



# ವಿಶ್ವೇಶ್ವರಯ್ಯ ತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ

"ವಿಜ್ಞಾನ ಅಧಿನಿಯಮ ೧೯೯೪"ರ ಅಡಿಯಲ್ಲಿ, ಕರ್ನಾಟಕ ಸರ್ಕಾರದಿಂದ ಸ್ಥಾಪಿತವಾದ ದಾಖ್ತೆ ವಿಶ್ವವಿದ್ಯಾಲಯ  
"ಜ್ಞಾನ ಸಂಗಮ", ಬೆಳಗಾವಿ-೫೯೦೦೧೮, ಕರ್ನಾಟಕ, ಭಾರತ

## Visvesvaraya Technological University

(State University of Government of Karnataka Established as per the VTU Act, 1994)

"Jnana Sangama" Belagavi-590018, Karnataka, India  
Phone: (0831) 2498100, Fax: (0831) 2405467, Website: vtu.ac.in

**Dr. A. S. Deshpande** B.E., M.Tech., Ph.D.  
Registrar

Phone: (0831) 2498100  
Fax: (0831) 2405467

Ref: VTU/BGM/BOS/A9/2020-21 / 31

Date: -2 APR 2021

### CIRCULAR

**Subject:** Updated Open Elective Subjects syllabus in B.E. in Biotechnology of 2018 scheme regarding.

**Reference:**

1. Chairperson BOS in Biotechnology email dated 26.03.2021 and BOS Proceedings dated 12.02.2021
2. Hon'ble Vice-Chancellor's approval dated 31.03.2021

Concerning the subject cited above, the OPEN Elective subjects' syllabi of B.E. in Biotechnology program(2018 scheme) are updated. The complete list of subjects along with the syllabus is enclosed with this circular for kind reference to the concerned. And also updated scheme and syllabus is uploaded on the VTU web portal @ <https://vtu.ac.in/en/b-e-scheme-syllabus/#menu0>

All the Principals of Engineering Colleges are hereby requested to inform the faculty of the Biotechnology department to counsel the students regarding the OPEN elective subjects  
Encl: As mentioned above

Sd/-  
REGISTRAR

To,

- All the Principals of the Engineering Colleges under the ambit of VTU Belagavi.

**Copy to:**

1. The Registrar(Evaluation) for information and needful
2. The Registrar's Office, VTU, Belagavi, for information.
3. The Special Officer, Academic Section, VTU Belagavi, for information.
4. The Special Officer CNC section to upload the circular on the VTU web portal.

  
REGISTRAR  


## ANNEXURE -1

### REVISED CONTENTS FOR THE OPEN ELECTIVES -1

<b>OpenElective -A</b>	
<b>Course code under 18BT65X</b>	<b>Course Title</b>
18BT651	BIOLOGY FOR ENGINEERS (syllabus Modified)
18BT652	BIOMATERIALS (syllabus Modified)
18BT653	NANOBIOTECHNOLOGY (syllabus Modified)

B.E BIOTECHNOLOGY Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER - VI			
<b>BIOLOGY FOR ENGINEERS</b>			
Course Code	<b>18BT651</b>	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<ul style="list-style-type: none"> <li>• To know the fundamentals of biological cellular systems and related class of biomolecules involved.</li> <li>• To learn about the various bioengineering applications as case studies.</li> <li>• To explore solving biological problems with engineering knowledge and tools.</li> </ul>			
<b>Module-1</b>			
<b>BASIC CELL BIOLOGY:</b>			
Introduction to Biology and Bioengineering concepts, The cell structure (Prokaryotes and Eukaryotes), Cell types (microbial, plant, animal) and their Cell Organelles (Nucleus, Endoplasmic reticulum, Golgi apparatus, Mitochondria, Chloroplast, Lysosome, Peroxisome etc.), Cell cycle and cell division (Mitosis and Meiosis), Factors affecting cell growth (Prokaryotes - Bacteria and Eukaryotes – Somatic Cells), Stem cells - types and their applications. Cancer and its types (carcinoma, sarcoma, melanoma, lymphoma, and leukemia), Cell staining and imaging (Gram staining, Fluorescence staining), cell sorting and counting (FACS – its principle and instrumentation).			
<b>Module-2</b>			
<b>BIOMOLECULES:</b>			
Qualitative information about Biomolecules (Carbohydrates, Lipids, Amino acids and Proteins, Nucleic acids – classification, source and their functions. Vitamins and Hormones – types and functions (qualitative). Bonds in Biomolecules (covalent and non-covalent); basic unit of life: double helical structure of DNA, Central dogma of biology: DNA to RNA to Protein; DNA Replication (qualitative), Protein synthesis - Transcription and translation as a flow diagram, Protein architecture (primary, secondary, tertiary and quaternary with examples) and their specific functions.			
<b>Module-3</b>			
<b>ENZYMES AND APPLICATIONS:</b>			
Enzymes and classification (6 classes), comparison of chemical catalysts and enzymes, Active site, Enzyme action (Lock & key and Induced fit hypothesis), Catalysis - factors affecting (temperature, pH, substrate concentration, Enzyme concentration and inhibitors – reversible and irreversible), Enzyme Immobilization and their applications, Applications of enzymes (cellulases in textile and paper industry, amylases food and baking industry, proteases in food and leather industry, lipases in detergents and biofuels, carbonic anhydrase in fermentation industry, restriction enzymes in genetic engineering). Enzymes in glucose biosensor and urea biosensor.			
<b>Module-4</b>			
<b>BIOMATERIALS AND BIOMECHANICS:</b>			
Introduction, Biomaterials and its properties, scaffolds and body implants. Collagen, silk fibroin, heparin and heparin-like polysaccharides, proteoglycans, microbial glycosaminoglycan, Gelatin - their			

applications. Surface immobilization of biomaterials. Biomaterials in cell growth and culture, biomaterials in wound healing. Protein as biological motors/molecular machines (rotatory – ATP synthase complex and Flagella and linear – kinesin, Dynein and myosin).

### Module-5

#### BIOENGINEERING APPLICATIONS:

Basics concepts of Biodesigns/Biomimicry/Biomimetics (learning from spider, gecko feet, flight of birds, shape of beaks), Qualitative correlation of Eye as a Camera, Heart as a pump, Kidney as a filtration system, Lungs as purification system. Bioprinting techniques, 3D printing of ear, cornea, bone and skin. Biosensors - Electrical tongue and electrical nose, DNA origami and superconducting nanowires, Robotic arms for prosthetics / spastics. ECG monitoring and heart related issues, EEG and its monitoring in neurological disorders (Alzheimer's, Parkinson's, paralysis, and epilepsy). Examples related to Bioconcrete (production of calcium carbonate through bio mineralization) and Bioremediation (for removal of heavy metals like Lead, Cadmium, Mercury and Arsenic).

#### Course outcomes:

- To understand the fundamentals of biological cellular systems and related class of biomolecules involved.
- To analyze the various bioengineering applications and their merits, in the domains like biomechanics, biomaterial sciences, bio-design, biosensors, bioremediation etc.
- To apply bioengineering knowledge and tools for solving societal relevant problems.

#### Question paper pattern:

1. The question paper will have ten full questions carrying equal marks.
2. Each full question will be for 20 marks.
3. There will be two full questions (with a maximum of four sub- questions) from each module.
4. Each full question will have sub- question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Sl. No.	Title of the Book	Name of the Authors	Name of the Publisher	Edition and Year
<b>Text Books</b>				
1.	Biology for Engineers	ThyagaRajan.S., Selvamurugan. N., Rajesh.M.P.,Nazeer.R.A., Richard W. Thilagaraj, Barathi.S., and Jaganthan.M.K	Tata McGraw Hill	2012
<b>Reference Books</b>				
1.	Biochemistry	Jeremy M. Berg, John L. Tymoczko and Lubert Stryer	W.H. Freeman and Co. Ltd.	6th Ed., 2006.
2.	Robert Weaver	Molecular Biology	MCGraw-Hill	5th Edition, 2012.
3.	Biosensors - A Practical Approach	Jon Cooper	Bellwether Books	2004
4.	Biodegradation and Bioremediation	Martin Alexander	Academic Press,	1994
5.	Biomaterials - Science and Engineering	J B Park	Plenum Press	1984
6.	Fundamental of Biomechanics	Duane Knudson	Springer	2007
<b>Web links and Video Lectures</b>				

B.E BIOTECHNOLOGY			
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)			
SEMESTER - VI			
BIOMATERIALS			
Course Code	<b>18BT652</b>	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<ul style="list-style-type: none"> <li>☑ To learn about various biomaterials and its properties,</li> <li>☑ To learn about the manufacturing methods of some of the biomaterials</li> <li>☑ To learn about the applications of biomaterials</li> </ul>			
<b>Module - 1</b>			
<b>INTRODUCTION:</b>			
Introduction, Historical developments, Implants and implant materials, Performance, thermal treatments, surface improvements, sterilization and applications of metallic, composites, ceramics, biodegradable polymers and hydrogels, carbon materials. Examples include Stainless steel, Cobalt-Chromium alloys, Titanium based alloys, Nitinol, other metals, Carbons, Alumina, Ytria stabilized zirconia.			
<b>Module-2</b>			
<b>BIOPOLYMERS:</b>			
Polymers as biomaterials, microstructure, mechanical properties – effects of environment on elastic moduli, yield strength and fracture strengths, Biocompatibility of polymers, heparin and heparin-like polysaccharides, proteoglycans, heparin like substances from non-glycosaminoglycan polysaccharides and microbial glycosaminoglycan, surface immobilized heparins..			
<b>Module-3</b>			
<b>SYNTHETIC POLYMERS:</b>			
Polymers in biomedical use, polyethylene and polypropylene, perfluorinated polymers, acrylic polymers, hydrogels, polyurethanes, polyamides, biodegradable synthetic polymers, silicone rubber, plasma polymerization, micro-organisms in polymeric implants, polymer sterilization.			
<b>Module-4</b>			
<b>BIOCOMPATIBILITY:</b>			
Definition, Wound healing process-bone healing, tendon healing. Material response: Function and Degradation of materials in vivo. Tissue response to biomaterials, Methods of test for biological performance, In vitro implant tests, Qualification of implant materials. Tissue replacement biomaterials (soft and hard).			
<b>Module-5</b>			
<b>CARDIOVASCULAR BIOMATERIALS:</b>			
Tissue properties of blood vessels, Treatments of atherosclerosis; Biomechanical design issues pertaining to stents, balloon angioplasty, and pacemakers. Soft Tissue Reconstruction; Natural and Synthetic. Wound healing. Tissue ingrowths: Stability; Biofixation, Foreign Body response, Soft implants. Case Studies. Tissue Engineering: Current issues and Future Directions			
<b>Course outcomes:</b>			
•			
<b>Question paper pattern:</b>			
<ol style="list-style-type: none"> <li>1. The question paper will have ten full questions carrying equal marks.</li> <li>2. Each full question will be for 20 marks.</li> <li>3. There will be two full questions (with a maximum of four sub- questions) from each module.</li> <li>4. Each full question will have sub- question covering all the topics under a module.</li> <li>5. The students will have to answer five full questions, selecting one full question from each module</li> </ol>			

Sl. No.	Title of the Book	Name of the Authors	Name of the Publisher	Edition and Year
<b>Text Books</b>				
1	Biomaterials Science : An Introduction to materials in Medicine	Buddy D Ratner	Academic Press	1996
2.	Biomaterials, Medical Devices and Tissue Engineering	Frederick H	Chapman and Hall	1994
3.	Biomaterials	Sujata V. Bhat	Narosa Publishing House	2002
<b>Reference Books</b>				
1.	Biomaterials - Science and Engineering	J B Park	Plenum Press	1984
2.	Polymeric Biomaterials	Piskin and A S, Hoffmann, MartinusNijhoff	Springer	1986
<b>Web links and Video Lectures</b>				

B.E BIOTECHNOLOGY Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER - VI <b>NANOBIOTECHNOLOGY</b>			
Course Code	<b>18BT653</b>	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<input checked="" type="checkbox"/> To understand the field of nano-biotechnology, <input checked="" type="checkbox"/> To learn the principles behind nanobiotechnology <input checked="" type="checkbox"/> To comprehend the current applications of nanobiotechnology and its scope			
<b>Module - 1</b>			
<b>INTRODUCTION:</b>			
A Brief History, Definition of nanotechnology, Nanobiotechnology v/s Bionanotechnology, Bottom-Up versus Top-Down approaches; Methods of synthesis of nanoparticles – Physical (bead mill, laser ablation) chemical (sol-gel, precipitation, chemical reduction) and biological (use of microbes, enzymes, plant materials), parameters affecting nanoparticle growth, shape, size and structure. Structure-property relationships in materials, Nanolithography-UV and electron beam. Fabrication in Soft Materials: Hydrogels/PDMS/other polymers for biological applications.			
<b>Module-2</b>			
<b>NANOMATERIALS AND THEIR CHARACTERIZATION</b>			
Fullerenes - Buckyballs, carbon nanotubes, Carriers, Dendrimers, Nanoparticles, Nanocomposites, Nanoshells, Quantum Dot, Principle, Instrumentation and applications of UV, FTIR, Raman shift, Surface Plasmon resonance (SPR), SEM, TEM, Atomic force microscopy Dynamic light scattering (DLS), XRD.			
<b>Module-3</b>			
<b>NANOMOLECULAR DIAGNOSTICS:</b>			
Rationale of Nanotechnology for molecular diagnostics, Bio-functionalization methods, Nanoparticles like Gold, Quantum Dots, and Magnetic Nanoparticles in diagnostics, Bio-nanohybrids-with relevant applications. Nanopore technology, Nano arrays. Nanobiosensors: cantilever, carbon nanotube, nanowires. Pathogen detection by magnetic nanoparticle-based techniques. Nanobiotechnological applications in Environment and Food - detection and mitigation of pollutants and adulterants. Miniaturized devices in nanobiotechnology - types and applications, lab on a chip concept.			

<b>Module-4</b>				
<b>BIOMEDICAL AND LIFE SCIENCES APPLICATIONS:</b>				
Introduction to nanomedicine, nanocapsules, nanorobots, nanopharmacology. Use of micro needles and nanoparticles for local highly controlled drug delivery. Nanotechnology products and applications in ocular, oncology, neurology and cardiology. Functions and applications of DNA based nanostructures, Biomimetic fabrication of DNA based metallic nanowires and networks, Biomolecular nanomotors (ATP synthase complex and flagella).				
<b>Module-5</b>				
<b>ETHICS, SAFETY AND REGULATORY ASPECTS</b>				
Introduction, ethical, legal and social implications of Nano medicine, and nano-bio-products, Safety concerns - Health Risks, and Challenges. Assessment of the toxic effects of nanoparticles based on <i>in-vitro</i> & <i>In-Vivo experiments</i> . Case studies. Environmental effects, public perceptions, Guidelines and regulatory aspects and evaluation of Nano pharmaceuticals in India, Europe and USA, challenges and risks associated with Markets for Nano medicine. Trends in Research and education.				
<b>Course outcomes:</b>				
<ul style="list-style-type: none"> <li>• Define nano-biotechnology as an emerging field and its scope.</li> <li>• Understand the principles and applications of the technology in various fields</li> </ul>				
<b>Question paper pattern:</b>				
<ol style="list-style-type: none"> <li>1. The question paper will have ten full questions carrying equal marks.</li> <li>2. Each full question will be for 20 marks.</li> <li>3. There will be two full questions (with a maximum of four sub- questions) from each module.</li> <li>4. Each full question will have sub- question covering all the topics under a module.</li> <li>5. The students will have to answer five full questions, selecting one full question from each module</li> </ol>				
Sl. No.	Title of the Book	Name of the Authors	Name of the Publisher	Edition and Year
<b>Text Books</b>				
1	Nanobiotechnology: Concepts, Applications and Perspectives	Niemeyer, C.M. and Mirkin C A	Wiley-VCH	2004
2	Nanobiotechnology Protocols	Rosenthal, Sandra J and Wright, David W.,	Humana Press.	2005
3	Biological molecules in Nanotechnology	Stephen Lee and Lynn M Savage	International Business Communications, Inc.	1998
<b>Reference Books</b>				
1.	Nanobiotechnology: Bioinspired devices and materials	Shoseyov, O. and Levy, I.,	Humana Press	2007
2.	Nanobiotechnology Human Health and the Environment	AlokDhawan, Sanjay Singh, Ashutosh Kumar, Rishi Shanker	CRC Press	2018
<b>Web links and Video Lectures</b>				



Open Elective –B	
Course code under 18BT75X	Course Title
18BT751	BT for sustainable Environment (No Change in Syllabus)
18BT752	Forensic Science(No Change in Syllabus)
<b>18BT753</b>	<b>Food, Nutrition and Human Health (Change in Title and Syllabus)</b>

B.E BIOTECHNOLOGY			
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)			
SEMESTER - VI			
FOOD, NUTRITION AND HUMAN HEALTH			
Course Code	<b>18BT753</b>	CIE Marks	40
Teaching Hours/Week (L:T:P)	(3:0:0)	SEE Marks	60
Credits	03	Exam Hours	03
<b>Course Objectives:</b>			
<ul style="list-style-type: none"> <li>To familiarize students with fundamentals of food, nutrients and their relationship to health.</li> <li>To create awareness with respect to deriving maximum benefit from available food resources.</li> </ul>			
<b>Module - 1</b>			
<b>Basic aspects in Food and Nutrition</b>			
<p>Concept of Health, related terminologies. Terms used in study of food and nutrition, Relationship between foods, nutrition and health, Functions of food - Physiological, psychological and social.</p> <p>Micro and Macro-Nutrients: Functions, dietary sources and clinical manifestations of deficiency/excess of the following nutrients: Carbohydrates and dietary fibre, lipids and proteins Fat soluble vitamins - A, D, E and K, Water soluble vitamins – thiamin, riboflavin, niacin, pyridoxine, folate, Vitamin B12 and Vitamin Minerals – calcium, iron and iodine, Recommended Dietary Allowances,</p>			
<b>Module-2</b>			
<b>Balanced diet and Nutrition</b>			
<p>Dietary guidelines for Indians, Food pyramid, Balanced Diet and the factors affecting the planning of diets, Dietary Pattern, Physiological considerations and nutritional concerns for the following life stages: pediatrics and infant meal plans, Preschool children, Adolescent children, Adult man / woman, Pregnant and lactating women, meal plan for geriatrics. Role of dietitians. Nutrition for physical fitness and sports, Techniques of measuring body composition, BMI, BMR, work capacity, physical fitness lung capacity. Nutritional demands of sports and dietary, recommendations.</p>			
<b>Module-3</b>			
<b>Nutritional deficiency and diseases</b>			
<p>Nutritional deficiency diseases, Protein Energy Malnutrition, Biological Value, Protein Efficiency ratio, Vitamin A Deficiency (VAD), Iron Deficiency Anemia (IDA), Iodine Deficiency Disorders (IDD), Zinc Deficiency, Fluorosis. Pathophysiology of insulin resistance. Obesity - etiology, clinical assessment, treatment approaches, consequences of obesity and its prevention. Diabetes mellitus, aims of dietary treatments, special dietary consideration for type I and II diabetics, complications of diabetes. Diseases of the heart and blood vessels - etiology, symptoms and diagnosis; atherosclerosis, lipids and other dietary factors responsible for coronary heart diseases (CHD). Dietary habits during CHD, hypertension, congestive heart failure and hyperlipidemia.</p>			
<b>Module-4</b>			
<b>FOOD PROCESSING</b>			
<p>Nutrient Losses during processing, preventive measures; Selection, nutritional contribution and changes during cooking of the following food groups: Cereals, Pulses, Fruits and vegetables, Milk &amp; milk products, Eggs, Meat, poultry and fish, Fats and Oils. Methods of cooking/baking: Dry, moist, frying and microwave cooking; Advantages, disadvantages and the effect of various methods of cooking on nutrients, methods to minimize nutrient losses.</p>			
<b>Module-5</b>			
<b>Food product development and Entrepreneurship</b>			
<p>New food products &amp; food product development- Concepts, definitions &amp; characteristics. Factors to</p>			

consider for food product development (external and internal factors); Reasons for food product development- market concerns, consumer demands, societal changes, technological concerns, corporate influences, governmental influences; Types of new food products - Line extensions, “me too”, new to world products, innovative/creative products, existing products- repositioned, reformulated, new forms, new size and new package, FSSAI, HACCP - standards and guidelines.

**Course outcomes:**

- To understand the correlation between Food, nutrition and Health
- To apply the knowledge towards managing health and diseases
- To know about the methods of food processing with minimal nutritional losses.
- To related the aspects of food product development and prospects of entrepreneurial opportunities.

**Question paper pattern:**

1. The question paper will have ten full questions carrying equal marks.
2. Each full question will be for 20 marks.
3. There will be two full questions (with a maximum of four sub- questions) from each module.
4. Each full question will have sub- question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Sl. No.	Title of the Book	Name of the Authors	Name of the Publisher	Edition and Year
<b>Text Books</b>				
1	Essentials of Foods and Nutrition	M. Swaminathan	Ganesh & Company Madras	Vol-I and Vol-II, 1995
2	Fundamentals of Foods, Nutrition and Diet Therapy	Mudambi, S.R and Rajagopal, M V	New Age International Publishers	Fifth Ed; 2012
3	A Manual for Entrepreneurs: Food Processing Industry	Awasthi D, Jaggi R and Padmanand V.	Tata McGraw-Hill Publishing Limited	2006
<b>Reference Books</b>				
1.	Chemical changes in Food during Processing	Richardson T and Finley JW	CBS Publishers & Distributors	1997
2.	Diet Planning through the Life Cycle: Part 1 Normal Nutrition. A Practical Manual.	Seth V and Singh K	Elite Publishing House Pvt. Ltd. New Delhi	2006
<b>Web links and Video Lectures</b>				