

M.PHIL. SYLLABUS – 2015

BIOTECHNOLOGY



DEPARTMENT OF BIOTECHNOLOGY

ST. JOSEPH'S COLLEGE (Autonomous)

Accredited at A Grade (3rd cycle) by NAAC

College with Potential for Excellence by UGC

Tiruchirappalli – 620 002

GUIDELINES FOR FULL TIME M.PHIL.

1. **Duration:** The programme runs for one year consisting of two semesters. The Semester- I is from August to February and the Semester- II runs from March to August, of the following year.

2. Course Work:

Semester - I			Semester - II		
Course	Title	Cr	Course	Title	Cr
C1	Professional Skills for Teaching – Learning	3	C5	Dissertation (Topic selected should be relevant to the topic of the Guide Paper)	8
C2	Research Methodology	4			
C3	Core Course	5			
C4	Guide Paper	5			
Total		17	Total		8

2. a) Each Course should contain 5 units, covering the subject requirements of the courses offered.

Marks for CIA and SE are in the ratio 40 : 60.

The CIA components are **Mid Semester Test (25), End Semester Test (25), Seminar (15), Objective Type Assignment Test (15)**. The total mark 80 will be converted into 40 marks. **The tests and Semester Examination are centrally conducted by COE for 3 hours.**

CIA & SE	Tentatively on
Mid Semester Test	December 2 nd Week
End Semester Test	February 2 nd Week
Semester Examinations	February 4 th Week

Scholar should acquire a **minimum of 20 marks from CIA to appear for SE**. The Scholar should acquire a minimum of 30 marks in Semester Examination. He / She will be declared to have passed in the various courses in Semester I, provided he/she secures not less than 50 marks on an aggregate (CIA+SE).

2. b) (i) In course C1 on **‘Professional Skills for Teaching – Learning’** the first three units are common to all the Departments of the College. The Academic Council has granted permission to incorporate some modifications in the C1 Course by Physics, Computer Science and Mathematics Departments. The first three unit titles are **Soft Skills, E-teaching, E-learning, Elements of Technology of Teaching and Learning**. The remaining two units are department specific to make use of the above mentioned skills & techniques to teach the Core Course.

The C1 Course is (to be) designed to exploit the various Teaching – Learning – Research Skills to be imbibed / cultivated to make the research scholars to be fit for the profession they are likely to acquire in the Education Industry. Thus only for the course (C1) the written component is 60% and Practical component is 40% both in CIA and SE.

b) (ii) **Evaluation for C1:**

Theory Component: For both CIA & SE, there will be a 2 hour test only from the first THREE units. The CIA components are Mid Semester Test (35), End Semester Test (35) and Assignment (30). The total 100 will be converted into 25 marks.

Practical Component: The last TWO units are department specific. There is no Mid and End Semester Tests. But the CIA for the same are assessed continuously by the teacher(s) concerned totaling 15 marks. For SE, the Practical evaluation is done by an external examiner.

- c) Question papers for C1, C2 & C3 are set by External Examiners.
 d) Question paper for C4 will be set and valued by the Research Advisor only.
 e) Departments will be permitted to offer either paper 2 or paper 3 as Open Online Course to the M.Phil. students. The evaluation method will be the same for both C2 and C3 Courses.

3. Credits:

SEMESTER – I	Courses	Title		Contact Hrs.	Library Hrs.	Total Hrs.	Cr	CIA Mk.	SE Mk.	Total Mk.
	C1	Professional Skills for Teaching – Learning	T	3	2	5	2	25	35	60
			P	2	2	4	1	15	25	40
	C2	Research Methodology		5	4	9	4	40	60	100
	C3	Core Course		5	5	10	5	40	60	100
	C4	Guide Paper		5	5	10	5	40	60	100
Total				20	18	38	17	160	240	400

SEMESTER – II	C5 – DISSERTATION	INTERNAL			EXTERNAL		
			Cr	Mk		Cr	Mk
		Seminar & Review of Related Literature	2	15	Dissertation Evaluation	6	75
		Mid Term Review Presentation	2	15	<i>Viva-voce</i>	2	25
		Dissertation Work	3	60			
		<i>Viva-Voce</i>	1	10			
Total			8	100		8	100

4. Question Pattern:

Science	Course	Mid & End Semester Tests and Semester Examinations		
	C1	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C3	Section A : Short Answers Section B : Either / Or – Essay Type	10 5	10 x 2 = 20 5 x 8 = 40
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
Arts	Course	Mid & End Semester Tests and Semester Examinations		
	C1	Section A : Short Answers Section B : Either / Or – Essay Type	7/9 3	7 x 2 = 14 3 x 7 = 21
	C2	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C3	Open Choice : Comprehensive Type	5/8	5 x 12 = 60
	C4	Open Choice : Comprehensive Type	5/8	5 x 12 = 60

5. Dissertation

For carrying out the dissertation, it is mandatory to strictly adhering to the rules of the college as given below:

5.1. Requirement

Every student is expected to give two seminars one concerning Review of Related Literature within the four weeks from the beginning of the second semester and the other on Data Analysis/Result/Mid Term Review just before the submission of the final draft of the dissertation

5.2. Submission

Candidates shall submit the Dissertations to the Controller of Examinations **not earlier than five months but within six months** from the date of the start of the Semester –II. The above said time limit shall start from the 1st of the month which follows the month in which Semester - I examinations are conducted. If a candidate is not able to submit his/her Dissertation within the period stated above, he/she shall be given an extension time of **four** months in the first instance and another **four** months in the second instance with penalty fees. If a candidate does not submit his/her Dissertation even after the two extensions, his/her registration shall be treated as cancelled and he/she has to re-register for the course subject to the discretion of the Principal. However the candidate need not write once again the theory papers if he/she has already passed these papers.

At the time of Submission of Dissertation, the guide concerned should forward the marks for 90% as stated above to the COE in a sealed cover

5.3. All the M.Phil. Scholars (along with their Guides) have to submit at least one Research articles for publication, at the time of submitting the dissertation.

Departments (with the constituted Expert Committee) will scrutinize; select and recommend the best articles for a publication either in RETELL or in School-based Journals.

5.4. Requirement

For the valuation of dissertation it is mandatory to have passed in all the four courses. One external examiner and the Research Adviser shall value the Dissertation. The external examiner should be selected only from outside the college and shall be within the colleges affiliated to Bharathidasan University. In case of non-availability, the panel can include examiners from the other university/colleges in Tamil Nadu. The external examiner shall be selected from a panel of 3 experts suggested by the Research Adviser. However, the Controller of Examination may ask for another panel if he deems it necessary. Both the internal and external examiner will evaluate the Dissertation and allot the marks separately. However the *viva-voce* will be done by both of them. The average marks will be considered.

5.5. Viva-Voce

The external examiner who valued the Dissertation and the Research Adviser shall conduct the *Viva-Voce* for the candidate for a maximum of 100 marks. A Candidate shall be declared to have passed in *viva-voce* if he/she secures not less than 50% of the marks prescribed for Dissertation and 50% of the marks in the aggregate of the marks secured in *viva-voce* and Dissertation valuation. A student can undertake dissertation in the second semester whether or not he/she has passed the first semester.

6. Classification of Successful Candidates

6.1. The candidates who pass the Semester– I and Semester – II examinations in their first attempt shall be classified as follows:

S. No.	Total Marks secured in Semester – I and Semester–II Examinations	Classification
1.	80% and above in the case of Science Subjects & 75% and above in the case of Arts and Social Science Subjects	I Class with Distinction
2.	60% to 79% in the case of Science Subjects & 60 % to 74% in the case of Arts and Social Science Subjects	I Class
3.	50% to 59% in all the subjects	II Class

Note: Mathematics, Statistics and Computer Science/Application shall be treated as Science Subjects

6.2. Candidates who have failed in the courses may take the supplementary exams conducted by the COE immediately. Even then if they could not complete the course(s), they will be given two more chances only to appear for those courses along with the next batch scholars. The maximum duration for the completion of the M.Phil. Programme is 2 Years.

7. Attendance:

Daily attendance for 90 working days should be enforced for the students. Periodical report of a student to the guide concerned should be recorded in the register kept by the guide.

8. The Scholar must obtain 80% of attendance per semester in order to appear for the Semester Examinations/Viva-Voce.

M. PHIL BIOTECHNOLOGY COURSE PATTERN - 2015

Sem	Code	Title of the Paper
I	15 MBT 101	Course – C1: Professional Skills For Teaching – Learning
	15 MBT 102	Course – C2: Research Methodology
	15 MBT 103	Course – C3: Advances in Biotechnology (Open online course)
	15 MBT 104A	Course – C4: Stem Cells and Regenerative Medicine
	15 MBT 104B	Course – C4: Genetic Engineering
	15 MBT 104C	Course – C4: Bioprocess Engineering
	15 MBT 104D	Course – C4: Frontiers in Nutraceuticals
	15 MBT 104E	Course – C4: Microbial Biotechnology
II	15 MBT 205	Course – C5: Dissertation

15MBT101

C1: PROFESSIONAL SKILLS FOR TEACHING – LEARNING

Objectives:

- i. To empower scholars with soft skills
- ii. To introduce the techniques and dynamics of teaching
- iii. To facilitate e-learning/e-teaching with the ICT tools
- iv. To know the material resources for classroom teaching
- v. To introduce soft skill for class room teaching

Unit – I: Soft Skills

- a. Introduction to soft skills, soft skills vs hard skills, types of soft skills
- b. Communicative skills – basics in communication, structure of written and oral sentences, verbal, non-verbal, body language, JOHARI Window, intrapersonal and interpersonal communications, activities in effective communication
- c. Behavioural skills – leadership skills, time management, creativity and lateral thinking
- d. Interview skills – resume writing, different types of interviews, etiquettes in interviews, mock interviews
- e. Team building and group discussion – progressive stages of team building, parameters of GD (special reference to attending, listening, responding skills), mock group GDs

Unit – II: Techniques and dynamics of teaching – learning

- a. Emerging trends in educational psychology – meaning, scope and methods
- b. Learning different theories of learning, approaches to learning (classical conditioning – Ivan Pavlov, operant conditioning – b f skinner); kinds of learning, factors affecting learning
- c. Motivation: intrinsic and extrinsic motivation, development of memory and intelligence

Unit – III: e-Learning and e-Teaching

An overview of MS Office 2007, MS WORDS-2007, MS EXCELL-2007-MS Powerpoint-2007, concepts in e-resources and e-design: world wide web concepts – making use of web resources – website creation concepts – creating web page editions – creating web graphics – creating web audio files

Unit – IV: Practical Skill

Preparation of buffers (Acetate and Phosphate), Preparation of Standard curves. Electrophoresis: PAGE and AGE. Isolation and estimation of genomic DNA (plant and animal), Isolation of plasmid(bacteria), Restriction digestion and ligation. Antigen-Antibody interactions: Immuno electrophoresis-Rocket Immuno electrophoresis and Ouchterlony double immune diffusion. ELISA (Direct), Quantitative precipitin assay. SPSS (Statistical package).

Unit – V: Teaching skill

Preparation and Submission of Teaching aids- Power points, Animated and text materials for teaching the lessons- Teaching 15 hours theory.

References:**Unit – I:**

1. JASS (2013). Winners in the making. Introduction to soft skills. St. Joseph's college, Trichy
2. Murphy, Raymond. (1998). Essential English grammar. 2nd ed. Cambridge university press
3. Trishna (2004). Knowledge system how to do well in GDs and interviews. Reprographic and printing services, secunderabad

Unit – II:

1. Covey, Stephen. (2004). 7 habits of highly effective people, free press
2. Driscoll, M P (1994). Psychology of learning for instruction, Needham, Ma: Allyn and bacon
3. Gardner, Howard (1983; 1993). Frames of mind: the theory of multiple intelligences, new York; basic books

Unit – III:

1. Joyce cox, curtisfrye etc (2007), step by 2007 Microsoft Office system, prentice hall of India Pvt. Ltd, New Delhi

C2-RESEARCH METHODOLOGY

Unit – I:

Microscopy – Fluorescence, Flow cytometry, confocal and Electron Microscope (SEM and TEM). Chromatography: Principles and types- TLC, HPTLC, GC, HPLC, Ion exchange, Size exclusion, Hydrophobic interaction, Gel filtration and Affinity chromatography.

Unit – II:

Electrophoresis: Principles and types- Electrophoresis: PAGE and AGE (DNA&RNA). Blotting Technology- Southern, Northern and Western blot. PCR: Principle and types, Microarray: Principle and types, Gene sequencing: Automated and Pyrosequencing.

Unit – III:

Spectrophotometry: Principle and Instrumentation - UV-Vis, Atomic absorption Spectrophotometry, FTIR, NMR, X-ray Crystallography, MALDI-TOF. Tracer techniques - Nature of radio activity- GM Counter, Scintillation Counter, Auto radiography and applications of isotopes.

Unit – IV:

Research: Definition, Types and objectives- Hypothesis, Characteristics, Literature collection, Writing review and Journal article, Structure of thesis. Impact factor: Plagiarism, Retraction, Research Alert and Scientific red cards. NCBI- Nucleic acids and Protein Sequence Annotation, Submission and Accession. Writing research proposals.

Unit – V:

Biostatistics: Sampling techniques, data collection, classification, and presentation of data, Measures of location: Central values, Dispersions, Skewness, and Kurtosis. Probability: Binomial, Poisson and Normal distributions. Correlation: types and methods, regression analysis (simple, linear), T-test and Chi-square. ANOVA- one and two ways, Principles of experimental design-randomization and replication. Standard designs: CRD and RBD.

References:

1. Maniatis and Sambrook. 2012. Molecular Cloning- A Lab manual (Vol.I,II, III), 4th Ed. Coldspring Harbour Laboratory Press, New York.
2. Wilson K and Walker J.2000. Practical Biochemistry: Principles and Techniques, 5th Ed. Oxford University Press, UK.
3. Glick BR and Pasternak JJ. 2010. Molecular Biotechnology: Principles and applications of recombinant DNA, 4th Ed. ASM Press, Washington, USA.
4. Rudolf J. Freund, Donna Mohr and William J. Wilson. 2010. Statistical methods. 3rd Ed. Academic Press, Elsevier, London.
5. Veerakumari L. 2006. Bioinstrumentation. MJP Publishers, Chennai

Web Based References

<http://www.jkscience.org/archive/volume93/Journal%20Knowledge/impact%20factor.pdf>
<http://www.scientificredcards.org/content/misconduct>
<http://www.infoplease.com/biography/var/eugenegarfield.html#axzzowdMcGvHJ>

15MBT 103

C3: ADVANCES IN BIOTECHNOLOGY (Open Online Course)

Unit – I: Plant Biotechnology

Production of transgenic plants tolerant to biotic stresses. Genetically improved crops (Golden rice). Bt and Terminator - Technology Protecting Systems (GURTs), Clean Gene Technology. Gene silencing: Anti-Sense RNA technology (*Flavr Savr*) and RNA interference. Production technology for Plantigens, Plantibodies, Food vaccines and Bioplastics.

Unit – II: Animal Biotechnology

Animal cell cultures – Primary & Continuous cell lines. Animal Virus derived vectors: SV-40 & Baculovirus. Expression vectors - GST and pET-based vectors; Protein purification: His-tag, GST-tag, MBP-tag and Inclusion bodies. Transgenic mice, fish and sheep. Hybridoma technology and Recombinant vaccines production. Gene therapy, Stem cell technology – Somatic cell, nuclear transfer, Xeno-transplantation.

Unit – III: Microbial Biotechnology

Scope and techniques. Selection and improvement of strains for biomass production, Production of recombinant proteins, enzymes and vaccines in microbes. Bioprospecting of Microbial diversity Bioweapons and Bioshields. Direct Mutagenesis and Protein engineering. Principle of microbial reaction engineering and novel metabolites. Uses of Genetically Engineered Microbes in Agriculture, Industries and Medicine.

UNIT – IV: Nanobiotechnology

Carriers for Drug Delivery: Liposomes Cubosomes, Hexosomes, Virosomes and Virus like Nanoparticles. Microbial Nanoparticles: Magnetosomes and Bacteriorhodopsins. Nanoparticles for Biomedical Imaging-Immuno fluorescent Biomarker – Immuno gold labeling, Iron oxide nanoparticles for Magnetic Resonance Imaging (MRI). Applications of Nanobiotechnology – Biochips, Nucleic acid nanoparticles: Nanotubes and Nanorods. Fullerenes for Drug Delivery.

Unit – V: Ethical Issues in Biotechnology

Biosafety – Biosafety for human health and environment. Social and ethical issues of biosafety. Use of genetically modified organisms (BT cotton and BT brinjal) and their release into the environment. Special procedures for r-DNA based products. Intellectual property rights, patenting (Process and Product). Bioethics - Ethical issues of Synthetic biology and nanobiotechnology.

References:

1. Glick BR and Pasternak JJ. 2010. Molecular Biotechnology: Principles and applications of recombinant DNA, 4th Ed. ASM Press, Washington, USA.
2. Watson JD *et al.*, 2007. Recombinant DNA: Genes and Genomes- a short course. 3rd Ed. Cold Spring Harbor Laboratory Press, CSHL, New York, USA.

3. Brown TA. 2010. Gene cloning and DNA Analysis- An Introduction, 6th Ed. Blackwell Science Ltd. Oxford, UK.
4. Satish MK. 2008. Bioethics and Biosafety. I K International Publishing House Pvt Ltd, India.
5. Deepa Goel and Shomini Parashar. 2013. IPR, Biosafety and Bioethics. 1st Ed. Pearson Education, India

Web source: Open online Course

- a) <http://www.sjctni.edu/Department/BT/OOC/unit1.jsp>
- b) <http://www.sjctni.edu/Department/BT/OOC/unit2.jsp>
- c) <http://www.sjctni.edu/Department/BT/OOC/unit3.jsp>
- d) <http://www.sjctni.edu/Department/BT/OOC/unit4.jsp>
- e) <http://www.sjctni.edu/Department/BT/OOC/unit5.jsp>

For Units

S. No.	Topics	Type of content	Locations
1	Unit I- Plant Biotechnology	PPT and Animated Video	http://www.sjctni.edu/Department/BT/OOC/Plant Biotechnology.ppt and Animated video
2	Unit II-Animal Biotechnology	PPT and Animated Video	http://www.sjctni.edu/Department/BT/OOC/ Animal Biotechnology.ppt and animated video
3	Unit III- Microbial Biotechnology	PPT and Animated Video	http://www.sjctni.edu/Department/BT/OOC/ Microbial Biotechnology. PPT and Animated Video
4	Unit IV-Nano Biotechnology	PPT	http://www.sjctni.edu/Department/BT/OOC/ Nano Biotechnology.ppt
5	Unit V- Ethical Issues in Biotechnology	PPT	http://www.sjctni.edu/Department/BT/OOC/ Ethical Issues in Biotechnology.ppt

C4- STEM CELLS AND REGENERATIVE MEDICINE**Unit – I:**

Stem cells-definition; unique properties- proliferation and differentiation; Potency definitions: totipotent, pluripotent, multipotent and unipotent; Basics of early human embryology; History and key stem cell research event.

Unit – II:

Isolation, culture, identification and assays. Types: unlimited and limited; Embryonic and adult stem cells-bone marrow, cord blood, neural, endothelial, hematopoietic, epithelial, pancreatic, hepatic, glandular, cardiac and gastrointestinal, leukemia and cancer stem cells.

Unit – III:

Stem cells and cloning; Germ line stem cells; Recruiting Donors and Banking hEs Cells; IPRs and hES Cells. Fate mapping of stem cells in experimental systems.

Unit – IV:

Genetically engineered stem cells and experimental therapies. Stem cells based therapies: Stem cells and repair of heart and nervous system; regeneration strategies. Skin replacement, brain cell transplantation and stem cells in aging.

Unit – V:

Controversies and guidelines for hES cell research-Scientific background of hESC research; Ethical and Scientific concerns; Current regulation of human embryonic stem cell research. Future of Stem cells research.

Books:

1. Stewart Sell 2003 (Ed) Stem Cells Handbook, Humana Press, New York.
2. Verma IM and Gage FH 2002 (Ed) Regenerative Medicine, Natl Acad Sci & Engg, USA
3. The Natl Academies, USA 2007 Understanding Stem Cells.
4. The Natl Academies, USA 2002 Stem Cells and the future of Regenerative Medicine
5. Stem Cells Info 2008, NIH USA
6. Terese Winslow 2006 Regenerative Medicine, Natl Acad Sci & Engg, USA
7. Marshak et al., 2000 Stem Cell Biology, CSHL Biology, CSHL press, USA.
8. Regenerative Medicine (2006) NIH, Bethesda, USA.

C4 - GENETIC ENGINEERING**Unit – I:**

Genetic engineering-potentialities and limitations. Enzymes used in cutting DNA; Type I, II and III endonuclease, DNA modifying enzymes; Nucleases, polymerases, enzymes that modify ends of DNA molecules, DNA ligase.

Unit – II:

Cloning vectors: Genetic organization and utility of plasmids, Cosmids, Phagemids, BAC, YAC, Single stranded vectors, Shuttle vectors, role of adaptors, linkers, homopolymers in recombinant DNA technology.

Unit – III:

Recombinant selection techniques: Blotting techniques- Southern, Northern, Western and South-Western. DNA amplification techniques-PCR, RFLP, RAPD and DNA fingerprinting, DNA sequencing techniques, Cloning strategies for cDNA and genomic DNA.

Unit – IV:

Methods of gene transfer to plants and animals: natural gene transfer through gene transfer. Vector-less methods of gene transfer: Chemically mediated transfection, microinjection, lipofection, electroporation, nuclear transplantation, scrapefection. Gene knocksin and gene knocksout techniques.

Unit – V:

Production of Transgenic plants for pest resistance, herbicide, drought and salt tolerance. Production of transgenic animals for Insulin and Somatotropin, Stem cell technology, Xenografting. Biosafety aspects of transgenics, legal, ethical and environmental aspects of transgenics. Applications of genetically modified organisms.

Text Book (s)

1. Desmond ST. Nicholl.2004. An Introduction to Genetic Engineering. Cambridge University Press, UK.
2. Old R.N and Primros SB., 2004, Principles of Gene Manipulation-Blackwell Scientific Publications. USA.
3. Brown, TA. 2006. Gene Cloning and DNA. Analysis An Introduction. Blackwell Scientific Publications,5thedition.

Books for Reference:

1. Glover DM and BD Hames 1995. DNA cloning I and II IRL press.
2. Glover DM 1984. Gene cloning, Chapman and Hall, New York.
3. Glick BR. and Pasternak JJ., 1998, Molecular Biotechnology, ASM press Washington.
4. Sambrook, J.*et al.*,2001, Molecular Cloning-A Laboratory Manual. Spring Harbor Laboratory Press, New York.
5. Watson *et al.*, 1992, Recombinant DNA. Scientific American Books, New York.

C4 - BIOPROCESS ENGINEERING**Unit – I:**

Microbial growth kinetics: Introduction to Fermentor. Comparison of batch and continuous culture in industrial processes. Isolation, improvement and preservation of industrially important microorganisms.

Unit – II:

Media for industrial fermentations: Media formulation, energy sources, growth factors, precursors, inhibitors, inducers, oxygen requirements, media optimization, sterilization fermentor, feeds, liquid wastes and filter sterilization.

Unit – III:

Design of a Fermentor: Basic functions of a fermentor for microbial, animal cell culture. construction, aeration agitation and baffles. Valves and steam traps, other fermentor types: tower, airlift, deep jet, packed tower and stirred type.

Unit – IV:

Instrumentation and control: methods of measuring process variables, on line analysis, control systems-manual and automatic control, computer applications in fermentation technology. Physical and chemical sensors for the medium and gases, online sensors for cell properties, Off-line analytical methods.

Unit – V:

Recovery and purification: Removal of microbial cells and other solid mater. Precipitation, Filtration, centrifugation, cell-disruption-physical, mechanical and chemical methods. Chromatography, membrane process, drying, crystallization. Bioprocess economics.

Text Book (s):

1. Stanbury, PF. and Whitakar, A.1984. Principles of Fermentation Technology, Pergamon Press.

Books for Reference

1. Pepler HJ and Perriman D.2004. Microbial Technology, Vol I,II,III. Academic press, USA
2. Schuler, M and Kargi, F.2002. Bioprocesses Engineering-Basic concepts, Prantice Hall Pub.NJ
3. Crueger, W and Crueger, A.2004.Text book of Industrial Microbiology. Panima publishers, Bangalore.
4. Pauline Doran,2010.Bioprocess Engineering Principles, Elsevier, UK

C4 - FRONTIERS IN NUTRACEUTICALS**Unit – I:**

Nutraceuticals and phytochemicals: Basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX. Use of nutraceuticals in traditional health sciences such as Siddha, Ayurveda, Unani and Chinese.

Unit – II:

Natural occurrence of certain phytochemicals in foods, Antioxidants and flavonoids, Omega-3 fatty acids, carotenoids, dietary fiber, phytoestrogens; glucosinates; organosulphur compounds. Scientific, clinical evidence and *in vivo* & *in vitro* research studies. Regulatory issues.

Unit – III:

Concept of angiogenesis and the role of nutraceuticals; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels and contraindications.

Unit – IV:

Prebiotics and Probiotics: Usefulness of prebiotics and probiotics in gastro intestinal health and other benefits. Beneficiary microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes.

Unit – V:

Development of Functional foods - Uses of bioactive compounds: Protective substances and activators; Development of biomarkers to indicate efficacy of functional ingredients; Clinical testing of nutraceuticals and health foods; interactions of prescription drugs and nutraceuticals; adverse effects and toxicity of nutraceuticals; Nutrigenomics – an introduction and its relation to nutraceuticals.

Text Book(s)

1. Shi, J. 2007. Functional Food Ingredients and Nutraceuticals: Processing Technologies. Taylor & Francis Publ. CRC Press.
2. Yashwant Vishnupant Pathak. 2009. Handbook of Nutraceuticals Volume I: Ingredients, Formulations, and Applications. CRC Press – Taylor and Francis Group, USA.
3. Brigelius-Flohe, J and Joost, HG. 2006. Nutritional Genomics: Impact on Health and Disease. Wiley-VCH
4. Semih Otles. 2013. Probiotics and Prebiotics in Food, Nutrition and Health. CRC Press – Taylor and Francis Group, USA.
5. Zdzislaw E. Sikorski. 2006. Chemical and Functional Properties of Food Components, 3rd Ed. CRC Press – Taylor and Francis Group, USA.
6. Yashwant Vishnupant Pathak. 2011. Handbook of Nutraceuticals Volume II: Scale-Up, Processing and Automation. CRC Press – Taylor and Francis Group, USA.

Books for Reference:

1. Aluko, Rotimi E. 2012. Functional Foods and Nutraceuticals. Springer books, USA
2. Lynnette R. Ferguson. 2013. Nutrigenomics and Nutrigenetics in Functional Foods and Personalized Nutrition. CRC Press – Taylor and Francis Group, USA.
3. Mohammed H. Moghadasian and N.A. Michael Eskin. 2012. Functional Foods and Cardiovascular Disease. CRC Press – Taylor and Francis Group, USA.
4. Dilip Ghosh, Debasis Bagchi and Tetsuya Konishi. 2014. Clinical Aspects of Functional Foods and Nutraceuticals. CRC Press – Taylor and Francis Group, USA.

C4 - MICROBIAL BIOTECHNOLOGY**Unit – I:**

General concepts of Microbial biotechnology. Microorganisms as factories for the production of novel compounds. Genetic engineering of microbes to improve production of antibiotics, amino acids, Lipids, enzymes, steroids and secondary metabolites. Biopolymers and bioplastics.

Unit – II:

Definition, concepts-history, biotechnological potentials of microalgae-food – feed – colourant - fuel and Pharmaceutically valuable compounds. Cultivation methods of microbial biofertilizers - Cyanobacteria, Rhizobium, Azospirillum, Phosphobacteria and AM fungi.

Unit – III:

Biological pest control, scheme for selection of microbial antagonist for biological control of insects, bacterial, fungal and viral diseases. Mode of action of biological control involved in different biocontrol agents. Genetics of antimicrobial metabolites production in biocontrol bacteria. Risks associated with GMOs, Potential impacts on the environment and human health.

Unit – IV:

Bioconversion of cellulosic and non-cellulosic wastes: Mechanism of novel Carboxylase genes involved in bioconversion. Agro by-products. Bioremediation of wood, fuels, lubricants, rubber and plastics.

Unit – V:

Waste utilization: Waste water treatment –Aerobic and Anaerobic processes, Treatment schemes for waste water of dairy, distillery, tannery, sugar, antibiotic industries. Sewage disposal, compost making, methane generation. Hydrocarbons, Substituted hydrocarbons, oil pollution, surfactants, Pesticides.

Text Book(s)

1. Bernad R. Glick and JJ Pasternak.2003. Molecular Biotechnology: Principles and Applications of Recombinant DNA. WCB.
2. Desilva EJ, Domm Ergues YR, Nyns EJ, Ratledge C.1987. Microbial technology in the Developing world, Oxford Scientific Publications.

Reference Book (s)

1. Prescott and Dunn. 1992. Industrial Microbiology. 4e(Pb) 2004. CBS Publishers, Westport.
2. Watson, JD, Hopkins NH, Roberts JW, Steitz JA, Weiner AM.1987. Molecular Biology of the Gene. The Benjamin Cummings.
