**Course Outcomes**

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| **2015 Scheme** | **2017 Scheme** | **2018 Scheme** |
| **15MAT31-Engineering Mathematics-III** | **17MAT31-Engineering Mathematics-III** | **18BT41-Biostatics-(AE)**CO1:Application of data distribution in biotechnology problems, concepts about histogram, frequency curveCO2:Describe the abilities of central tendency and importance of statistics in biologyCO3: Applying the concepts of design of experiments by statistical method of analysisCO4:Illustrste the concept relating to discrete, continuous statistical concepts relating to binominal distribution, Normal distribution and regression analysisCO5: Study the importance of concepts of t-test, F-test, Chi-square test, ANOVA, factorial design and cluster design |
| **15BT32-Unit Operations-(KMV)**CO1: Describe the rheological behavior of fluidsCO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equationCO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.CO4: Analyze the heat governing laws and explain the about heat transfer equipmentsCO5: Evaluation of various mass transfer operations | **17BT32-Unit Operations-(KMV)**CO1: Describe the rheological behavior of fluidsCO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equationCO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.CO4: Analyze the heat governing laws and explain the about heat transfer equipmentsCO5: Evaluation of various mass transfer operations | **18BT32-Microbiology-(HPP)**CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organismCO2: Understanding of microbial techniques for isolation, growth and characterization of microbesCO3: Analyse different types of growth patterns, metabolites and metabolic pathwaysCO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases.  |
| **15BT33-Biochemistry-(SG)**CO1: Explain the basic types of chemical reactions and biomoleculesCO2: Analyze high energy molecules and Photosynthesis reactionsCO3: Illustrate about transport mechanism across the cell membrane and analyze its regulationCO4: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulations | **17BT33-Biochemistry-(VM)**CO1: Explain the basic types of chemical reactions and biomoleculesCO2: Analyze high energy molecules and Photosynthesis reactionsCO3: Illustrate about transport mechanism across the cell membrane and analyze its regulationCO4: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulations | **18BT33-Unit Operation-(KMV)**CO1: Describe the rheological behavior of fluidsCO2: Examine the principle of flow measuring instruments and analyze the application of Bernoulli equationCO3: Apply the principles of various mechanical operations like size reduction, sedimentation, filtration and mixing.CO4: Analyze the heat governing laws and explain the about heat transfer equipmentsCO5: Evaluation of various mass transfer operations |
| **15BT34-Microbiology-(RKC)**CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organismCO2: Understanding of microbial techniques for isolation, growth and characterization of microbesCO3: Analyse different types of growth patterns, metabolites and metabolic pathwaysCO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases.CO5: Describe the biogeochemical cycles and microbial pollutants present in water soil and air | **17BT34-Microbiology-(BBM)**CO1: Able to learn the classification, structural features and functional aspects of prokaryotic and eukaryotic organismCO2: Understanding of microbial techniques for isolation, growth and characterization of microbesCO3: Analyse different types of growth patterns, metabolites and metabolic pathwaysCO4: Outline the role of microorganisms towards environmental protection, industrial applications and infectious diseases.CO5: Describe the biogeochemical cycles and microbial pollutants present in water soil and air | **18BT34-Introduction to Biomolecules** CO1: Explain the foundational principles of biomolecules’ structure and their functionCO2: Analyze high energy molecules and Photosynthesis reactionsCO3: Illustrate about transport mechanism across the cell membrane and analyze its regulation |
| **15BT35-Cell biology & Genetics (SC)**CO1: Generalizing a on contemporary knowledge of cytoskeletal architectureCO2: Describe cell structure and functionCO3: Understand and analyze the principles and concept of genetics and population geneticsCO4: Appraise inherited disorders on the basis of heredity | **17BT35-Cell biology & Genetics (SC)**CO1: Generalizing a on contemporary knowledge of cytoskeletal architectureCO2: Describe cell structure and functionCO3: Understand and analyze the principles and concept of genetics and population geneticsCO4: Appraise inherited disorders on the basis of heredity | **18BT35-Cell biology & Genetics (SC)**CO1: Generalizing a on contemporary knowledge of cytoskeletal architectureCO2: Describe cell structure and functionCO3: Understand and analyze the principles and concept of genetics and population geneticsCO4: Appraise inherited disorders on the basis of heredity |
| **15BT36-Basics of computer application**CO1: Understand C- language with updated toolCO2: Apply the basic concepts of MATLAB, Internet. CO3:Use the software with special reference to biotechnological applications | **17BT36-Basics of computer application**CO1: Understand C- language with updated toolCO2: Apply the basic concepts of MATLAB, Internet. CO3:Use the software with special reference to biotechnological applications | **18BT36-Phyton Programming**CO1: Develop algorithmic solutions to simple computational problemsCO2: Read, write, execute by hand simple Python programs.CO3: Structure simple Python programs for solving problems.CO4: Decompose a Python program into functions. |
| **15BTL37-Unit Operation Laboratory**CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instrumentsCO2. Illustrate the fluid flow problems with the application of momentum and energy equations CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies | **17BTL37-Unit Operation Laboratory**CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instrumentsCO2. Illustrate the fluid flow problems with the application of momentum and energy equations CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies | **18BTL37-Microbiological Lab**CO1. Use different laboratory equipment and instruments for microbiological operations CO2. Prepare the media and use for the cultivation of the microbesCO3. Perform laboratory experiments for the isolation, identification and characterization of microorganismsCO4. Determination and evaluation of microbial load and its control |
| **15BTL38-Microbiological Lab**CO1. Use different laboratory equipment and instruments for microbiological operations CO2. Prepare the media and use for the cultivation of the microbesCO3. Perform laboratory experiments for the isolation, identification and characterization of microorganismsCO4. Determination and evaluation of microbial load and its control | **17BTL38-Microbiological Lab**CO1. Use different laboratory equipment and instruments for microbiological operations CO2. Prepare the media and use for the cultivation of the microbesCO3. Perform laboratory experiments for the isolation, identification and characterization of microorganismsCO4. Determination and evaluation of microbial load and its control | **18BTL38-Unit Operation Laboratory**CO1. Experiments on the basic principles of fluid mechanics and to analyze the flow measurement instrumentsCO2. Illustrate the fluid flow problems with the application of momentum and energy equations CO3. Examine the principles of sedimentation, filtration and mass transfer operations through experimental studies |
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| **15BT41-Biostatistics & Bio modeling-(AHV)**CO1: Apply the concepts of data distribution in Biotechnology problems-histogram, frequency curve etc.CO2: Describe about the utilities of statistics and probability to the biological data, suitable curve fitting by other methods.CO3: Apply the concepts relating to regression correlation, test of hypothesis for t-test and z-testCO4: Appreciate the concepts of probability, random variables and its distributions CO5: Perform modeling and simulations experiments for select biological processes using appropriate data | **17BT41-Biostatistics & Bio modeling-(AHV)** CO1: Apply the concepts of data distribution in Biotechnology problems-histogram, frequency curve etc.CO2: Describe about the utilities of statistics and probability to the biological data, suitable curve fitting by other methods.CO3: Apply the concepts relating to regression correlation, test of hypothesis for t-test and z-testCO4: Appreciate the concepts of probability, random variables and its distributions CO5: Perform modeling and simulations experiments for select biological processes using appropriate data | **18BT41-Stoichiometry-(KMV)**CO1: Practice and compute the material balance of three different phases such as solid, liquid and gasCO2: Illustrate material balance without chemical reaction in various unit operationsCO3: Analyze the material balance involving in chemical reactionCO4: Calculate the energy balance and heat capacity for different phases and mixturesCO5: Infer the stoichiometry principles in bioprocess technology |
| **15BT42-Biochemical Thermodynamics****(KVM)**CO1: State & describe the concepts of system, surrounding, process, laws of thermodynamics and entropy.CO2: Explain the PVT behavior of fluids & gases, equations of state for real gases and heat effects accompanying chemical reactionsCO3. Explain the different thermodynamic properties ,their relations and thermodynamic diagramsCO4. Determine the partial molar properties & explain criteria of phase, biochemical reaction equilibrium and equilibrium conversion | **17BT42-Biochemical Thermodynamics****(AHV)****CO1**: Discuss the basic concepts of thermodynamics in process industries**CO2:** Explain the PVT Behavior and compressibility charts **CO3:**Illustrate thethermodynamic properties of pure fluids**CO4:** Compute the properties of solutions and phase equilibriaCO5: Employ the knowledge ofbiochemical energetics – to determine the characteristics of energy rich compounds | **18BT42-Molecular Biology****(SC)**CO1: Explain replication in prokaryotes and EukaryotesCO2: Distinguish transcription process in prokaryotes and Eukaryotes CO3: Illustrate the process of translation in prokaryotes and EukaryotesCO4: Analyze gene regulation in prokaryotes and Eukaryotes CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes |
| **15BT43-Molecular Biology****(RKC)**CO1: Explain replication in prokaryotes and EukaryotesCO2: Distinguish transcription process in prokaryotes and Eukaryotes CO3: Illustrate the process of translation in prokaryotes and EukaryotesCO4: Analyze gene regulation in prokaryotes and Eukaryotes CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes | **17BT43-Molecular Biology (CS)**CO1: Explain replication in prokaryotes and EukaryotesCO2: Distinguish transcription process in prokaryotes and Eukaryotes CO3: Illustrate the process of translation in prokaryotes and EukaryotesCO4: Analyze gene regulation in prokaryotes and Eukaryotes CO5: Elaborate significance of genetic recombination and gene mapping in prokaryotes and Eukaryotes | **18BT43-Immunotechnology**CO-1: Discuss the molecular and cellular mechanisms involved in the development and regulation of theimmune responseCO-2: Describe the cause, challenges and treatment for Immune System Pathologies and Dysfunctions.CO-3: Apply the major immunological laboratory techniques and their application to both clinical analysisand experimental research |
| **15BT44-Bioprocess Principles and Calculations** **(SD)**CO1: Practice and compute the material balance of three different phases such as solid, liquid and gasCO2: Illustrate material balance without chemical reaction in various unit operationsCO3: Analyze the material balance involving in chemical reactionCO4: Calculate the energy balance and heat capacity for different phases and mixturesCO5: Infer the stoichiometry principles in bioprocess technology | **17BT44-Bioprocess Principles and Calculations (KMV/KLS)**CO1: Practice and compute the material balance of three different phases such as solid, liquid and gasCO2: Illustrate material balance without chemical reaction in various unit operationsCO3: Analyze the material balance involving in chemical reactionCO4: Calculate the energy balance and heat capacity for different phases and mixturesCO5: Infer the stoichiometry principles in bioprocess technology | **18BT44-Cell culture techniques**CO-1: Understand the concepts of laboratory design and equipments for cell culture techniquesCO-2:Correlate between different biological samples and understand the importance of different media intissue cultureCO-3: Comprehend the applications of plant, animal and microbial cell culture in industry, healthcare and environment |
| **15BT45-Structural Biology-(BBM)**CO1: Explain the fundamental principles and function of proteins.CO2: Describe and apply the foundational principles of macromolecular structure and functions.CO3: Apply the diverse techniques for the structural elucidation of biomolecules CO4: Explain and analyze macromolecular interactions and their dynamics. | **17BT45-Structural Biology**CO1: Explain the fundamental principles and function of proteins.CO2: Describe and apply the foundational principles of macromolecular structure and functions.CO3: Apply the diverse techniques for the structural elucidation of biomolecules CO4: Explain and analyze macromolecular interactions and their dynamics. | **18BT45-Biochemical thermodynamics (AHV)****CO1**: Discuss the basic concepts of thermodynamics in process industries**CO2:** Explain the PVT Behavior and compressibility charts **CO3:**Illustrate thethermodynamic properties of pure fluidsCO4: Compute the properties of solutions and phase equilibriaCO 05: Employ the knowledge ofbiochemical energetics – to determine the characteristics of energy rich compounds |
| **15BT46-Clinical Biochemistry**CO1: Discuss the biochemistry and pathophysiology associated with various disorders of metabolismCO2: Assessment and evaluation of clinical manifestations of organ function test and enzymes involvedCO3: Assess and analyze the clinical manifestations of hormonal disturbancesCO4:Discuss the medical problems associated with blood and mechanism of detoxification  | **17BT46-Clinical Biochemistry**CO1: Discuss the biochemistry and pathophysiology associated with various disorders of metabolismCO2: Assessment and evaluation of clinical manifestations of organ function test and enzymes involvedCO3: Assess and analyze the clinical manifestations of hormonal disturbancesCO4:Discuss the medical problems associated with blood and mechanism of detoxification | **18BT46-Clinical Biochemistry**CO1: Understand the basic metabolic pathways of CHO, Lipids, amino acid and nucleic acids and analyze their regulationsCO2: Discuss the biochemistry and pathophysiology associated with various disorders of metabolism and hormonal disturbanceCO3: Assessment and evaluation of clinical manifestations of organ function test and enzymes involved |
| **15BTL47- Cell and Molecular Biology Laboratory**CO-1: Prepare and analyze the mitotic and meiotic cell divisionsCO-2: Create and interpret somatic cell fusionCO-3: Generate DNA and run various fragments through electrophoresis | **17BTL47-Cell and Molecular Biology Laboratory**CO-1: Prepare and analyze the mitotic and meiotic cell divisionsCO-2: Create and interpret somatic cell fusionCO-3: Generate DNA and run various fragments through electrophoresis | **18BTL47-Biochemistry Laboratory**CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, andprepare buffer solutionsCO-2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules |
| **15BTL48-Clinical Biochemistry lab**CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, andprepare buffer solutionsCO2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules | **17BTL48-Clinical Biochemistry lab**CO-1: Demonstrate the basic laboratory mathematics necessary to perform tests, make dilutions, andprepare buffer solutionsCO2: Compare/contrast Qualitative and quantitative analysis of various Biomolecules | **18BTL48- Immuno technology laboratory**CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitationCO-2: Examination of qualitative and quantitative analysis such as ELISA, Lymphocytes count and ImmunoblotCO-3: Execution of isolation and purification of antibodies |
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| **15BT51-Bio kinetics and Bio reaction Engineering**CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data CO-2: Design of performance equations for the different reactors CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometryCO-5: Describe medium requirements and media formulation for the optimal bio process | **17BT51-Bio kinetics and Bio reaction Engineering**CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data CO-2: Design of performance equations for the different reactors CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometryCO-5: Describe medium requirements and media formulation for the optimal bio process | **18BT51-Biobusiness and Entrepreneurship****CO-1:** Discussabout the Bio Entrepreneurship**CO-2:** Illustrate the importance of Business in Agriculture at present era**CO-3: -** Assess the entrepreneurship opportunity in Industrial Biotechnology **CO-4:**Infer the project Management, IPR and start up schemes **CO-5:**Describethe Importance of bioethics, bio safety and Regulatory norms |
| **15BT52-Genetic Engineering and applications**CO1:Explain & compare the different tools & enzymes used in recombinant DNA CO2: Illustration of techniques such as PCR, Blotting & construction of librariesCO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniquesCO4:Outline the various methods of producing transgenic organisms and Plants**CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society producing transgenic organisms | **17BT52-Genetic Engineering and applications**CO1:Explain & compare the different tools & enzymes used in recombinant DNA CO2: Illustration of techniques such as PCR, Blotting & construction of librariesCO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniquesCO4:Outline the various methodsof producing transgenic organisms and Plants**CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society | **18BT52 - Chemical reaction engineering**CO-1: Discuss about the different chemical reactions and analysis of experimental reactor data CO-2: Design of performance equations for the different reactors CO-3: Discuss the performance and distinguish between the different types of ideal and non-ideal reactors CO-4: Determine enzyme activity, to study the fundamentals of Microbial growth kinetics and its stoichiometryCO-5: Describe medium requirements and media formulation for the optimal bio process |
| **15BT53-Immuno Technology (RKC)**CO-1: Outline the basic concept of immune system and different types of antibodiesCO-2: Discuss the molecular and cellular mechanisms involved in the development and regulation of theimmune responseCO-3: Explain the types of hypersensitivity and autoimmune diseasesCO-4:Describe the various methods of transplantation and role of tumor antigensCO-5: Apply the major immunological laboratory techniques and their application to both clinical analysis and experimental research | **17BT53-Immuno Technology (RNK)**CO-1: Outline the basic concept of immune system and different types of antibodiesCO-2: Discuss the molecular and cellular mechanisms involved in the development and regulation of theimmune responseCO-3: Explain the types of hypersensitivity and autoimmune diseasesCO-4:Describe the various methods of transplantation and role of tumor antigensCO-5: Apply the major immunological laboratory techniques and their application to both clinical analysis and experimental research  | **18BT53-Enzyme technology and Biotransformation****CO-1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes **CO-2:**Discuss the catalytic action, mechanism & kinetics **CO-3:** Choose and apply scientific method to the process of enzyme immobilization techniques **CO-4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs **CO-5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries |
| **15BT54-Bioinformatics**CO-1: Understand and apply different databases, resource and software tools for sequence alignment CO-2: Apply and analyze the phylogenetic analysis and different predictive methods for DNA and protein CO-3: Apply different tools for genomics analysisCO-4: Design various biomolecules by in-silico tools | **17BT54-Bioinformatics**CO-1: Understand and apply different databases, resource and software tools for sequence alignment CO-2: Apply and analyze the phylogenetic analysis and different predictive methods for DNA and protein CO-3: Apply different tools for genomics analysisCO-4: Design various biomolecules by in-silico tools | **18BT54-Genomics and Proteomics**CO-1:Define structural, comparative and functional genomics and proteomics and its uses in various researchFieldsCO2: Summarize on genomics and genome managementCO3: Describe various methods and techniques of Genomics, high throughput DNA sequencing technology, expression profiling, proteome analysis, and its applications |
| **15BT553-Animal Biotechnology**CO1: Explain the basic principles and techniques in genetic engineering, gene transfer techniques for animals and animal cell lines.CO:2 Gain knowledege about the recent advances in animal breeding.CO3: Explain the contribution ‘Functional genomics’ is making and is likely to make in animal biotechnology now and in future.CO4: Appraise the role of biotechnology in animal science for sustainable eco-system and human welfare. | **17BT553-Animal Biotechnology**CO1: Explain the basic principles and techniques in genetic engineering, gene transfer techniques for animals and animal cell lines.CO:2 Gain knowledege about the recent advances in animal breeding.CO3: Explain the contribution ‘Functional genomics’ is making and is likely to make in animal biotechnology now and in future.CO4: Appraise the role of biotechnology in animal science for sustainable eco-system and human welfare. | **18BT55-**Bio analytical TechniquesCO1: Define the fundamentals of downstream processing for product recoveryCO2: Understand the requirements for successful operations of analytical techniquesCO3: Apply principles of various analytical devices used in in research and enhance problem solving techniques |
| **15BT563-Biotechnology for Sustainable Environment**CO 1: Apply reasoning to identify the components of environmental eco systems and effect of pollutant on environment.CO2: Characterize the various parameters of water , waste water and solid waste from their sources to provide valid conclusions.CO3: Understand the impact of recovery , recycle of the useful resources from wastes by adopting advanced techniques to demonstrate the need for sustainable development.CO4: Identify and Demonstrate the knowledege to use suitable equipment for abatement and control of air and noise pollution. | **17BT563-Biotechnology for Sustainable Environment**CO 1: Apply reasoning to identify the components of environmental eco systems and effect of pollutant on environment.CO2: Characterize the various parameters of water , waste water and solid waste from their sources to provide valid conclusions.CO3: Understand the impact of recovery , recycle of the useful resources from wastes by adopting advanced techniques to demonstrate the need for sustainable development.CO4: Identify and Demonstrate the knowledege to use suitable equipment for abatement and control of air and noise pollution. | **18BT56-Genetic Engineering and Applications**CO1:Explain & compare the different tools & enzymes used in recombinant DNA CO2: Illustration of techniques such as PCR, Blotting & construction of librariesCO3: Differentiate and learn the gene/DNA transfer techniques between & learn the different gene/DNA transfer techniquesCO4:Outline the various methods of producing transgenic organisms and Plants**CO-5:** Summarize the applications of genetic engineering for the welfare of mankind & society |
| **15BTL57-Genetic Engineering and Immunotechnology laboratory**CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitationCO-2:Examination of qualitative and quantitative analysis such as ELISA, Lymphocytes count and ImmunoblotCO-3: Execution of genetic engineering techniques for the isolation of NA, quantification, purity check, amplification and gene cloning. | **17BTL57-Genetic Engineering and Immunotechnology laboratory**CO-1: Perform the various Immunodiagnostic techniques based on agglutination and precipitationCO-2:Examination of qualitative and quantitative analysis such as ELISA, Lymphocytes count and ImmunoblotCO-3: Execution of genetic engineering techniques for the isolation of NA, quantification, purity check, amplification and gene cloning. | **18BTL57-Biokinetics and Enzyme technology Laboratory**CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activityCO2: Compose RTD data in MFR and PFRCO3: Describe the batch reactor performance |
| **15BTL58-Bioinformatics Laboratory**CO1:Apply and analyze sequence analysis using different tools CO2: Apply online resource tools to solve protein structureCO3: Design and evaluate different biomolecules using online and offline tools | **17BTL58-Bioinformatics Laboratory**CO1:Apply and analyze sequence analysis using different tools CO2: Apply online resource tools to solve protein structureCO3: Design and evaluate different biomolecules using online and offline tools | **18BTL58****Genetic Engineering and cell Culture laboratory** |
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| **15BT61-Bio-business and entrepreneurs hip****CO-1:** Discuss about the Bio Entrepreneurship**CO-2:** Illustrate the importance of Business in Agriculture at present era**CO-3:** Assess the entrepreneurship opportunity in Industrial Biotechnology **CO-4:** Infer about the Project Management, IPR and start up schemes **CO-5:** Describethe Importance of bioethics, bio safety and Regulatory norms | **17BT61-Bio-business and entrepreneurs hip****CO-1:** Discuss about the Bio Entrepreneurship**CO-2:** Illustrate the importance of Business in Agriculture at present era**CO-3:** Assess the entrepreneurship opportunity in Industrial Biotechnology **CO-4:** Infer about the Project Management, IPR and start up schemes **CO-5:** Describethe Importance of bioethics, bio safety and Regulatory norms | **18BT61-Process control and Automation**Understand the basics of process dynamics principles and instrumentationStudy various types of input functions and its responsePerform computational modelling to study different types of controllersAnalyse different control algorithms |
| **15BT62-Bioprocess control and automation**CO1: Discuss the principles of instrumentation of instruments to measure biochemical parameter CO2: Analyze the first order system for various inputs(Step, impulse, sinusoidal)CO3: Examine the different types of controllers and control elementsCO4: Illustrate the second order system for various inputs(Step, impulse, sinusoidal)CO5: Determine and compute the concept of controller design and its stability | **17BT62-Bioprocess control and automation**CO1: Describe the practical application of instruments used for measuring physical quantities and chemical quantities by using offline and online measurements CO2: Analyze the first order system for various inputs(Step, impulse, sinusoidal)CO3: Compute the second order system with respect to different forcing function and understand concept of damping coefficientCO4: Illustrate the practical applications of pneumatic control wall, controllers and reduction of flow diagramsCO5: Determine and compute the concept of controller design and its stability | **18BT62-Bioprocess Equipment design and CAED**CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.CO3. Examine the concepts of designing Fermenter and packed bed distillation column. |
| **15BT63-Enzyme technology & biotransformation****CO -1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes **CO -2:** Discuss the catalytic action, mechanism & kinetics **CO - 3:** Choose and apply scientific method to the process of enzyme immobilization techniques **CO - 4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs **CO - 5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries | **17BT63-Enzyme technology & biotransformation****CO-1:** Explain and apply the knowledge to select appropriate methods for isolation, purification and characterization of enzymes **CO-2:** Discuss the catalytic action, mechanism & kinetics **CO-3:** Choose and apply scientific method to the process of enzyme immobilization techniques **CO-4:** Comprehend the applications of nonconventional media in enzyme catalysis and design the methods for the creation of novel enzymes and biotransformation of drugs **CO-5:** Explain and apply uses of enzymes in clinical diagnostics and bioprocess industries | **18BT63-Bioinformatics**CO-1: Understand and apply different databases, resource and software tools for sequence alignment CO-2: Apply and analyze the phylogenetic analysis and different tools for genomics analysis CO-3: Apply and analyses different predictive methods for DNA and proteinCO-4: Design various biomolecules by in-silico tools |
| **15BT64-Bioprocess equipment design & CAED**CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.CO3. Examine the concepts of designing Fermenter and packed bed distillation column. | **17BT64-Bioprocess equipment design & CAED**CO1. Analyse and enumerate designing concepts of Double Pipe Heat Exchanger.CO2. Solve and practice on design of Shell and tube heat exchanger and condenser.CO3. Examine the concepts of designing Fermenter and packed bed distillation column. | **18BT64X-Professional Elective-I**18BT641: Food Process Engineering18BT642: Phyto-Chemistry and Phyto-Harmones18BT643: Human Physiology |
| **15BT65-Cell Culture Techniques**CO-1: Understand the concepts of laboratory design and equipments for cell culture techniquesCO-2:Correlate between different biological samples and understand the importance of different media intissue cultureCO-3: Comprehend the applications of plant culture in industrial secondary metabolitesCO-4: Explain the applications of animal cell culture in industry and environmentCO-5: Apply and analyze the applications of microbial cell culture in industry and environment | **17BT653-Cell Culture Techniques**CO-1: Understand the concepts of laboratory design and equipments for cell culture techniquesCO-2:Correlate between different biological samples and understand the importance of different media intissue cultureCO-3: Comprehend the applications of plant, animal and microbial cell culture in industry, healthcare and environment | **18BT65X- Open Elective-I**18BT651: Biology for Engineers18BT652:Biomaterials18BT653: Nanobiotechnology |
| **15BT662-Nanobiotechnology**CO1: Explain nano-biotechnology as an emerging field and its scopeCO2: Apply the principles and application of techniques in characterization of nanomaterialsCO3: Apply nanotechnology in diagnostic, drug delivery system, microfluidic and biomemsCO4: Discuss the application of biological molecules and system in nanotechnology | **17BT662-Nanobiotechnology**CO1: Define nano-biotechnology as an emerging field and its scope.CO2: Understand the principles and applications of the technology in various fields. | **18BTL66-Process Control and Automation Laboratory**CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control systemCO-2: Illustrate the characteristics of transducers based on critical process parametersCO-3: Demonstrate the working of first order systems for tanks connected in seriesCO-4: Calculate and analyze the output obtained from different systems and perform theoretical validationCO-5: Distinguish the effect of offset in different controllers |
| **15BTL67-Bioprocess control & automation laboratory**CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control systemCO-2: Illustrate the characteristics of transducers based on critical process parametersCO-3: Demonstrate the working of first order systems for tanks connected in seriesCO-4: Calculate and analyze the output obtained from different systems and perform theoretical validationCO-5: Distinguish the effect of offset in different controllers | **17BTL67-Bioprocess control & automation laboratory**CO -1: Comprehend the basics of Instrumentation, classification different input function of automatic process control systemCO-2: Illustrate the characteristics of transducers based on critical process parametersCO-3: Demonstrate the working of first order systems for tanks connected in seriesCO-4: Calculate and analyze the output obtained from different systems and perform theoretical validationCO-5: Distinguish the effect of offset in different controllers | **18BTL67-Bioinformatics laboratory**CO1:Apply and analyze sequence analysis using different tools CO2: Apply online resource tools to solve protein structureCO3: Design and evaluate different biomolecules using online and offline tools |
| **15BTL68-Biokinetics and Enzyme technology laboratory**CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activityCO2: Compose RTD data in MFR and PFRCO3: Describe the batch reactor performance | **15BTL68-Biokinetics and Enzyme technology laboratory**CO1: State and define the nature of the reaction, rate of the reaction, rate constant and enzyme activityCO2: Compose RTD data in MFR and PFRCO3: Describe the batch reactor performance | **18BTMP68-Mini Project** |
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| **15BT71-Fermentation technology**CO1: Describe the factors affecting Primary and secondary metabolite production and its industrial importance.CO2: Compute the basic requirements of downstream processing for biochemical product recoveryCO-3: Identify and summarize the effect of change in unit's operations and its impact on the bioprocessCO-4:Illustrate how emerging technologies would benefit the bio chemical product recovery and outline the process involving in large scale CO5: Apply product recovery techniques for high-purity protein production | **17BT71-Fermentation technology**CO1: Describe the factors affecting Primary and secondary metabolite production and its industrial importance.CO2: Compute the basic requirements of downstream processing for biochemical product recoveryCO-3: Identify and summarize the effect of change in unit's operations and its impact on the bioprocessCO-4:Illustrate how emerging technologies would benefit the bio chemical product recovery and outline the process involving in large scale CO5: Apply product recovery techniques for high-purity protein production | **18BT71-Bioprocess Engineering** |
| **15BT72-Genomics & Proteomics**CO1: Discuss on genome database & genome projectsCO2: Summarize on genomics and genome managementCO3: Describe structural genomics and genome analysis.CO4: Describe proteomics and proteome analysis | **17BT72-Genomics & Proteomics**CO1: Discuss on genome database & genome projectsCO2: Summarize on genomics and genome managementCO3: Describe structural genomics and genome analysis.CO4: Describe proteomics and proteome analysis | **18BT72-Clinical and pharmaceutical Biotechnology****18BT73X-Professional Elective-2**18BT731-Process Equipment & Plant Design18BT732-Bioreactor Design Concepts18BT733-Transport Phenomena  |
| **15BT73-Plant biotechnology**CO-1: State the basic concepts of plant tissue culture and their applications, media preparation, tools of genetic engineering in producing transgenic plants (For eg., disease resistant)CO-2: Describe the applications of plant genetic engineering in production transgenic plants to with stand abiotic and biotic stress and discuss ethical and social issues regarding genetically-modified crops**CO-3**: Discuss the role, importance & applications of tissue culture in molecular farming**CO-4**: Explain the mechanism of signal transduction and nitrogen fixation in plants**CO-5**: Explain the principles, technical requirement, scientific and commercial applications in algal technologies with suitable examples | **17BT73-Plant biotechnology**CO-1: State the basic concepts of plant tissue culture and their applications, media preparation, tools of genetic engineering in producing transgenic plants (For eg., disease resistant)CO-2: Describe the applications of plant genetic engineering in production transgenic plants to with stand abiotic and biotic stress and discuss ethical and social issues regarding genetically-modified crops**CO-3**: Discuss the role, importance & applications of tissue culture in molecular farming**CO-4**: Explain the mechanism of signal transduction and nitrogen fixation in plants**CO-5**: Explain the principles, technical requirement, scientific and commercial applications in algal technologies with suitable examples | **18BT74X-Professional Elective-3**18BT741-Bioethics, Biosafety and IPR18BT742- Agricultural Biotechnology18BT743-Tissue Engineering |
| **15BT743-Lab to industrial scaling**CO-1: Discuss fermentation as a basic biochemical process, types of fermentation and fermentation productsCO-2: Understand and emphasis on scale up media , inoculum and sterilization processCO-3: Understand the concept of rheology and fermenter designCO-4:Describe the analytical instruments used in fermenter and biomass estimationCO-5:Explain and infer the process of upstream and down stream process | **18BT74X-Professional Elective-3**18BT741-Health Informatics18BT742- Bioreactor Design Concepts18BT743-Lab to industrial scaling18BT744-Food Biotechnology | **18BT75X-Open Elective-B**18BT751-BT for sustainable Environment18BT752-Forensic Science18BT753-Biological data Management |
| **15BT752-Forensic sciences**CO1: Learn about forensic science as a field of study, discuss about history and development, role and responsibilities of forensic scientistCO2: Analysis of physical evidence, biological evidence, firearm evidence, and evidence examinationCO3: Investigation, collection and packing of evidence and legal guidelinesCO4: Learn about ethics in forensic science and ethical dilemmas, Application of computers in forensic scienceCO5: Characterization of the evidence and interpretation of the crime scenes | **18BT75X-Professional Elective-4**18BT751-Dairy Biotechnology18BT752-Forensic Science18BT753-Molecular Diagnostics18BT744-Big data Management | **18BTL76-Bioprocess Engineering laboratory** |
| **15BTL76-Fermentation laboratory**CO1: Demonstrate about Product enrichment operation using different methods.CO2: Estimate level of secondary metabolites production in fermented brothCO3: Comprehended analysis of protein | **17BTL76-Fermentation laboratory**CO1: Describe the techniques involved in downstream processCO2: Analyze the product identification and separation techniquesCO3: Study the membrane processCO4: Determine the techniques involved in product enrichment and recovery processCO5: Comprehended the analysis of biomolecules using various techniques | **18BTP77-Project Work Phase-I** |
| CO1: Describe the techniques involved in downstream processCO2: Analyze the product identification and separation techniquesCO3: Study the membrane processCO4: Determine the techniques involved in product enrichment and recovery processCO5: Comprehended the analysis of biomolecules using various techniques |
| **15BTL77-Plant biotechnology laboratory**CO-1: Preparation of resources and materials for plant tissue cultureCO-2: Estimation of secondary metabolites and different biomoleculesCO-3: Comprehend the applications of tissue culture | **17BTL77-Plant biotechnology laboratory**CO-1: Preparation of resources and materials for plant tissue cultureCO-2: Estimation of secondary metabolites and different biomoleculesCO-3: Comprehend the applications of tissue culture | **Internship** |
|  | **17BTP78-Project Work Phase-I + Project Work Seminar** |  |
|  |  |  |
| **15BT81-Clinical & Pharmaceutical Biotechnology**CO-01: Discuss about pharma industry and drug developmentCO-02: Explain the significance of pharmaco-kinetic models, pharmaco-dynamic principles, various dosage forms and formulationCO-03 :Describe different agents in drug therapy CO-04: Illustrate Bio therapeutics and stem cells applicationCO-05: Comprehend specific applications of pharmaceutical & clinical Biotechnology | **17BT81-Clinical & Pharmaceutical Biotechnology**CO-01: Discuss about pharma industry and drug developmentCO-02: Explain the significance of pharmaco-kinetic models, pharmaco-dynamic principles, various dosage forms and formulationCO-03 :Describe different agents in drug therapy CO-04: Illustrate Bio therapeutics and stem cells applicationCO-05: Comprehend specific applications of pharmaceutical & clinical Biotechnology | **18BT81-Regulatory Affairs in Biotech Industry**CO 01: Outline the Regulatory Rules and Guidelines for product developmentCO 02: Describe the safety and quality standards in the biotech industry CO 03: Comprehend the Validation Process in the biotech industryCO 04: Analyze the Product quality and its Implementation CO 05: Describe the concepts of Quality Management System |
| **15BT82-Regulatory affairs in Biotech Industry**CO 01: Outline the Regulatory Rules and Guidelines for product developmentCO 02: Describe the safety and quality standards in the biotech industry CO 03: Comprehend the Validation Process in the biotech industryCO 04: Analyze the Product quality and its Implementation CO 05: Describe the concepts of Quality Management System | **17BT82-Regulatory affairs in Biotech Industry**CO 01: Outline the Regulatory Rules and Guidelines for product developmentCO 02: Describe the safety and quality standards in the biotech industry CO 03: Comprehend the Validation Process in the biotech industryCO 04: Analyze the Product quality and its Implementation CO 05: Describe the concepts of Quality Management System | **18BT82X- Professional Elective-4**1. Environmental biotechnology
2. Industrial Microbiology
3. Marine Biotechnology
 |
| **15BT833-Environmental Biotechnology**CO1: Discuss the concepts of pollutants and its accumulation and detoxificationCO2: Explain wastewater treatment process and its application in aerobic and anaerobic treatmentCO3: Illustrate the biodegradation and bioremediation of xenobiotic compounds CO4: Distinguish the importance of biocatalysts and its mechanism involved in different biological reaction CO5: Explain the process microbial leaching on metal ores | **17BT83X-Professional Elective-5**17BT831-Protein engineering Environmental Biotechnology17BT832-Metabolic Engineering17BT833-Environmental Biotechnology | **18BTP83- Project Work Phase-2** |
|  | **17BT84-Internship/Professional Practice** | **18BTS84-Technical Seminar** |
|  | **17BTP85-Project Work-II** | **18BTI85-Internship** |
|  | **17BTS86-Seminar on Current trends in Engineering and technology** |  |

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| **Mapping of Course outcomes (COs) and Program Outcomes (POs)** |
| **Note:** 1 = Slight 2 = Moderate 3 = Good  |
|   |
| **Course outcomes** | **Program Outcomes** | **PSO** |
|  | **PO****1** | **PO****2** | **PO****3** | **PO****4** | **PO****5** | **PO****6** | **PO****7** | **PO8** | **PO9** | **PO****10** | **PO****11** | **PO****12** | **POS****1** | **POS****2** | **POS****3** | **POS****4** |
| **CO-1** | 3 | 2 | 2 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 1 | 2 | 1 |
| **CO-2** | 3 | 2 | 2 | 1 | 2 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 0 | 2 | 0 |
| **CO-3** | 3 | 2 | 2 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 2 | 0 | 2 | 0 |
| **CO-4** | 3 | 2 | 2 | 1 | 2 | 0 | 1 | 1 | 0 | 2 | 0 | 0 | 2 | 1 | 2 | 0 |
| **CO-5** | 2 | 2 | 2 | 2 | 0 | 0 | 0 | 0 | 2 | 0 | 1 | 0 | 1 | 1 | 2 | 0 |

**COLLEGE VISION AND MISSION**

**VISION**

The vision of the institution is to create and maintain an enabling learning environment for the students to transform them as thorough professionals to meet diverse professional demands of global environments.

### **MISSION**

## The mission of the institution is to provide quality education to the students to pursue courses in different engineering disciplines and to transform their professional dreams into reality and to offer competent budding professionals to the society.

**DEPARTMENTAL VISION AND MISSION**

**VISION**

To be a Centre of excellence in the field of Biotechnology equipped to create technically strong ethically moral global man power that endeavor for the welfare of mankind.

**MISSION**

Creating state-of-the-art infrastructure for education and research to induct lifelong professional growth and different career avenues for BT engineers in collaboration with industries, research organizations and academia.

**PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)**

**PEO1:** Students will be lucrative professionals in different sectors of Biotechnology fields with high proficiency in multidisciplinary tasks.

**PEO2**: Operate technically at competent level in concocting problems of biotechnology and utilize the knowledge to develop Biological processes and bio-techniques.

**PEO3:** Students will endure higher education with harmonious combination of the skills of engineering, management &amp; life science.

**PEO4:** Students will inculcate Scio-ethical values, exhibit professionalism, team spirit for lifelong learning and well-being of society and mankind.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**

**CHOICE BASED CREDIT SYSTEM (CBCS)**

**BIOTECHNOLOGY ENGINEERING BOARD**

**BE-CBCS SYLLABUS 2017-18 Scheme**

**B.E Biotechnology Engineering**

**Program Outcomes (POs)**

At the end of the B.E program, students are expected to have developed the following outcomes.

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.

2. **Problem analysis:** Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

**Program Specific Outcomes (PSOs)**

**At the end of the B.E Biotechnology engineering program, the students are expected to have developed the following program specific outcomes.**

**PSO1**

The graduates will have the ability to plan, analyse, design, execute andcontribute to the field of biotechnology and allied industries designing ,developing and providing solutions for product/processes/technologydevelopment.

**PSO2**

The graduates of Biotechnology engineering program will have the ability to take up employment, entrepreneurship, research and development for sustainable society.

**PSO3**

The graduates will be able to pursue opportunities for personal and professional growth, higher studies, demonstrate leadership skills and engage in lifelong learning by active participation in the Biotechnology profession.

**PSO4**

The graduates will be able to demonstrate professional integrity and an appreciation of ethical, environmental, regulatory and issues related to Biotechnology.