & PLANT BIOTECHNOLOGY

1. Chatwal. G.R. 1995: Text Book of Biotechnology. Anmol Publ. Pvt. Ltd.
2. Chrispeel M.J. and Sdava D.E. 1994. Plants, Genes and Agriculture. Jones and Barlett Publishers Boston.
3. Crueger. W. and Crueger. A.: Biotechnology - A text book of Industrial Microbiology, 2nd Ed.
4. Gamborg and Phillips 1996: Plant Cell. Tissue and Organ Culture: Fundamental methods. Narosa Publ.
5. Gupta. P.K. 1996: Elements of Biotechnology, Rastogi and Company.
6. Ignacimuthu, S. 1996: Applied Plant Biotechnology.
7. Natesh, S. Chopra, V.L. and Ramachandran. S. 1994 "Biotechnology in Agriculture" Oxford and IBM Publ. Co. Pvt. Ltd. New Delhi.
8. Prakash. M. and Arora. C.K. 1998: Cell and Tissue Culture. New Delhi. Anmol Publication.
9. Razdan. M.K. 1993: An introduction to Plant Biotechnology.
10. Singh, B.D. 2000: Biotechnology, Kalyani Publishers. Ludhiana.
11. Bhan 1998. "Tissue culture", Mittal publication. New Delhi.
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14. Gamborg and Phillips .1996 Plant Cell, Tissue and Organ Culture: Fundamental methods.Narosa Publ,
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17. Ignacimuthu, S. 1996: Applied Plant Biotechnology.
18. Lyeliane Kyte and Jhon Kleyn, 1996. Plants from test tubes - An Introduction to Micro propagation III edition, Timber press Portland.
19. Narayanaswamy, S. 1994: Plant Cell and tissue Culture. New Delhi. Tata McGraw Hill Publishing Company.
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21. Razdan. M.K. 1993: An introduction to Plant Biotechnology.
22. Shrivastava P.S. "Plant Tissue culture and molecular Biology; applications and prospects, Narosa publishing house, New Delhi.

SEMESTER V
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER BT 5.2-DSE 1.2: ANIMAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-2)
Theory
Total hours allotted 60

1. Historical perspectives, development and scope. (2 hrs)
2. **Basic techniques of animal cell culture:** Preparation and sterilization of glassware's and apparatus, preparation and sterilization of reagents and media, preparation of animal material and applications. (4 hrs)
3. **Animal tissue culture media:** Culture media containing naturally occurring ingredients. Blood plasma, blood serum, serum free media, tissue extracts, complex natural media, chemically defined media and methods to adapt for serum free media. (5 hrs)
4. Growth factors –promoting proliferation of animal cells. EGF, FGF, GSF, PDGF, IL-1, IL-2, NGF and erythropoietin. (3 hrs)
5. **Primary culture, cell lines and cloning:** Primary and established cell lines, somatic cell fusion, tissue cultures, whole embryo culture example chick embryo. Common laboratory cell line, like Hela cell line, COS cell lines, etc., MTT assay (Vero, HepG2, MCF-7) Commercial important Cell line its development, Cell line like-CHO cell line, etc., Maintains of recombinant cell line with therapeutic important genes and importance of marker genes. (10hrs)
6. **Tissue engineering:** Cell source and culture, cell orientation and support materials, design and engineering of tissues and modelling, 2D cell culture and 3D cell culture in hydrogel (4 hrs)
7. *In vitro* fertilization, embryo transfer techniques and their applications, nuclear transfer techniques. (3 hrs)
8. **Transgenic animals:** Techniques and applications (Transgenic mice specifically knockout mice i.e. single knockout and double knockout mice as animal model for drug discovery), Production of therapeutic protein in sheep milk. (6 hrs)
9. **Application of genetics in animal breeding:** Breeding selected traits into livestock- Breeding with markers of genetic diseases. Inbreeding and Introgression. Parentage determination, Velogenesis. (mice, Rabbits, dogs, sheep, chickens and cows), Molecular Breeding makers, etc., (5 hrs)
10. **Apiculture:** Rearing and management of Honey bees and production of Honey and

Honey bees as pollination agents in agriculture

(3hrs)

11. Sericulture: Rearing and management of Silkworms and production of silk

(3hrs)

12. Dairy Industry: Rearing of cows and buffalos, cryopreservation of semen and production of milk, common vaccines for cows and buffalos,

(3hrs)

13. Poultry: Rearing of Broilers, and Layers chickens, Management of Health condition of chickens, Feeding of chickens, Meat processing and cryopreservation, etc.,

(4 hrs)

14. Biotechnology and intellectual property rights (IPR). Patents, Trade mark, trade secrets, copy right and choice of IPR. Importance Biodiversity Act in India, Germplasm origin, country or germplasm its GI tags. Etc., Patent Laws, etc.,

(5 hrs)

PRACTICALS:

ANIMAL BIOTECHNOLOGY

1. Cell viability test using Tryphan blue exclusion method.
2. Preparation of balanced salt solutions: (Hank and Earl).
3. Extraction of serum (Chicken / mammalian).
4. Chick embryo extracts (10-11 days embryos).
5. Culture of animal cells (Chick embryo cells) by following techniques.
6. Plasma clot.
7. Single slide method / hanging drop technique.
8. Range method
9. Grid method.
10. Isolation of DNA from animal tissues and quantification
11. Study of animal cells blood cells and tissue sections

REFERENCES:

ANIMAL BIOTECHNOLOGY

1. Cartwnzht, T. 1994: Animal Cells as Bioreactors, Cambridge University Press, New York.
2. Freshney, R.L. 1987: Culture of animal cells: A manual of basic techniques.
3. Ian, R. Freshney: Wiley-Liss (3rd edn.) Culture of Animal Cells.
4. John. R. W.: Animal Cell culture - Practical approach Marters, Oxford.
5. Puhler. A. 1993: Genetic Engineering of Animals. VCH Publishers, Weinheim FRG.
6. Ravi Shankar, G.A. and Venkataram, L.V. 1997: Recent Advances in Biotechnology. Application of Plant Tissue and Cell Culture. New Delhi, Oxford and IBH Publishing Company.
7. Sateesh M.K. 2003. Biotechnology-5. New age international publishers.
8. Spier, R.E. and Griffith, T.B. 1987: Modern approaches to Animal Cell Technology, Somerset, Butterworth and Company Ltd.
9. Singh, A. (2020). Animal Biotechnology: Models in Discovery and Translation. Netherlands: Elsevier Science.
10. Singh, R. K. (2018). Animal Biotechnology. India: CBS Publishers PVT Limited India.

SEMESTER V
SKILL ENHANCEMENT COURSE
PAPER BT-SEC 1.1:BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES
(Credits: Theory-2)

Theory

Total hours allotted 30

1. **Chromatography techniques:** Basic Concepts of adsorption & partition Chromatography, Paper and TLC chromatography and optimization of solvent systems. HPLC, UPLC, different columns Principle HPTLC column (gel filtration, ion exchange, affinity), Gas Chromatography (GC, GLC), LCMS, detectors in chromatographic Instrument (UV-detector, RI detector, MS)

(8 hrs)
2. **Spectroscopic techniques:** Spectroscopy, Beer-Lambert's law, types of detectors, UV-Visible spectroscopy, Infrared spectroscopy, Raman spectroscopy, Fluorescent spectroscopy, Flame photometry, Biological importance of Lasers, and Microwaves.

(5 hrs)
3. **Membrane Techniques:** filtration and various types of membrane and its application in separation of molecules, techniques Criteria of protein purity, equilibrium dialysis, ultra.

(4 hrs)
4. **Centrifugation:** Basic principles of centrifugation, Forces involved, RCF Centrifugation, techniques- principles, types and applications. Centrifuges & Ultra-centrifuges types, optical methods used and applications of preparative (Differential, Density Gradient) and analytical (sedimentation velocity, sedimentation equilibrium) ultra-centrifugation.

(5 hrs)
5. **Radio Activity:** Radioactivity, types of rays (alpha, beta and gama rays) its detection methods, and application in biology (P₃₂, N₁₅ Labelling methods), safety method in handling Radioactive compounds.

(4hrs)
6. **Electrophoresis:** Paper Electrophoresis, Horizontal Electrophoresis and vertical Electrophoresis with examples (Agarose and SDS-PAGE)

(4hrs)

REFERENCES:

BIOPHYSICAL AND BIOCHEMICAL TECHNIQUES

1. Donald Voet, Judith G Voet, Charlotte W Pratt (2016) Fundamentals of Biochemistry: Life at the Molecular Level, 5th edition, John Wiley and sons.
2. Strayer. L. (2002) Biochemistry, 5th edn. W. H Freeman and company New York.
3. Boyer, R (2002) Concepts in Biochemistry. 2nd edn – Brooks / Cole, Australia.
4. Montgonary, R. M, Conway, T.W- and Spectator, A.A, (1996) Biochemistry- A Case – Oriented Approach 6th edn, Mosby Inc, Missouri.
5. Rao, CNR, (1999) Understanding chemistry, University press Hyderabad.
6. Nelson, D.L., and Cox, M.M. (2014) Biochemistry Mac Milan worth Publishers. Hampshire.
7. Zubey, G.L, Pason, W.W, and Vance, D.E. (2000) Principles of Biochemistry WMC. Brown Publishers, Oxford.
8. Devlin, T. M. (2010) Text book of Biochemistry with Clinical correlations, 7th Edition, Wiley and sons, Inc New York.

SEMESTER V
SKILL ENHANCEMENT COURSE
PAPER BT-SEC 1.2: MOLECULAR BIOLOGY TOOLS
(Credits: Theory-2)

Theory

Total hours allotted 30

1. Basic biochemical principle for the Isolation and purification of DNA, RNA and protein from different cells (Bacteria, fungi, plant and animal cells).

(2 hrs)
2. **Electrophoresis:** Principle, Electrophoretic mobility (EPM) estimation, factors affecting EPM, Instrument design & set-up, Methodology & Applications (Agarose & Starch gel, Pulsed-field, PAGE, SDS-PAGE, Capillary) Electrophoresis techniques, Principle, Experimental set-up, Methodology & Applications isoelectric focusing, 2D electrophoresis

(5 hrs)
3. **Plasmid:** Cloning vectors like pBR322, pUC18 & 19, and commercial expression vector like, pET series, pGEX vectors structure.

(3 hrs)
4. Southern blot, Northern blot, and Western blot techniques, for the detection of nucleic acids and proteins in gels. Probes (Radioactive labelled probe, Fluorescent probes)

(4 hrs)
5. **Nucleic acid Amplification:** Classical molecular biology tool is cloning for DNA amplification, In 1985 Muller discovery PCR for DNA amplification

(3 hrs)
6. Expression of Recombinant Protein and Purification: Design of Expression vector, basic element like promoter, Operator, Termination sequence, and selection marker (Antibiotic Resistance gene in *E. coli*)

(5 hrs)
7. **Enzymes:** *E. coli* DNA polymerase I, Klenow fragment, Taq DNA polymerase, T4 DNA ligase, T4 polynucleotidekinase, Recombinase, DNA Helicases, Alkaline phosphatase, SSB proteins etc.,

(3 hrs)
8. **Molecular Diagnostic:** Basic principles of Polymerase Chain Reaction (PCR) its DNA specificity in the detection of specific sequence and its application in detection of pathogens (Virus, Bacteria, protozoan s), Real time PCR, role of SYBR green and other molecular probes like TaqMan probes, etc

(5hrs)

REFERENCES:

MOLECULAR BIOLOGY TOOLS

1. Lodish, H., Ber, A., Zipursky, L.S., Matsudaira, P., Baltimore, D and Darnell J. 2001, Molecular Biology W. H. Freeman
2. De Robertis. E.D.P. and De Robertis E.M.S. 1998: Cell and Molecular Biology, Lea and Jeliger. Philadelphia K.M Varghese Company
3. Freifelder, D. and Malacinski, G.M. 2015: Essentials of molecular biology, 4th Edition Jones and Bartlett Publishers, Inc

4. George, M. and Malacinski 1998: Essentials of molecular biology, Jones and Barklett Publishers, Inc
5. Glick, B.R and Pasternak j. j 2017: Molecular Biotechnology, principle and applications of recombinant DNA. 5th edition American society for Microbiology, Washington DC
6. Griffiths, A.J.F. Miller, J.H. Suzuki, D.T. Lewontic, R.C. Gilbert W.M 2000. An introduction to genetic analysis. 7th edn W.H. Freeman. New York
7. Howe. C.2012. Gene cloning and manipulation, 2nd Edition, Cambridge University Press. USA
8. Karp, G 2015: Cell and Molecular Biology Concept and Experiments. 8th edition, John Wiley and Sons Inc. New York
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10. Smith 1998: Molecular Biology. Faber and Faber publication
11. David Leader RLP Adams, John Knowler (2020) The Biochemistry of the nucleic acids. 11th edn Chapman and Hall

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER BT 6.1-DSE 1.1:INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-2)
Theory
Total hours allotted 60

PART A: INDUSTRIAL BIOTECHNOLOGY **Total hours allotted: 30**

1. Introduction to Industrial biotechnology, Basic principles of fermentation technology. **(2 hrs)**
2. Screening and isolation of industrially important microorganisms for the production of enzymes and other secondary metabolites from microbes. **(3 hrs)**
3. **Fermentation media:** Natural and synthetic media. Sterilization techniques – dry heat and steam, Radiation, Filtration methods. **(4 hrs)**
4. **Fermenters:** Process of Aeration, Agitation, Temperature regulation and foam control. Types of Fermenters - Typical, Airlift. Bubble-up fermenter. Batch Fermenter, continuous Fermenter. **(4 hrs)**
5. **Process Development:** Shake flask fermentation. Downstream processing (DSP). Disintegration of cells. Separation. Extraction. Concentration and purification of products. **(4 hrs)**
6. **Production of microbial products:** Lactic acid. Alcohol, citric acid, Penicillin and amylase **(4 hrs)**
7. **Fermented Foods:** Yoghurt, Buttermilk. Dosa. Cheese. Tempeh. Microbial Foods - Single cell protection (SCP),Single cell oils (SCO). Mass culture of algae (Spirulina). **(5hrs)**
8. Plant cell suspension culture for the production of food additives: Saffron and Capsaicin and shikonin.

- (2 hrs)
9. Microbial polysaccharides and polyesters; production of xanthan gum and polyhydroxy alkananoates (PHA).

(2 hrs)

PART B: ENVIRONMENTAL BIOTECHNOLOGY

Total hours allotted: 30

1. Study of Air, water and Soil pollution. (3hrs)
2. Renewable and non-renewable resources of energy. (2hrs)
3. Impact of conventional and non-conventional fuels on environment (2hrs)
4. Biodegradation (xenobiotic compounds - aliphatic, aromatic and petroleum products) and Bioremediation. (5hrs)
5. Solid waste management - Biogas production and its advantage. (3 hrs)
6. Microbial ore leaching and recovery - Biomining. (3 hrs)
7. Treatment of municipal waste and industrial effluents. Design of Effluent treatment plant (ETP) and water Quality-checking methods like, TDS, BOD and COD. Microbial load of coliform bacteria in water. (5hrs)
8. Study of Vermi composting. (2hrs)
9. Environmental protection Act and related issues (2 hrs)
10. Concept of global warming, ozone depletion (Greenhouse effect, acid rain and eco-farming) (3 hrs)

PRACTICALS:

INDUSTRIAL AND ENVIRONMENTAL BIOTECHNOLOGY

1. Isolation and identification of industrially important microorganisms;
2. Algal and Fungal culture - Spirulina, Agaricus, Yeast and Aspergillus.
3. Study of sugar fermentation by microorganisms by acid and gas production.
4. Preparation of wine from; Grape. Banana / sweet potato.
5. Study of Bio gas plant.
6. Production of Biofertilizers. Vermi composting
7. Estimation of lactic acid.
8. Estimation of Lactose.
9. Bacteriological examination of water by MPN method.
10. Analysis of water samples for BOD. O₂, toxic chemicals and microbial flora.
11. Standard analysis of water samples.
12. Estimation of solids in sewage.
13. Demonstration of sewage treatment plants.
14. Visit to research centers / institutions / Industries.

Note:

A report on the visit should be written and submitted along with Practical record.

REFERENCES:

INDUSTRIAL BIOTECHNOLOGY

1. Casida, LE. 1968: Industrial Microbiology, Wiley Eastern Ltd., New Delhi.
2. Dubey, A.R.C. 1995: A Text book of Biotechnology.
3. Glazer A.N and Nikaido, H- 1995: "Microbial Biotechnology W.H. Freeman and Co.

4. Harrison, Maureen, A., Ral, Ian, F. 1997: General Techniques of cell culture, Cambridge University Press.
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12. Singh. B.D. 2000: Biotechnology. Kalyani publishers. Ludhiana
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14. Stanbury P.F., Whitaker H. T. Hall S.J. 1997: "Principle of Fermentation Technology" Aditya book limited.
15. Sullia S.B. and Shantharam S. 1998: "General microbiology" Oxford and IBM publishing Co. Pvt.
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ENVIRONMENTAL BIOTECHNOLOGY:

1. Agrawal, K.C. 1996: Biodiversity, Agro-botanical publishers. New Delhi.
2. Alexander N.Glazer Hiroshi Nikaido, 1995 "Microbial biotechnology, Free man and company.
3. Allsopp D. and Seal. K.J.: Introduction to Biodeterioration, EL 85/Edward Arnold.
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5. Chatterji A.K. 2002, "Introduction to Environmental Biotechnology", Prentice Hall of India, New Delhi.
6. Christon, J., Harst 1997: Manual of Environmental Microbiology, ASM Press, Washington, DC.
7. D.P.Singh, and S.K. Dwivedi, "Environmental Microbiology and Biotechnology, New age International publishers.
8. Dicastri. F. and Younes, T. 1996: Biodiversity Science and development CAB international, Walfingfords U.K.
9. Lehniger, T. et. al.: Microbiology Degradation of Xenobiotics and Recalcitrant Compounds, Academic Press. New York.
10. Gothandam, K. M., Ranjan, S., Lichtfouse, E. (2020). Environmental Biotechnology. Germany: Springer International Publishing.
11. Hiremath, M. B., Baligar, P. (2011). Environmental Biotechnology. India: Preteeksha Publications.
12. Metcalt and Eaddy Inc. Waste Water Engineering - Treatment Disposal and Reuse. Tata McGraw Hill. Delhi.
13. Mitchell. R.: Water Pollution Microbiology Vol. I and II Wiley inter science. New York.

SEMESTER VI
DISCIPLINE SPECIFIC ELECTIVE-DSE
PAPER BT 6.2-DSE 1.2: MEDICAL BIOTECHNOLOGY
(Credits: Theory-4, Practicals-2)

Theory

Total hours allotted 60

1. Introduction and scope of biotechnology in medical science. **(4hrs)**
2. **Antibiotics and chemotherapy:** Antimicrobial agents, classification of Antibiotics- Penicillin, Cephalosporin's, chloroamphenicol, Tetracycline's, Erythromycin, Broad spectrum antibiotics, antibiotics mode of action, Antifungal agents. **(6 hrs)**
3. **Vaccines:** Production of Bacterial and viral vaccines, recombinant vaccines and its production (FMDV) DNA/RNA vaccines. A brief study of BCG vaccine. **(6 hrs)**
4. **Enzymes in diagnosis:** Assay of enzymes in serum (Amylase, SGOP, SGPT, etc.) Immobilized enzymes uses in medical diagnostics (Examples: Glucose oxidase in Glucometer, HRP and ALP in ELISA) **(5 hrs)**
5. **Enzymes in Therapy:** Important enzymes and their therapeutic applications. Eg- Adenosine deaminase, streptokinase, tissue plasminogen activator, etc., **(4 hrs)**
6. **Therapeutic proteins:** Important proteins and their applications in therapy–insulin Human Serum Albumin (HSA), Human Growth Hormone (hGH), Somatostatin, Cytokines. Interleukin, Interferon, Human factor-VIII and IX. Monoclonal antibodies in therapy. **(8 hrs)**
7. **Hybridoma Technology:** Production of monoclonal antibodies and their applications in diagnosis and therapy **(3hrs)**
8. **Human gene therapy:** Somatic and germ line therapy, *in vivo* and *in vitro* gene therapy with an example each, scope of human gene therapy. **(3 hrs)**
9. **Robust recombinant protein Factories:** cloning and expression of Insulin (*E. coli*), HAS (*Pichia sps*) etc., production of recombinant protein for crystallography for understanding structure and Biochemical function of proteins **(7 hrs)**
10. **Emerging Technologies:** Stem Cell Therapy, Antisense Technology and its Principles and applications. **(4 hrs)**
11. Biofarming: Production of biopharmaceuticals in animal cells, culturing of recombinant CHO cell line for the production of TNFR, erythropoietin, etc., A baculovirus expression vector (BEV). **(7 hrs)**
12. Introduction and applications of bioinformatics and nanotechnology. **(3 hrs)**

PRACTICALS:

MEDICAL BIOTECHNOLOGY

1. Photographic demonstration of transgenic crop plants / animals and agricultural biotechnology innovations.
2. Production of polyclonal sera in Mice / Rabbit.
3. ELISA
4. Biochemical Analyzer in medical diagnostics
5. Western Blot
6. Culturing of antibiotic resistant strains of bacteria and verification for resistance.
7. Antibiotic sensitivity test - paper disc method.
8. Demonstration of PCR for diagnosis of a disease.
9. Study of lifecycle of Honeybee and Silkworm
10. Study of blood group and Rh factor

REFERENCES:

MEDICAL BIOTECHNOLOGY

1. Anathnarayana, R., and C.K. Jayaram Paniker. 1997. Text Book of Microbiology, Orient Longman.
2. Colle, J.G., 1989. Practical Medical microbiology, Churchill living stone
3. Credric, A. mims 2004. Medical microbiology – 3rd edn. Moshy Inc.
4. Glick, B. R., Delovitch, T. L., Patten, C. L. (2020). Medical Biotechnology. United States: Wiley.
5. Hoghl and Mottet. Clinical microbiology, J.b. Lippincott Company.
6. Jawetz, E., Melonick, J.L., Adelberg, E.A. 1987: Review of Medical microbiology, Prentice Hall,.
7. Kenneth, J. R. Medical microbiology – introduction to infectious diseases, Printice Hall Int.
8. Khan, F. A. (2014). Biotechnology in Medical Sciences. United Kingdom: Taylor & Francis.
9. Leslic collier, john oxford.2000. Human virology: A text book for students of medicine, dentistry and microbiology 2nd Edn, Oxford university Press
10. Mackie, and McCarthy 1996. Medical microbiology, Vol-I, Microbial infection Vol-II, Practical Medical microbiology, churchil living stone.
11. Nester, Roberts, Pearsall, Anderson. 1998. Microbiology – a human perspective, 2nd Edn, McGraw-Hill.
12. Strokes, J., *et al.* 1993 Clinical microbiology – 7th Edn
13. Topley and Wilson. Principles of Bacteriology, Virology and Immunity, Edward Arnold.
14. Warren, Levinson. 2000. Medical microbiology and immunology: Examination and Board review. 8th Edn, McGraw Hill.
15. **Note: Additional reference material can be down loaded from Internet**

SEMESTER VI
SKILL ENHANCEMENT COURSE
PAPER BT-SEC 2.1: PHARMACEUTICAL BIOTECHNOLOGY
(Credits: Theory-2)

Theory

Total hours allotted 30

1. **Introduction:** Introduction pharmaceutical biotechnology, current status and future prospects, generic and branded biopharmaceuticals, overview of life history for development of biopharmaceuticals and specifically Identification of Target and selection of protein or peptide based therapeutics: In-silico, pharmaco-informatics. Drug Discovery stages (Drug Target selection, screening of drugs, *In vivo* and *In vitro* study of drug efficacy, cell based analysis.), Pre-clinical toxicity assessment, Clinical trial phases and design, clinical data management, concept of Pharmacovigilance.

(9 hrs)
2. Overview of protein based therapeutics (Insulin, streptokinase, erythropoietin, Rituximab, etc), biologics for autoimmunity and inflammation, vaccine- adjuvant technology (Complete and Incomplete Adjuvants), genetically engineered vaccines, cancer vaccines, present and future biologics.**(6 hrs)**
3. Introduction to Genomics, transcriptomics, proteomics, and study of structural, functional proteins, and comparative genomics, pharmacogenomics. DNA & oligonucleotides microarrays, genetically engineered animals, Integration of personalized and systems medicines, pharmacogenomics in preclinical and clinical development of drugs.

(7 hrs)
4. Drug delivery systems for biopharmaceuticals (rate controlled and site specific), Nanotechnology based miniaturization of biopharmaceuticals and therapeutics,**(4 hrs)**
5. **Bio-safety:** Genetic Engineering Appraisal Committee (GEAC), rules and regulations of handling genetically modified organisms. (Formation of Institutional bio-safety committee, Central Drugs Standard Control Organisation (CDSCO) Drug Control General of India.)

(4 hrs)

REFERENCES:

PHARMACEUTICAL BIOTECHNOLOGY

1. Bhatia, S., Goli, D. (2018). Introduction to Pharmaceutical Biotechnology: Basic Techniques and Concepts. United Kingdom: Institute of Physics Publishing.
2. Daan J A Crommelin (2010), Pharmaceutical Biotechnology, 2nd Edition, Taylor & Francis Group.
3. Gary Walsh (2007) Pharmaceutical Biotechnology: Concepts and Applications. John Wiley & Sons, Inc.
4. Oliver Kayser, Heribert Warzecha (2012) Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications, 2nd Edition. John Wiley & Sons, Inc.
5. Pharmaceutical Biotechnology by Daan J. A. Crommelin, et al
6. "Principles of Pharmacology by D. Golan, A. Tashjian, E. Armstrong, J.Galanter, A.W. Armstrong, R. Arnaout and H.Rose. 2005, Lippincott Williams and Wilkins.
7. Rodney J. Y. Ho (2013) Biotechnology and Biopharmaceuticals: Transforming Proteins and Genes into Drugs, 2nd Edition, John Wiley & Sons, Inc.
8. Walsh, G. (2013). Pharmaceutical Biotechnology: Concepts and Applications. Germany: Wiley.

SEMESTER VI
SKILL ENHANCEMENT COURSE
PAPER BT-SEC 2.2:GENETIC ENGINEERING
(Credits: Theory-2)

Theory

Total hours allotted 30

1. Introduction to genetic engineering. (2hrs)
2. **Tools of genetic engineering:** Enzymes-Restriction endonucleases: Classification, nomenclature, types and their application in recombinant DNA technology. Ligases-DNA ligases and their application, enzymes to modify ends of DNA molecules. DNA polymerase Vectors/Vehicle DNA- Plasmid and their features, some common plasmid vectors-PBR 332. (10 hrs)
3. **Gene cloning:** Methods of introducing gene in prokaryotes and eukaryotes (*E. coli* and yeast cells as cloning host).direct screening of insert DNA release, colony PCR, etc., (4 hrs)
4. **Cells for cloning:** *E. coli*, strains used for cloning (DH5a, TOP10, etc.), expression of cloned DNA in *E. coli*. [BL21; BL21 (DE3)], etc. (4 hrs)
5. **Gene libraries:** Genomic library and cDNA library. (4 hrs)
6. **DNA sequencing:** Outline of Maxam-Gilbert's method and Sanger's dideoxy method. (4 hrs)
7. Human genome project and its importance. (2 hrs)

REFERENCES:

GENETIC ENGINEERING

1. Benjamin Lewin, "Genes-II, Genes III, Wiley and sons publications.
2. Benjamin Lewin, Genes-V & VI Oxford University press.
3. Brown, T.A. 1998: Genetics: A molecular approach 3rd Ed. Stanley Thornes (Publishers) Ltd. United Kingdom.
4. Christopher H. 1995 "Gene cloning and Manipulation", Cambridge University Press.
5. Davis, R.W. Boterin, D. and Roth, J.R. 1980: A manual for genetic engineering, cold spring harbour laboratory. Cold Spring Harbor. New York.
6. Gardner. Simmons. Snustad 1991: Principles of genetics. 8" Ed. John Wiley and Sons. Inc.
7. Mitchell, D.S.T. 1994: An introduction to genetic Engineering. Cambridge University Press.
8. Old and Primrose, "Principles of gene Manipulation", Black well Scientific publications.
9. Peters. P. 1993: A guide to genetic engineering. Dubuque, Iowa. WMC Brown.
10. Rigbu, P.W.J. 1987: Genetic Engineering 6, Academic Press Inc. Florida, USA.

KARNATAK UNIVERSITY, DHARWAD

GENERAL PATTERN OF THEORY EXAMINATION (for DSC and DSE)

B.Sc BIOTECHNOLOGY

Duration: 3 Hours

Maximum: 80 Marks

All questions are compulsory

Draw neat labelled diagrams wherever necessary

QNo. I Answer any TEN of the following

2X10=20

- | | |
|------|------|
| (1) | (2) |
| (3) | (4) |
| (5) | (6) |
| (7) | (8) |
| (9) | (10) |
| (11) | (12) |

QNo. II Answer any SIX of the following

5X6=30

- | | |
|------|------|
| (13) | (14) |
| (15) | (16) |
| (17) | (18) |
| (19) | (20) |

QNo. III Answer any three the following

10X3=30

- (21)
- (22)
- (23)
- (24)
- (25)

GENERAL PATTERN OF THEORY QUESTION PAPER FOR ALL SEC PAPERS (1.5 hrs)

1. Question number 1-6 carries 2marks to answer any 5 questions : 10 marks
2. Question number 7-14 carries 4marks to answer any 5 questions : 20 marks
3. Question number 15-17 carries 5marks to answer any 2 questions : 10marks
40 marks

KARNATAK UNIVERSITY, DHARWAD

GENERAL PATTERN OF THEORY EXAMINATION (for SEC)

B.Sc BIOTECHNOLOGY

Duration: 1.5 Hours

Maximum: 40 Marks

All questions are compulsory

Draw neat labelled diagrams wherever necessary

QNo. I Answer any FIVE of the following 2X5=10

- | | |
|-----|-----|
| (1) | (2) |
| (3) | (4) |
| (5) | (6) |

QNo. II Answer any FIVE of the following 4X5=20

- | | |
|------|------|
| (7) | (8) |
| (9) | (10) |
| (11) | (12) |
| (13) | (14) |

QNo. III Answer any TWO the following 5X2=10

- (15)
(16)
(17)

KARNATAK UNIVERSITY, DHARWAD
PATTERN OF PRACTICAL EXAMINATION
Practical examination – B. Sc BIOTECHNOLOGY

Duration: 3 hours

Max. Marks: 40

Q. 1	Major question	12 Marks
Q. 2	Minor question	08 Marks
Q. 3	Identify and comment	5X2 = 10 marks
Q. 4	Record	05 Marks
Q. 5	Viva - Voce	05 Marks