Academic Council
Item No.

UNIVERSITY OF MUMBAI

Revised Syllabus for T.Y.B.Sc.

Programme- B.Sc.

Course- Biotechnology (USBT)

(Third Year – Sem. V & VI)

(Credit Based Semester and Grading System with effect from the academic year **2016-2017**)

T.Y.B.Sc.
BIOTECHNOLOGY
SEMESTER V AND VI
REVISED SYLLABUS (CBSGS) 2016-2017

SEMESTER V

COURSE	TITLE	UNIT	TOPICS	CREDITS	L/WEEK
USBT501	Cell Biology and Medical Biotechnology	I	Cytoskeleton	2	1
		II	Cell membrane		1
		III	Medical Biotechnology- Causative organisms		1
		IV	Virology		1
USBT502	Biochemistry, Immunology and Instrumentation	I	Immunology	2	1
		II	Endocrinology		1
		III	Carbohydrate metabolism		1
		IV	Instrumentation		1
USBT503	Genetics and Molecular Biology	I	Genetic mapping	2	1
		II	Operon concept and transposons		1
		III	Vectors and enzymes in Molecular Biology		1
		IV	Recombinant DNA libraries		1
USBT504	Industrial Biotechnology	I	Types of fermentors and process control	2	1
		II	Screening, inoculum and strain development		1
		III	Fermentations		1
		IV	Downstream processing		1
USBTP05 & 06		Practical Based on theory		2	9

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SEMESTER VI

COURSE	TITLE	UNIT	TOPICS	CREDITS	L/WEEK
USBT601	Cell Biology, Medical Biotechnology and Biostatistics	I	Cell signaling and signal transduction	2	1
		II	Cell cycle, apoptosis and cancer		1
		III	Chemotherapeutic agents		1
		IV	Biostatistics		
USBT602	Biochemistry, Immunology and Instrumentation	I	Immunotechnology	2	1
		II	Endocrinology		1
		III	Lipid Metabolism		1
		IV	Instrumentation		1
USBT603	Molecular Biology and Bioinformatics	I	rDNA technology	2	1
		II	Transgenic plants		1
		III	Transgenic animals		1
		IV	Bioinformatics		1
USBT604	Industrial Biotechnology	I	Dairy technology	2	1
		II	Environmental Biotechnology		1
		III	Biofertilizers, Biopesticides, Biosurfactants and biosensors		1
		IV	IPR ,Quality Assurance, Entrepreneurship		1
USBTP07 & 08		Practical Based on theory and Skill based project		2	9

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SEMESTER V

COURSE CODE	TITLE	CREDITS
USBT501	**Cell Biology and Medical Biotechnology**	**2 credits**
Unit I Cytoskeleton	Overview of Cytoskeleton Microtubules: Structure, Composition, MAPs, Functions- Role in mitosis, Structural support and Intracellular motility. Motor proteins, MTOCs, Dynamic properties of microtubules, Microtubules in cilia and flagella. Drugs targeting microtubules Microfilaments: Structure, composition, Assembly and Disassembly Motor protein-myosin Muscle contractility- sliding filament model. Actin binding proteins: Examples of non-muscle motility Intermediate filaments: Structure and composition, Assembly and Disassembly Types and functions.	15 lectures
Unit II Cell membrane	Introduction and overview of functions: Fluid Mosaic Model, Chemical composition; Membrane Lipids- Phosphoglycerides, Sphingolipids, Cholesterol, Membrane Carbohydrates- Sugars, Oligosaccharides. Membrane Proteins- Integral, Peripheral, Lipid anchored. Membrane lipids and fluidity- Importance, Maintenance & Asymmetry. Dynamic nature- Flip flop and lateral movement. Cell permeability-Principles of membrane transport: Transporters and Channels. Active transport, Passive transport. Types of transporters, Types of ATP driven pumps - Na+ K+ pump. Cell junctions, cell adhesion and extracellular material Microvilli, Tight junctions, Gap junctions, Cell coat and cell recognition, Cellular interactions. ECM of animal connective tissue: Hyaluronic acid, GAGs, Proteoglycans.	15 lectures

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Unit III Medical Biotechnology- Causative organisms	Skin Infections- *Staphylococcus:* Characteristics Pathogenesis and immunity Toxins, Enzymes, Clinical Disease, Lab diagnosis, Treatment, Prevention and Control. *Dermatophytes:* Superficial and Cutaneous mycoses Respiratory Tract Infections- *M. tuberculosis*: Characteristics Transmission, Course of infection, Lab diagnosis, Management of TB, Prevention and Control, Immuno and Chemoprophylaxis, DOTS and MDR. Urinary Tract Infections- *E.coli* : Characteristics, Virulence, Clinical disease, Traveller's diarrhoea and *E.coli* infections. GI Tract Infections- *Salmonella:* Characteristics, Virulence- Pathogenesis &Immunity, Clinical Disease, Carriers Lab diagnosis, Phage typing Prophylaxis and Treatment Sexually Transmitted Diseases- HIV: Characteristics Pathogenesis Transmission &Population at risk, Opportunistic infections, Lab diagnosis, Treatment, Prevention and Control, Vaccine development Parasitic Blood infection- Malarial parasites: Life Cycle, Diagnosis and Treatment	15 lectures
Unit IV Virology	Introduction to viruses-Position in biological spectrum Virus properties, General structure of viruses Baltimore Classification and Taxonomy(ICTV), Cultivation of viruses, Virulent phages and Lytic cycle - T even phages, One step growth experiment Temperate phages and lysogeny - lambda phage, Reproduction of ds DNA phages, animal viruses and plant virus Virus purification and assays Cytocidal infections and cell damage Viruses and cancer Viroids and Prions	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT502	**Biochemistry, Immunology and Instrumentation**	**2 credits**
Unit I Immunology	Structure and Function of the Immune system: Cells and organs of immune system Membrane receptors for antigens: MHC–Class I and Class II molecules. Antigen Presentation by Endocytic and Exocytic Pathway Immune response Theories, B Cell Receptor, T Cell Receptor and Accessory Molecules CD4, CD8. Complement system : Classical Pathway and Alternate Pathway.	15 lectures
Unit II Endocrinology	Mechanism of action of group II hormones Storage, Release, transport, functions and disorders of – Hypothalamic hormones Anterior Pituitary hormones – GH & stimulating hormones (hCG, LH, FSH, TSH) Posterior pituitary hormones – ADH and oxytocin Adrenal medulla hormones – epihephrine and nor-epinephrine Pancreatic hormones – Insulin and Glucagon	15 lectures
Unit III Carbohydrate metabolism	Biochemical pathway for Synthesis and regulation of carbohydrates in Bacteria –Peptidoglycan Plants - Calvin cycle, C4, CAM, starch and sucrose Animals – Glycogen synthesis and breakdown Gluconeogenesis	15 lectures
Unit IV Instrumentation	Chromatography: Principle , working and application of Affinity, Ion-exchange, Gel permeation, HPLC and GC. Centrifugation: Types, principle, working and applications of Differential and Density Gradient - Isopycnic, Rate zonal, Gradient materials, preparation, sample application, recovery, choice of rotors.	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT503	**Genetics and Molecular Biology**	**2**
Unit I Genetic mapping	Genetic mapping in bacteria and Bacteriophages: Gene mapping in bacteria by conjugation, transformation and transduction. Mapping bacteriophage genes, Fine structure analysis of bacteriophage gene, Deletion mapping, and Defining genes by complementation tests.	15 lectures
Unit II Operon concept and transposons	Regulation of gene expression in bacteria and bacteriophages: Operon concept. *lac* and *trp* operons- Gene organization and regulation. Regulation of gene expression in phage λ. Transposons in prokaryotes and eukaryotes- IS elements, composite and non-composite transposons, plant transposons Transposable phage (phage Mu)	15 lectures
Unit III Vectors and enzymes in Molecular Biology	Enzymes - Sources, types, mode of action and applications of Restriction endonucleases, DNA polymerases, Ligases, Kinases, Phosphatases, Terminal transferases, Reverse transcriptases and Nucleases, Sequenase and Taq polymerase Vectors - Features and applications of pBR322, pUC19, cosmids, λ phage, M13 bacteriophage vector, Shuttle vector, Expression vector, Ti plasmid, Artificial chromosomes- YAC, BAC	15 lectures
Unit IV Recombinant DNA libraries	Construction and screening of Genomic libraries, cDNA libraries, Chromosome libraries. Probes-synthesis (Random priming, Nick translation) Use of probes to identify genes and cDNA in libraries. Molecular analysis of cloned DNA- restriction mapping	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT504	**Industrial Biotechnology**	**2**
Unit I Types of fermentors and Process control	Fermentors – Acetator & Cavitator, Tower fermentor, Airlift fermentor, Bubble column fermentor, Deep jet fermentor, Packed Bed, Bioreactors for animal cell culture, Stirred tank fermentor, Packed glass bead reactor. Process Control-Temperature control, flow measurement, pressure, biomass, DO, pH, redox, inlet and exit gas analysis. Addition of inoculum and nutrients. Sampling port, feed port, sensor probes, foam control.	15 lectures
Unit II Screening, inoculum and strain development.	Primary screening, secondary screening, inoculum and strain development Scale up, scale down	15 lectures
Unit III Industrial Fermentations	Wine and beer: Introduction, manufacturing/processing, spoilage Malo-lactic fermentation Production of : Penicillin, Streptomycin, Vinegar, Citric acid Single cell protein (Mushroom)	15 lectures
Unit IV Downstream processing	Introduction of DSP Foam separation, Types of Precipitation, Filtration, Centrifugation, Chromatography in DSP Cell disruption- physical and chemical methods. Solvent recovery, Membrane processes, Drying, Crystallization and Whole broth processing.	15 lectures

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PRACTICALS		
COURSE CODE	**TITLE**	**CREDITS**
USBTP05	Determination of Total RBC count Determination of Total WBC count Differential staining of Blood Film Medical Biotechnology: ✓ Identification of *S.aureus*-Isolation, Catalase, Coagulase test ✓ Identification of *E.coli*-Isolation, Sugar fermentations, IMViC ✓ Identification of *Salmonella*- Isolation, Sugar fermentations, TSI slant MIC and MLC of antibiotic Preparation of Solutions Glucose estimation from serum using GOD-POD method Estimation of starch (Willstater's method)	**1**
USBTP06	Isolation of plasmid bearing culture and extraction of plasmid DNA and demonstration of its presence by agarose gel electrophoresis Transformation and Screening for transformants by replica plate method Construction of restriction map Problems on mapping of bacterial genes Bioassay of penicillin Isolation of antibiotic producing organism- crowded plate technique & Wilkins agar overlay technique Encapsulation of yeast and estimation of invertase activity Vinegar analysis	**1**

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SEMESTER VI

COURSE CODE	TITLE	CREDITS
USBT601	**Cell biology and Medical Biotechnology**	**2 credits**
Unit I Cell signalling & Signal Transduction	General Principles of cell communication: Introduction, Extracellular signal molecules binding to receptors, Forms of intercellular signalling - Autocrine, Contact dependent, Paracrine, Synaptic and Endocrine. Role of gap junction in signalling Response to multiple extracellular signal molecules Morphogens, Lifetime of intracellular molecule, Role of Nitric oxide and nuclear receptors Binding reaction and role of Kd, Extracellular messengers and their receptors, GPCRs RTKs, Second messengers Role of Calcium- Introduction, Calcium binding proteins	15 lectures
Unit II Cell cycle, apoptosis and cancer	Cell cycle- Overview of cell cycle and Phases, Check points Apoptosis and Necrosis: Definition and Process Apoptosis: Caspases and targets, Factors which regulate apoptotic death in normal cells. Significance and role of apoptosis in various diseases. Cancer: Definition, Characteristics of normal cell and cancerous cell. Tumor- Benign and malignant, types of cancer, oncogenes and tumor suppressor genes, invasion metastasis, angiogenesis, preventive measures for cancer Cancer vaccines	15 lectures
Unit III Chemotherapeutic agents	Discovery and Design of antimicrobial agents: Classification of Antibacterial agents Selective toxicity, MIC,MLC, Inhibition of cell wall synthesis: Beta lactam antibiotics, Penicillins Cephalosporins, Glycopeptides Vancomycin, Polypeptides Bacitracin,	15 lectures

	Injury to Plasma membrane: Polymyxin Inhibition of protein synthesis: Aminoglycosides, Tetracyclines Chloramphenicol, Macrolides-Erythromycin Inhibition of Nucleic acid synthesis: Quinolones Rifampin Metronidazole, Antimetabolites Sulphonamides, Trimethoprim Drug Resistance: Mechanism, Origin and transmission of drug resistance Use and misuse of antimicrobial agents, Antifungal drugs, Antiviral drugs	
Unit IV Biostatistics	Concept of Biostatistics- Definition of biostatistics, terms used and Scope in Biological sciences, Types of Data and Representation of data using frequency distribution diagram (Simple/Multiple/Subdivided bar diagram, Pie chart), Graphs (Histogram, polygon, curve) Normal probability curve Measures of central tendency: Mean – Arithmetic mean, assumed mean. Median- raw data and grouped data. Mode: - raw data and grouped data. Measures of dispersion: Concept of Variance, Standard deviation and Coefficient of variance Coefficient of correlation and Regression analysis: Steps in testing statistical hypothesis: Parametric tests:- Z test – Single mean and Two means, t-test – Single mean, Paired and unpaired Nonparametric test:- Chi-square test.	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT602	**Biochemistry, Immunology and Instrumentation**	**2 credits**
Unit I Immunotechnology	Antigen-antibody reaction General Features of Antigen antibody reactions Measurements of Antigen-antibody reactions Types of Serological Reactions: Precipitation, Agglutination, Flocculation. Types and Application of Immunoassay techniques: RIA, ELISA, Elispot, Immuno precipitation, Immunoflourescence. FACS ImmunoBlotting Diagnostic Tests: Coomb's test and Complement Fixation Test	15 lectures
Unit II Endocrinology	Definition and Classification of hormones based on chemical nature and mode of action Mechanism of action of group I hormones: Storage, release, transport, functions and disorders of – Thyroid hormones – T_3 and T_4 Adrenal cortex hormones – Glucocorticoids and mineralocorticoids Calcitriol Hormones of Gonads – Androgen, estrogen, progesterone.	15 lectures
Unit III Lipid metabolism	Biochemical pathway for Synthesis and regulation of- Fatty acids (even and unsaturated), Triacylglycerol, Phospholipids (Phosphatidyl choline, Phosphatidyl ethanolamine and Phosphatidyl serine), Cholesterol and Ketone bodies	15 lectures
Unit IV Instrumentation	Isotopes in Biology: Detection Techniques of Radioactivity using GM counter, Scintillation counter, Applications of Tracer techniques in Biology Microscopy: Principle, working and applications of TEM,SEM & confocal Spectroscopy- Principle, working and applications of IR and Spectrofluorimetry	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT603	**Molecular Biology and Bioinformatics**	**2**
Unit I rDNA technology	Principle, method and applications of Southern Hybridization, DNA fingerprinting, RFLP, DNA sequencing(Sangers, Automated) PCR(qPCR /Real time PCR, RT PCR) Vaccines: Sub unit vaccines(HSV), Peptide vaccines(FMDV), Attenuated vaccines(cholera), vector vaccines(vaccinia), DNA vaccine	15 lectures
Unit II Transgenic plants	Genetic engineering of plants- Methodology. Plant transformation with the Ti plasmid of *A.tumefaciens*, Ti plasmid derived vector system Physical methods of transferring genes to plants- electroporation, microprojectile bombardment, liposome mediated, protoplast fusion. Golden rice, bt cotton and edible vaccines	15 lectures
Unit III Transgenic animals	Transgenic mice- methodology-retroviral method, DNA microinjection, ES method, genetic manipulation with *cre-lox*P recombination system. Cloning live stock by nuclear transfer. Green Fluorescent Protein, Transgenic fish	15 lectures
Unit IV Bioinformatics	Bioinformatics:- Definition, history, scope and applications of bioinformatics. Role of computer, internet, world wide web, NCBI. Database:- Types of databases DNA databases Protein databases Tools :- Web search tools, Data retrieval tools – Entrez databases Heuristic tools in Sequence similarity searching - FASTA and BLAST	15 lectures

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COURSE CODE	TITLE	CREDITS
USBT604	**Industrial Biotechnology**	**2**
Unit I Dairy technology	Milk: Normal flora, changes in raw milk, enumeration. Factorsaffectingbacteriological quality. Preservation methods, Pasteurisation. Starter Cultures. Fermented products-Production process and spoilage- Cheese: Swiss and Cheddar, Butter, Yogurt and Buttermilk	15 lectures
Unit II Environmental Biotechnology	Industrial Waste- Characteristics, Nature, Treatment Types-Dairy, Distillery and Pharmaceutical industry Monitoring criteria- pH, temp, TSS, TDS, TS, BOD, COD and heavy metals Energy sources renewable, non-renewable. Biofuels and biogas Bioremediation- plants and microbes	15 lectures
Unit III Biofertilizers, Biopesticides, and biosensors	Biopesticides and Biofertilizers- Production, application. advantages and limitations Biosensors-principle, working and application	15 lectures
Unit IV IPR ,Quality Assurance, Entrepreneurship	IPR-introduction, Patents, trade secrets copyrights. Plant variety protection. Patenting genes and DNA sequences, genetic resources Management of IPR Patenting related to GMO QA, QC and GMP Entrepreneurship	15 lectures

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PRACTICALS		
COURSE CODE	**TITLE**	**CREDITS**
USBTP07	• Antibiotic sensitivity test using agar cup method, • Antibiotic sensitivity test using paper disc method • Antibiotic sensitivity test using ditch method. • To determine synergistic action of two drugs. • Problems based on : - Standard deviation , Coefficient of correlation, Regression, Z-test , t-test chi-square test • Cholesterol estimation in Serum • Determination of Antigen identity by Ouchterlony and Mancini methods	1
USBTP08	• Sterility checking of injectible. • Extraction of DNA from yeast • Isolation of Normal flora from raw milk and curd • Determination of milk protein • Determination of BOD • Determination of COD • Enrichment and Isolation of *Azotobacter* and biopolymer production • Analysis of milk Methylene blue reduction test (MBRT) Resazurin reduction test (RRT) Phosphatase test for milk • Skill based Project	1

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REFERENCES

Title	Author	Publisher
Cell and Molecular Biology: Concepts and Experiments,	Gerald Karp 5th edition	Wiley International Student Version
Molecular Biology of the Cell	Alberts,B., Bray,D, Lewis,J, Raff,M, Roberts,K, and Watson, J 3rd edition	Garland Publishing, Inc
Biostatistics	P.N.Arora and P.K. Malhan	Himalaya Publishing House
Methods in Biostatistics	Mahajan ,B.K	Jaypee brothers
Textbook of Microbiology	Pelczar, Kreig and Chan 5th edition	Tata Mc Graw Hill
Mims' Medical Microbiology,	Goering, R.V, Dockell, H.M, Zuckerman, M, Roitt, I.M. 5th edition	Elsevier Publications
Medical Microbiology	Jawetz,E.,Brooks,G.E, Melnick,J.L., Butel,J.S, Adelberg, E. A 18th edition	Prentice Hall International
Foundations In Microbiology	Talaro and Talaro Third edition	W.C Brown Publishers
Medical Microbiology	Ananthnarayan 8th edition	Orient Longman
Microbiology	Prescott Harley and Klein 5th edition	Mc Graw Hill
Principles of Biochemistry	Lehninger Nelson and Cox 4th edition	WH Freeman & Co
Biochemistry	Voet & Voet 3rd edition	John Wiley & sons
Introduction to Endocrinology	Chandra S. Negi	PHI learning pvt ltd
Biochemistry and Molecular Biology of Plants	Buchanan, Gruissem and Jones	IK International
Principles of Biochemistry	Lehninger 2nd Ed	Kalyani publications

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Textbook of Medical Physiology	Guyton, A.C and Hall 11th edition	J.E Saunders
Harper's Illustrated Biochemistry	Murray, R.K, Granner, M.D, Mayes, P.A and Rondwell, V.W 27th Edition	Mc Graw Hill
Biochemistry	Satyanarayana 2nd edition	Books and Allied pvt Ltd
Kuby Immunology	Goldsby, R.A, Kindt, T.J and Osborne, B.A, 5th Edition	W.H Freeman and Company
Biochemistry and Molecular Biology	Keith Wilson and John Walker 6th edition	Cambridge University Press
Bioinstrumentation	L. Veerakumari	MJP Publishers
Biophysical chemistry	Upadhyay Upadhyay and Nath	Himalaya Publishing House
Practical Biochemistry, Principles and techniques	Wilson and walker, 5th Edition	Cambridge University Press
Essential i genetics	Peter Russell	Pearson Education
Molecular Biotechnology – Principles and Applications of Recombinant DNA	Glick, B.R, Pasternak, J.J Patten, C.L 3rd edition	ASM press
Biotechnology expanding horizons	BD Singh	Kalyani Publishers
Biotechnology-Fundamentals and Applications	S.S.Purohit 3rd edition	Student edition
Basic Genetics	Harlt,D Friedfelder,D and Snyder,L	Jones and Bartlett Publishers
Bioinformatics- methods and applications Genomics, Proteomics and Drug discovery,	S.C.Rastogi, N. Mendiratta, P.Rastogi 3rd edition	PHL learning Pvt. Ltd.
Applied Dairy Microbiology	Elmer H Marth and James L Steele 2nd edition	Mercel Dekker Inc New York
Microbial Technology	Peppler,H.J and Perlman,D 2nd edition	Academic Press
Microbiology in Health and Disease	Frobisher	WB Saunders and Company
Industrial Microbiology	A.H.Patel 1st edition	Macmillan India
Environmental Biotechnology	S.D. Jogdand	Himalaya Publishing

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(Industrial pollution management)		House
Pharmaceutical Microbiology	Hugo, W.B, Russell, A.D 6th edition	Oxford Black Scientific Publishers
Environmental Biotechnology	Allan Scragg	Oxford University press
Environmental Biotechnology (Basic concepts and applications)	Indushekar Thakur	IK International

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SUGGESTED READING

Semester V

Topic	
Cytoskeleton	http://www.tifr.res.in/~roop/Publications_files/CurrBioMolMotor-Review.pdf
Cell membrane	http://assets.cambridge.org/97805217/04632/excerpt/9780521704632_excerpt.pdf
Medical Biotechnology-Causative organisms	http://www.ajtmh.org/content/77/6_Suppl/181.full.pdf+html
Virology	http://www.cdc.gov/prions/pdfs/tse-in-humans.pdf
Role of Complement in health and disease	Factor H: A Complement Regulator in Health and Disease, and a Mediator of Cellular Interactions Biomolecules 2012, 2 46-75; doi:10.3390/biom2010046 Biomolecules ISSN 2218-273X Anne Kopp, Mario Hebecker, Eliška Svobodová, Mihály Józsi www.mdpi.com/journal/biomolecules/
The endocrine system and its disorders	http://teachers.sduhsd.net/ahaas/Anatomy%20Physiology/Endocrine%20system/AandPendocrineclinicalapplicationswithquestions.pdf.
Disorders of carbohydrate metabolism	REVIEW Dietary carbohydrate: relationship to cardiovascular disease and disorders of carbohydrate metabolism J Mann; European Journal of Clinical Nutrition (2007) 61 (Suppl 1), S100–S111
GC-MS	Principle, Technique and its application in Food Science, REVIEW ARTICLE Syed Zameer Hussain and Khushnuma Maqbool INT J CURR SCI 2014, 13: E 116-126 ISSN 2250-1770
Reterotransposons	**www.sciencedirect.com/science/article/pii**

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Probes	Probe design, production and applications pdf by M.A de Muro
Fermentation.	http://www.massey.ac.nz/~ychisti/FermentInd.PDF.
Scale up	http://fermentationtechnology.blogspot.com/2008/01/scale-down-in-fermentation-technology.html.
Industrial fermentation	http://www.gitam.edu/eresource/environmental/em_maruthi/industrial.htm
DSP	http://microbiology.ukzn.ac.za/Libraries/MICR304/DOWN_STREAM_PROCESSING.sflb.ashx.

Semester VI

Topic	
Cell signaling and Signal transduction	http://web.mit.edu/9.013/www/lectures/03-04_MS_Neuronal_Receptors.pdf
Cell cycle, apoptosis and cancer	http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3384434/pdf/aging-04-330.pdf http://www.radio.cuci.udg.mx/bch/ES/papers/CellCycleCheck_EncyclopedLifeSci_2002.pdf https://www.roswellpark.edu/sites/default/files/therapeutic_vaccines_for_cancer_review_2014.111_april_7.pdf
Chemotherapeutic agents	http://icmr.nic.in/ijmr/2004/1009.pdf
Biostatistics	http://www.datastep.com/SPSSTutorial_1.pdf
Immunodiagnostics	**Immunodiagnostics**: Major Advances and Future Insights Sandeep Kumar VashistVashist, Biochip Tissue Chip 2013, 3:2 http://dx.doi.org/10.4172/2153-0777.1000105
Role of hormone in heart disease	The Endocrine System and the Heart: A Review Soo S. Rhee, Elizabeth N. Pearce Rev Esp Cardiol. 2011;64:220-31 - Vol. 64 Num.03 DOI: 10.1016/j.rec.2010.10.016

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Lipoproteins	**LIPOPROTEINS** – ROLE IN HEALTH AND DISEASES Edited by Saša Frank and Gerhard Kostner ISBN 978-953-51-0773-6 library.umac.mo/ebooks/b28050137.pdf
Application of Radioisotopes	**Application of Radioisotopes** in Biochemical Analyses: Metal Binding Proteins and Metal Transporters Miki Kawachi, Nahoko Nagasaki-Takeuchi, Mariko Kato and Masayoshi Maeshima http://www.intechopen.com/download/pdf/23692
Next generation sequencing technology	**www.illumina.com/technology/nextgenerationsequencinghtml**
Recombinant vaccines	**Vaccine development using recombinant DNA technology-CAST www.cast.science.org**
Green fluorescent protein	**The Green fluorescent protein Roger.Y.Tsein www.chem.ualberta.ca> resources>gfp**
Transgenic and knock out animals	**www.lab.anhb.uwa.edu.au>tutorials**
Starter cultures	https://www.dairyscience.info/index.php/cheese-starters/49-cheese-starters.html
Bioremediation	http://www.moef.nic.in/downloads/public-information/BioremediationBook.pdf
Biosurfactants	http://www.dli.gov.in/rawdataupload/upload/insa/INSA_1/2000c4de_31.pdf
Filing a patent	http://www.ipindia.nic.in/ipr/patent/manual/HTML%20AND%20PDF/Manual%20of%20Patent%20Office%20Practice%20and%20Procedure%20-%20html/Chapter%203.htm

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List of You tube videos

Semester V

Topic	
Cytoskeleton	https://www.youtube.com/watch?v=5rqbmLiSkpk
Cell membrane	https://www.youtube.com/watch?v=rR7NOSRyzhM
Medical Biotechnology- Causative organisms	https://www.youtube.com/watch?v=odRyv7V8LAE
Virology	https://www.youtube.com/watch?v=wLoslN6d3Ec
Immunology	**Antigen presentation and processing** https://www.youtube.com/watch?v=LwLYGTS_3EI
Endocrinology	**Mode of action of group two hormones** https://www.youtube.com/watch?v=Nt2r5R0ZO5U
Carbohydrate metabolism	**Photosynthesis Light reaction, Calvin cycle, Electron Transport** https://www.youtube.com/watch?v=wJDlxp17rY4
Instrumentation	**Separation on WBC using Ficoll density gradient centrifugation.** https://www.youtube.com/watch?v=6lsldFFMEhE
Types of fermentors And process control	https://youtu.be/B7LfT7BIYSQ.
Screening inoculums and strain development	https://youtu.be/LYLjlSU7kOg.
Fermentations	https://youtu.be/zglgFHAPg7E
DSP	https://youtu.be/VKpthcW1llU https://youtu.be/N7vxq948l-U

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Semester VI

Topic	
Cell signaling and Signal transduction	https://youtu.be/qOVkedxDqQo https://youtu.be/ZBSo_GFN3qI
Cell cycle, apoptosis and cancer	https://youtu.be/brXqJIEx1EU https://youtu.be/g1kEDSx23jU https://youtu.be/paw2SUY22_s https://youtu.be/67NhsSGsxC8
Chemotherapeutic agents	https://www.youtube.com/watch?v=cC9kyoAo1ac&list=PLMO1589WRspykVPiy6SgKi3OPKbe9b0EI
Immunotechnology	**Complement FixationTest** https://youtu.be/lKAxV0WOaQE?list=PLewW6YqYSNaaqbPQDlxCHvggJaCuoheoF **ELISA** https://youtu.be/lNxZxJtvB94?list=PLewW6YqYSNaaqbPQDlxCHvggJaCuoheoF
Endocrinology	**Mode of action of group one hormones** https://www.youtube.com/watch?v=CaMKuXKZ70g
Lipid metabolism	**Familial hypercholesterolemia** https://www.youtube.com/watch?v=Yanklj65zjs
Instrumentation	**Confocal microscopy** https://www.youtube.com/watch?v=jUAvneBhDcQ
Dairy Technology	Cheese making https://youtu.be/7-s2Kql0CHI
Environment Biotechnology	Biofuels https://youtu.be/ZGmwtDffc74
Biosensors	https://youtu.be/8zbcib44XCc https://youtu.be/mliAE51s618
IPR	Geographical indications - https://youtu.be/0darIuNMxk8

T.Y.B.Sc.
BIOTECHNOLOGY
SEMESTER V AND VI
REVISED SYLLABUS (CBSGS) 2016-2017

THEORY EXAMINATION PATTERN

Internal Assessment- 25marks

Sr. no	Particulars	Marks
1	Class test	
	Objective type questions(10)	1/2
	Concept based questions-Answer in one/two sentences (5)	1
	Short notes-answer any two out of three	5
	Total	20
2	Class participation	5

Semester end exam- 75 marks

Sr. no	Particulars
1	No of questions: 5
	Questions 1-4 based on each unit Marks per question:15 No of subdivisions per question:2 a- Short answers-one/two sentences (with internal choice) b- Descriptive type (with internal choice) Question-5 medley of all four units-short notes(with internal choice)
	Total-75

Practical examination pattern

Course	USBTP05	USBTP06	Marks	USBTP07	Marks	USBTP08	Marks
Particulars	Major I	Major I	50	Major I	25	Major I	25
	Major II	Major II	50	Major II	25	Major II	25
	Minor I	Minor I	20	Minor I	10	Project (Skill based)	50
	Minor II	Minor II	20	Minor II	10		
	Journal	Journal	20	Journal	10		
	Viva	Viva	20	Viva	10		
	Identification and spots		20	Spots	10		