GIET MAIN CAMPUS (AUTONOMOUS), GUNUPUR 765022
Approved by AICTE, Govt. of Odisha and Affiliated to BPUT, Rourkela, Odisha
Accredited by NAAC with a CGPA of 3.28/4 at *A Grade* and Accredited by NBA
Dist. - Rayagada, Odisha, INDIA
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Curriculum, Syllabus and Course Structure

For

Under Graduate Degree Programme

In

Engineering & Technology

Regulation 2017

BIOTECHNOLOGY ENGINEERING

4 Year B.Tech Degree Programme

Regulation 2017

Choice Based Credit System

Outcome Based Assessment

Biotechnology Engineering

Programme Educational Objectives

Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve. Programme educational objectives are broad statements that describe the career and professional accomplishments that the program is preparing graduates to achieve.

1. To provide technical education in order to develop problem solving abilities in the field of Biotechnology and its successfulness with relevance to industry.

2. To establish competence in research, design of new experiments/projects in the field of Environmental Biotechnology, Biochemistry, Bioprocess technology and allied fields.

3. Development of urge for advanced learning in the latest techniques and skills of biotechnology and to serve the society as a professional for sustainable development.

4. The ability to apply the professional knowledge and skills with ethical values to evolve themselves as an entrepreneur.

Program Outcomes (POs)

Engineering Graduates will be able to:

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

2. Problem analysis: Identify, formulate, review research literature, and analyze 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 modeling 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, and 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: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

I SEMESTER [FIRST YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BS	BBSBS1010	Engineering Mathematics-I	3	1	0	4
2	BS	BBSBS1021	Engineering Physics	3	0	0	3
		BBSBS1022	Engineering Chemistry				
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3
		BBSES1032	Basics of Thermodynamics				
4	ES	BBSES1041	Basics of Electronics	3	0	0	3
		BBSES1042	Basics of Electrical Engineering				
5	ES	BBSES1050	Programming for Problem Solving	3	0	0	3
6	HS	BBSHS1060	Communicative English-I	2	0	0	2
PRACTICAL / SESSIONAL							
7	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1
		BBSBS1122	Engineering Chemistry Laboratory				
8	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1
		BBSES1142	Basics of Electrical Engineering Laboratory				
9	ES	BBSES1150	Programming for Problem Solving Laboratory	0	0	2	1
10	HS	BBSHS1160	Communicative English-I Laboratory	0	0	2	1
11	ES	BBSES1171	Engineering Drawing	0	0	2	1
		BBSES1172	Engineering Workshop				
12	MC	BBSHS1180	NSS	-	-	-	0
TOTAL				**17**	**1**	**10**	**23**

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II SEMESTER [FIRST YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BS	BBSBS2010	Engineering Mathematics-II	3	1	0	4
2	BS	BBSBS1021	Engineering Physics	3	0	0	3
		BBSBS1022	Engineering Chemistry				
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3
		BBSES1032	Basics of Thermodynamics				
4	ES	BBSES1041	Basics of Electronics	3	0	0	3
		BBSES1042	Basics of Electrical Engineering				
5	ES	BBSES2050	Data Structure using 'C++'	3	0	0	3
6	HS	BBSHS2060	Communicative English-II	2	0	0	2
PRACTICAL / SESSIONAL							
7	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1
		BBSBS1122	Engineering Chemistry Laboratory				
8	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1
		BBSES1142	Basics of Electrical Engineering Laboratory				
9	ES	BBSES2150	Data Structures using 'C++' Laboratory	0	0	2	1
10	HS	BBSHS2160	Communicative English-II Laboratory	0	0	2	1
11	ES	BBSES1171	Engineering Drawing	0	0	2	1
		BBSES1172	Engineering Workshop				
12	MC	BBSHS2180	YOGA	-	-	-	0
TOTAL				**17**	**1**	**10**	**23**

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III SEMESTER [SECOND YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits

THEORY							
1	BS	BBSBS3010	Engineering Mathematics-III	3	1	0	4
2	PC	BBTPC3020	Basics of Biology	3	0	0	3
3	PC	BBTPC3030	Biochemistry	3	0	0	3
4	PC	BBTPC3040	Microbiology	3	0	0	3
5	ES	BCSES3050	Object Oriented Programming through JAVA	3	0	0	3
6	BS / HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
PRACTICAL / SESSIONAL							
7	PC	BBTPC3120	Basics of Biology Lab	0	0	2	1
8	PC	BBTPC3130	Biochemistry Lab	0	0	2	1
9	PC	BBTPC3140	Microbiology Lab	0	0	2	1
10	ES	BCSES3150	JAVA Programming Laboratory	0	0	2	1
TOTAL				**18**	**1**	**8**	**23**

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IV SEMESTER [SECOND YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC4010	Molecular Biology	3	1	0	4
2	PC	BBTPC4020	Biostatistics	3	0	0	3
3	PC	BBTPC4030	Bio-analytical Techniques	3	0	0	3
4	PC	BBTPC4040	Biochemical Reaction Engineering	3	0	0	3
5	ES	BMEES3050	Fluid Mechanics and Hydraulic Machine	3	0	0	3
6	BS / HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
PRACTICAL / SESSIONAL							
7	PC	BBTPC4110	Molecular Biology Laboratory	0	0	2	1
8	PC	BBTPC4120	Biostatistics Laboratory	0	0	2	1
9	PC	BBTPC4130	Bio-analytical Techniques Laboratory	0	0	2	1
10	PC	BMEES3150	Fluid Mechanics and Hydraulic Machine Lab	0	0	2	1
TOTAL				**18**	**1**	**8**	**23**

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V SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC5010	Genetic engineering and r- DNA Technology	3	1	0	4
2	PC	BBTPC5020	Immunology and Immunotechnology	3	0	0	3
3	PC	BBTPC5030	Upstream Process Engineering	3	0	0	3
4	PE	BBTPE5041	Industrial Microbiology and Enzyme Technology	3	0	0	3
		BBTPE5042	Fermentation Technology				
		BBTPE5043	Bio kinetics and Thermodynamics				
5	OE	BAEOE5051	Process Dynamic and Control	3	0	0	3
		BCHOE5052	Process Utility and Industrial Safety				
		BEEOE5053	IOT for Engineering Applications				
		BAEOE5051	Process Dynamic and Control				
PRACTICAL / SESSIONAL							
6	PC	BBTPC5110	Genetic engineering and r- DNA Technology Laboratory	0	0	2	1
7	PC	BBTPC5120	Immunology and Immunotechnology Laboratory	0	0	2	1
8	PC	BBTPC5130	Upstream Process Engineering Laboratory	0	0	2	1
9	EC	BBTEC5150	*Skill Development Project and Hands on Training	0	0	2	1
10	EC	BBTEC5170	Summer Internship-I	0	0	2	1
TOTAL				**15**	**1**	**10**	**21**

*College should conduct at least one NSDC program under this category.

^ Four (4) weeks duration summer internship either in industry or in an R&D organization, including educational institutes with excellent research culture. The student is expected to submit a formal report at the end of the programme.On-line MOOC courses may contribute upto 20% of the credits, with in-house examination being conducted.

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VI SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC6010	Plant Biotechnology	3	1	0	4
2	PC	BBTPC6020	Bioinformatics	3	0	0	3
3	PC	BBTPC6030	Downstream Process Engineering	3	0	0	3
4	PE	BBTPE6041	Environmental Biotechnology	3	0	0	3
		BBTPE6042	Bioprocess Engineering				
		BBTPE6043	Proteomics and Genomics				
5	OE	BCHOE6051	Biochemical Reaction Engineering	3	0	0	3
		BAEOEE6052	Industrial Instrumentation				
		BCVOEE6053	AIR & Noise Pollution				
PRACTICAL / SESSIONAL							
6	PC	BBTPC6110	Plant Biotechnology Laboratory	0	0	2	1
7	PC	BBTPC6120	Bioinformatics Laboratory	0	0	2	1
8	PC	BBTPC6130	Downstream Process Engineering Laboratory	0	0	2	1
9	PC	BBTPC6140	Advanced Laboratory-I	0	0	2	1
10	EC	BBTEC6160	#Soft Skill and Employability Skill	0	0	2	1
TOTAL				**15**	**1**	**10**	**21**

#To be conducted by the Training & Placement Department of the College.

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VII SEMESTER [FOURTH YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC7010	Bioreactor Design and Analysis	3	0	0	3
2	PC	BBTPC7020	Medical and Phamaceutical Biotechnology	3	0	0	3
3	PE	BBTPE7031	Food Biotechnology	3	0	0	3
		BBTPE7032	Animal Biotechnology				
		BBTPE7033	Biosystem Engineering				
4	PE	BBTPE7041	Biomaterial	3	0	0	3
		BBTPE7042	Molecular modeling and Drug Designing				
		BBTPE7043	Nanobiotechnology				
5	OE	BCHOE7051	Green Technology	3	0	0	3
		BCVOE7052	Municipal Solid Waste Management				
		BCHOE7053	Fuel and Energy Technology				
		BCHOE7051	Green Technology				
PRACTICAL / SESSIONAL							
6	PC	BBTPC7110	Bioreactor Design and Analysis Laboratory	0	0	2	1
7	PC	BBTPC7140	Advanced Laboratory-II	0	0	2	1
8	EC	BBTEC7150	Mini Project / Projects on Internet of Things	0	0	4	2
10	EC	BBTEC7170	Summer Internship-II	0	0	2	1
TOTAL				**15**	**0**	**10**	**20**

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VIII SEMESTER [FOURTH YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PE	BBTPE8011	IPR, Bioethics and Biosafety	3	0	0	3
		BBTPE8012	Bioprocess Optimization				
		BBTPE8013	Biofuel and Energy Technology				
2	PE	BBTPE8021	Protein Engineering	3	0	0	3
		BBTPE8022	Structural Biology				
		BBTPE8023	Biosensor and Diagnostics				
3	OE	BEEOE8031	Bio Medical Instrumentation	3	0	0	3
		BCHOE8032	Integrated solid waste management				
		BEEOE8033	Industrial Safety & Hazard Management				
		BEEOE8031	Bio Medical Instrumentation				
PRACTICAL / SESSIONAL							
4	EC	BBTEC8150	Major Project / Industrial Project / Startup Training cum Project	0	0	10	5
5	EC	BBTEC8180	Seminar and Technical Writing	0	0	2	1
6	EC	BBTEC8190	Comprehensive Viva-Voce	0	0	2	1
TOTAL				**9**	**0**	**14**	**16**

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SCHEME OF INSTRUCTION SUMMARY

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDITS	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities, Social & Management Study (HS)	3	3	-	3	-	-	-	-	**9**	**5**
2	Basic Sciences (BS)	8	8	7	-	-	-	-	-	**23**	**14**
3	Engineering Sciences (ES) / Basic Engineering (BE)	12	12	4	3	-	-	-	-	**31**	**18**
4	Professional Core (PC)	-	-	12	17	13	14	8	-	**64**	**37**
5	Professional Electives (PE)	-	-	-	-	3	3	6	6	**18**	**11**
6	Open Electives (OE)	-	-	-	-	3	3	3	3	**12**	**7**
7	Project Work, Seminar and/or Internship in Industry or elsewhere (EC)	-	-	-	-	2	1	3	7	**13**	**8**
8	Mandatory Courses (MC)	-	-	-	-	-	-	-	-	**0**	**0**
	TOTAL	**23**	**23**	**23**	**23**	**21**	**21**	**20**	**16**	**170**	**100**

CREDIT REPRESENTATION

Lectures (hrs/wk/Sem.)	Tutorials (hrs/wk/Sem.)	Practical Work (hrs/wk/Sem.)	Credits (L: T: P)	Total Credits
3	0	0	3:0:0	3
3	1	0	3:1:0	4
0	0	2	0:0:2	1
0	0	4	0:0:4	2
0	0	6	0:0:6	3
0	0	12	0:0:12	6

SCHEME OF INSTRUCTION SUMMARY

SL. NO.	COURSE WORK - SUBJECTS AREA	CREDITS / SEMESTER								TOTAL CREDITS	%
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities, Social & Management Study (HS)	3	3	-	3	-	4	-	-	13	7
2	Basic Sciences (BS)	8	8	7	-	3	-	-	-	26	14
3	Engineering Sciences (ES) / Basic Engineering (BE)	12	12	4	4	-	-	-	-	32	17
4	Professional Core (PC)	-	-	13	17	13	14	5	-	62	33
5	Professional Electives (PE)	-	-	-	-	3	3	11	6	23	12
6	Open Electives (OE)	-	-	-	-	3	3	3	3	12	7
7	Project Work, Seminar and/or Internship in Industry or elsewhere	-	-	-	-	2	-	4	10	16	9
8	Mandatory Courses (MC)	1	1	-	-	-	-	-	-	2	1
	TOTAL	**24**	**24**	**24**	**24**	**24**	**24**	**23**	**19**	**186**	**100**

DISTRIBUTION OF CREDITS AND MARKS

Year	Semester	THEORY				PRACTICAL / SESSIONAL			Total	
		No. of Subjects	Credits	ISA	ESA	No. of Labs	Credits	ISA	Credits	Marks
I Year	I Sem	6	18	300	600	6	6	300	24	1200
	II Sem	6	18	300	600	6	6	300	24	1200
II Year	III Sem	6	20	300	600	4	4	200	24	1100
	IV Sem	6	20	300	600	4	4	200	24	1100
III Year	V Sem	6	19	300	600	5	5	250	24	1150
	VI Sem	6	19	300	600	5	5	250	24	1150
IV Year	VII Sem	5	15	250	500	5	8	400	23	1150
	VIII Sem	3	9	150	300	3	10	500	19	950
TOTAL		44	138	2200	4400	38	46	2400	186	9000

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FIRST YEAR

FIRST SEMESTER									
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**ISA**	**ESA**
				L	**T**	**P**			
			THEORY						
1	BS	BBSBS1010	Engineering Mathematics-I	3	1	0	4	50	100
2	BS	BBSBS1021	Engineering Physics	3	0	0	3	50	100
		BBSBS1022	Engineering Chemistry						
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3	50	100
		BBSES1032	Basics of Thermodynamics						
4	ES	BBSES1041	Basics of Electronics	3	0	0	3	50	100
		BBSES1042	Basics of Electrical Engineering						
5	ES	BBSES1050	Programming in ‘C’	3	0	0	3	50	100
6	HS	BBSHS1060	Communicative English-I	2	0	0	2	50	100
			PRACTICAL/ SESSIONAL						
7	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	50	-
		BBSBS1122	Engineering Chemistry Laboratory						
8	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	50	-
		BBSES1142	Basics of Electrical Engineering Laboratory						
9	ES	BBSES1150	‘C’ Programming Laboratory	0	0	2	1	50	-
10	HS	BBSHS1160	Communicative English-I Laboratory	0	0	2	1	50	-
11	ES	BBSES1171	Engineering Drawing	0	0	2	1	50	-
		BBSES1172	Engineering Workshop						
12	MC	BBSHS1180	NSS / NCC	0	0	2	1	50	-
		TOTAL:		**17**	**1**	**12**	**24**	**600**	**600**
			SEMESTERMARKS: 1200	**SEMESTER CREDITS: 24**					
			CUMULATIVE MARKS: 1200	**CUMULATIVE CREDITS: 24**					

SECOND SEMESTER									
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**ISA**	**ESA**
				L	**T**	**P**			
			THEORY						
1	BS	BBSBS2010	Engineering Mathematics-II	3	1	0	4	50	100
2	BS	BBSBS1021	Engineering Physics	3	0	0	3	50	100
		BBSBS1022	Engineering Chemistry						
3	ES	BBSES1031	Basics of Mechanics	3	0	0	3	50	100
		BBSES1032	Basics of Thermodynamics						
4	ES	BBSES1041	Basics of Electronics	3	0	0	3	50	100
		BBSES1042	Basics of Electrical Engineering						
5	ES	BBSES2050	Data Structure using ‘C++’	3	0	0	3	50	100
6	HS	BBSHS2060	Communicative English-II	2	0	0	2	50	100
			PRACTICAL/ SESSIONAL						
7	BS	BBSBS1121	Engineering Physics Laboratory	0	0	2	1	50	-
		BBSBS1122	Engineering Chemistry Laboratory						
8	ES	BBSES1141	Basics of Electronics Laboratory	0	0	2	1	50	-
		BBSES1142	Basics of Electrical Engineering Laboratory						
9	ES	BBSES2150	Data Structures using ‘C++’ Laboratory	0	0	2	1	50	-
10	HS	BBSHS2160	Communicative English-II Laboratory	0	0	2	1	50	-
11	ES	BBSES1171	Engineering Drawing	0	0	2	1	50	-
		BBSES1172	Engineering Workshop						
12	MC	BBSHS2180	YOGA / Project Work	0	0	2	1	50	-
		TOTAL:		**17**	**1**	**12**	**24**	**600**	**600**
			SEMESTERMARKS: 1200	**SEMESTER CREDITS: 24**					
			CUMULATIVE MARKS: 2400	**CUMULATIVE CREDITS: 48**					

I Semester

Subject Code	Title of the subject	L	T	P	C	QP
BBSBS 1010	Engineering Mathematics-I	3	1	0	4	A

Course Educational Objectives

CEO1	To find critical points, and use them to locate maxima and minima
CEO2	To provide the standard methods for solving differential equations
CEO3	To study Fourier series and to express a function in Fourier series
CEO4	To use matrices, determinants and techniques for solving systems of linear equations in the different areas of Linear Algebra.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Implement the engineering problems using the concept of Partial differentiation and series and to understand its application.
CO2	Solve the initial value and boundary value problem of ODE related to SHM, Electrical circuit, Growth and Decay problem etc.
CO3	Execute the technique of Fourier series for learning advanced Engineering Mathematics.
CO4	Relate the tools of matrices and linear algebra including linear transformations, eigen values, diagonalization and orthogonalization in Engineering.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2													
CO2	2	2													
CO3	2	2													
CO4	2	2													
Avg.	2	2													

SYLLABUS

UNIT:1 MULTIVARIABLE CALCULUS [13 Hours]

Partial differentiation, Euler's theorem, Total derivative, Taylor's theorem two variable (without proof), Maxima and Minima, Differentiation under integral sign (Leibtinz rule).

UNIT:2 DIFFERENTIAL EQUATION-I [12 Hours]

Ordinary differential Equation: First order and first degree differential equations and its method of solving, Application to Electrical circuits and conduction heat and their solution.

Differential Equation-II

Linear differential equation of higher order and its different methods of finding solution (operator method). Second order liner differential equation and its solution: Euler Cauchy equation, solution by undermined coefficient method and variation of parameter. Modeling of electrical circuit with solution.

UNIT:3 Fourier series [10Hours]

Fourier series, Fourier expansion of functions of any period, Even and odd functions, Half Range

Expansion.
UNIT:4 LINEAR ALGEBRA **[15 Hours** Matrices, Types of matrices, Rank of matrix Eigen values and Eigen vectors, Cayley – Hamilton theorem(without proof), system of liner equation, Orthogonal matrices, Complex matrices, Hermitian and skew-Hermitian matrices, Unitary matrices,similarity of matrices. Quadratic forms and Canonical forms.
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books 1. *Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, WilleyDifferential* 2. *Calculus by Santi Narayan and Mittal, S.Chand Publications*
Reference Books: 1. *Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.* 2. *Higher Engineering Mathematics by B.V.Raman, McGraw Hills Education* 3. *Advanced Engineer methods by N. P. Daly & Manish Goel.*

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Subject Code	Title of the subject	L	T	P	C	QP
BBSBS1021	Engineering Physics	3	0	0	3	A

Course Educational Objectives

CEO1	To provide the students about the elementary features and the basic concepts of Physics and its applications to different physical systems.
CEO2	Students will be able to communicate these concepts clearly, develop problem solving skills and critical thinking.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Solve engineering problems using the concept of oscillation and wave mechanics and recognize the scientific application of Laser.
CO2	To analysis the structural properties of elemental solids
CO3	Determine gradient of scalar field, divergence and curl of vector fields and solve engineering problems on electromagnetism
CO4	Construct a quantum mechanical model to explain the behavior of a system at microscopic level.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1													
CO2	1	1													
CO3	2	1													
CO4	1	1													
Avg.	1.5	1													

SYLLABUS

UNIT:1 Interaction of Wave and Matter (12 Hours)

Introduction to Harmonic Oscillator, Waves and its Characteristics, Superposition of Waves, Interference by division of wavefront (Biprism experiment) and division of amplitude (Newton's Ring experiment). Introduction to Diffraction, types of diffraction.

LASER, spontaneous & stimulated emission, Einstein's relation, Ruby Laser and He-Ne Gas Laser, application of Laser. Optical fiber, Acceptance angle, Numerical aperture, Step index and Graded index fibers, applications of optical fiber.

UNIT:2Physics of Materials(12 Hours)

Crystallography, Crystal structure, crystal direction and plane, Miller indices, Interplanar spacing's, Reciprocal Lattice and its characteristics, Reciprocal Lattice of SC, FCC and BCC, Brillouin Zone, Bragg's law.

Energy bands in solids (conduction band, valence band and fermi level), Classification of matter on the basis of band theory.

UNIT:3Electromagnetic theory and wave (10 Hours)

Physical significance of grad, divergence and curl operators, Gauss divergence theorem and Stoke's theorem (no derivations), fundamental laws of electrostatics, magneto statics and electromagnetism, displacement current and conduction current, Maxwell's relations.

Electromagnetic wave and its characteristics, electromagnetic wave equation for free space in terms of **E** and **B**, electromagnetic energy, Poynting vector and Poynting theorem.

UNIT:4Quantum mechanics(12 Hours)

Introduction to dual nature: Black body radiation, photoelectric effect, Compton effect (qualitative idea only), de-Broglie's hypothesis, uncertainty principle & its application to non-existence of electron inside the nucleus and one dimensional harmonic oscillator, wave function and its characteristics, probability, normalization and expectation value, Schrodinger's equation & its application to one dimensional potential well, potential step and potential barrier (qualitative idea).

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books :

1. *Engineering Physics by D. K. Bhattacharya and PoonamTanden, Oxford University Press.*
2. *Engineering Physics, H K Malik and A K Singh, Tata McGraw Hill, MGH*

Reference Books:

1. *Materials Science &Engg., V. Raghvan, Prentice Hall of India.*
2. *Concepts of Modern Physics, A. Beiser, S. Mahajan, S.R. Choudhary, Tata McGraw Hill.*
3. *Lasers & Optical engineering, P Dass, Narosa Publishers, Springer Publisher.*
4. *Engineering Physics by B. B. Swain and P. K. Jena, KitabMahal,Cuttack*
5. *Quantum Mechanics by SatyaPrakash, KitabMohal, etc. KedarNath Ram Nath Publisher*

Subject Code	Name of the Subject	L	T	P	C	QP
BBSBS1022	**Engineering Chemistry**	3			3	A

Course Educational Objectives

CEO1	To impart the knowledge of application of chemical sciences in the field of engineering
CEO2	The course aims at elucidating principles of applied chemistry in industrial systems, Water treatment and engineering materials.
CEO3	To give detailed knowledge about the reactivity of metal with environment and it's Prevention from corrosion.
CEO4	To give an idea about fuel and its characteristics.
CEO5	To enlighten the students with the applications of advanced materials.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Identify suitable water treatments techniques for domestic and industrial purposes
CO2	Differentiate various types of corrosion, and gain knowledge on control measures associated with corrosion
CO3	Classify the different types of fuel, it's analysis and gain knowledge on fractional distillation of petroleum.
CO4	Understand various types of polymers, their preparation along with applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2			1	2								
CO2			2			1	2								
CO3			2			1	2								
CO4			1			1	1								
Avg.			1.75			1	1.75								

SYLLABUS

UNIT:1 WATER TREATMENT **(12 Hours)**

Types of water, Impurities in water, Types of Hardness, Determination of Hardness by EDTA method, treatment of water for Domestic use, Water softening processes Lime-soda process, Ion Exchange method, Boiler feed water, Scale and Sludge, Caustic embrittlement, Priming and Foaming ,Removal of dissolved gases, Carbonate and phosphate conditioning, colloidal conditioning, Calgon conditioning, Desallination of brackish water by Reverse osmosis

UNIT:2CORROSION CHEMISTRY **(12 Hours)**

Introduction, Electrochemical cell, electrode potential E.M.F, Definition of corrosion, Types of corrosion: Dry corrosion and wet corrosion, Galvanic corrosion, Concentration cell corrosion, Factors influencing corrosion, corrosion control: Cathodic protection (Sacrificial anodic protection and Impressed current cathodic protection), Inhibitors, protective coatings: Galvanization and Tinning, Passivation.

UNIT:3FUEL TECHNOLOGY(12 Hours)

Introduction, Classification of Fuels, Calorific Value, Charcteristics of a good fuel, Types and analyses (Proximate and ultimate analysis) of coal, Dulong's Formula, Petroleum, (Extraction,

purification and refining),Cracking(thermal cracking, catalytic cracking), Knocking, Antiknocking , Octane numbers, Cetane numbers, Unleaded and synthetic petrol, LPG and CNG, Combustion Numericals.

UNIT:4 CHEMISTRY OF ENGINEERING MATERIALS(12 Hours)

Introduction, polymer, Classification of polymers, Types of polymerization and mechanism, Plastics: Thermosetting and thermo plastic, PVC, PE,PS,PMMA, PTFE, Bakelite,Nylon-6,6,Nylon-6, Fiber reinforced plastic.

*ADD-ON COURSES: Conducting Polymer (Polyaniline, Polyacetylene),Polycarbonates Bio-Degradable and Non-Bio Degradable polymer, Nano composite.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1Engineering chemistry by Jain & Jain, DhanpatRai publishing company (p) Ltd.

Reference Books:

1. *A Text Book of Engineering Chemistry by S.S.Dara,S Chand Publishers*
2. *A Text Book of Engineering Chemistry by SashiChawla,DhanpatRai Publishing house.*
3. *Text Book of Engineering chemistry, 2nd edition, by R.Gopalan,D.Venkapaya&SulochanaNagarajan, Vikas Publishing House Pvt.Ltd.*
4. *B. Tech Chemistry-II by P. K. Kar, S. Dash, B. Mishra kalyani publishers.*

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Subject Code	Name of the Subject	L	T	P	C	QP
BBSES1031	**Basics of Mechanics**	**3**	**0**	**0**	**3**	A

Course Educational Objectives

CEO1	To know the basics of mechanical forces, stress and their compositions
CEO2	Properties of various surfaces and particles

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Determine the resultant force and moment for a given force system
CO2	Analyze planar and spatial systems to determine the forces in members of trusses, frames and problems related to friction.
CO3	Calculate the motion parameters for a body subjected to a given force system.
CO4	Determine the deformation of a shaft and understand the relationship between material constants.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1													
CO2	1	2													
CO3	1	2													
CO4	1	2													
Avg.	1	1.75													

SYLLABUS

UNIT:1 STATICS OF PARTICLES(16 Hours)

Fundamental concepts and principles of engineering mechanics. Resolution of forces - Resultant of several concurrent forces - Free body diagram. Principles of transmissibility. Moment of a force - Varignon's theorem - Equivalent system of forces -Types of supports and corresponding reactions.

UNIT:2ANALYSIS OF TRUSSES AND FRICTION(12 Hours)

Introduction to Truss - Analysis of Trusses - Method of joints- Method of sections.
Laws of Friction - Angle of Friction-Angle of Repose-Ladder and Wedge Friction

UNIT:3PROPERTIES OF SURFACES(12 Hours)

Determination of first moment area of plane figures by integration – Determination of centroid of composite figures by using standard formula.
Determination of second moment area of plane figures by integration - Parallel and perpendicular axis theorems - Determination of area moment of inertia of composite figures by using standard formula - Polar moment of inertia - Radius of gyration.

UNIT - 4 - DYNAMICS OF PARTICLES (10 Hours)

Rectilinear motion: uniform velocity and uniformly accelerated motion Newton second law- D'Alembert's principle and its applications- work and energy equation- Impulse and Momentum - Impact of elastic bodies.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Timoshenko, and Young, "Engineering Mechanics", Tata Mc-Graw Hill Book Company.*
2. *S. S. Bhavikatti, "Engineering Mechanics", New Age International Publishers,*

Reference Books:

1. *Dr.Bansal.R.K, & Sanjay Bansal, "A Text book of Engineering Mechanics", Lakshimi publications.*
2. *A.K.Tayal, "Engineering Mechanics Statics And Dynamics", Umesh Publications*
3. *Rajasekaran.S, &Sankarasubramanian.G, "Engineering Mechanics", Vikas Publishing House Pvt Ltd, 2011.*
4. *Engineering Mechanics, (3ed edition) by Statics and Dynamics K.Vijaya Kumar Reddy and J Suresh Kumar, BS Publications.*

Subject Code	Name of the Subject	L	T	P	C	QP
BBSES1032	**Basics of Thermodynamics**	**3**	**0**	**0**	**3**	A

Course Educational Objectives

CEO1	To know the basic concepts of Thermodynamics
CEO2	To know the concepts thermodynamic properties

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Explain the basic concepts of system, control volume, thermodynamic properties, thermodynamic equilibrium, temperature, work and heat energy.
CO2	Apply the laws of thermodynamics to refrigerators, heat engines, heat pumps compressors and nozzles etc.
CO3	Interpret and apply the concept of entropy to thermodynamic systems
CO4	Evaluate properties of pure substances, gases and their mixtures and to derive and apply to thermodynamic problems.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2													
CO2	1	2													
CO3	1	1													
CO4	1	2													
Avg.	1	1.75													

SYLLABUS

UNIT - 1 **(15 Hours)**

Basic concepts & definition, scope of thermodynamics. Macroscopic & microscopic approach. Definition of fixed mass (closed) system & control volume (open) system, isolated system. Thermodynamic properties (extensive & intensive), state & its representation on a property diagram, process and its representation, cyclic process Characteristics of properties (point & path function), reversible & irreversible process, Quasistatic Process. Thermodynamic equilibrium.

Pressure, Types of pressure, Zeroth law of thermodynamics & temperature scales, calibration of thermometers. Ideal gasses & their P-V-T relation. Energy transfer; Work transfer(definition & calculation), different modes of work Displacement work for various process, Free expansion work, Heat transfer; modes of heat transfer, basic laws in conduction, convection & radiation.

UNIT - 2 **(13 Hours)**

First law of thermodynamics, formal statement (using cyclic process) first law for processes of fixed masses (closed system) Introduction of internal energy, enthalpy as thermodynamic properties Definition of sp.heats (C_p&C_v) and their use in calculation of internal energy & enthalpy with emphasis on ideal gas.

Application of first law to control volume (Steady Flow); nozzle, diffuser, compressor, turbine,

throttling device.

UNIT - 3 **(12 Hours)**

Second law of thermodynamics, Kelvin Planck & Clausius statements, Carnot cycle. Reversible &

irreversible engines and their efficiency (Thermal and maximum Efficiency)
Entropy concepts, Clausius inequality, Entropy Principle.

UNIT - IV **(10 Hours)**

Properties of pure substance, P-v, T-s, h-s diagram for steam , Steam properties, Introduction to steam table with respect to specific volume, pressure, temperature, enthalpy & entropy, Mollier Diagram. Application of thermodynamics: Steam power plant, Refrigerators and Heat Pump, I C Engines (working principle with schematic diagrams only)

Teaching Methods: Chalk& Board/ PPT/Video Lectures/

Text Books:

1. *Engineering Thermodynamics by P.K.Nag, Publisher: TMH*
2. *Basic Engineering Thermodynamics by D S Kumar, Publisher: S K Kataria& Sons-New Delhi*

Reference Books:

1. *Fundamental of Engineering Thermodynamics by E. Rathakrishnan, publisher. PHI*
2. *Thermodynamics: An Engineering Approach by Yunus A. Cengel, Michael A. Boles Publisher: Mcgraw Hill Education*
3. *Thermal engineering by R.K.Rajput, Laxmi Publications Pvt. Ltd.*
4. *Steam Tables in SI Units by K. Ramalingam, Scitech Publications (P) Ltd.*

Subject Code	Name of the Subject	L	T	P	C	QP
BBSES1041	**Basics of Electronics**	**3**	**0**	**0**	**3**	A

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Recognize different components such as transistors, resistors, capacitors and diodes which fit on a small chip with each leg of the chip connecting to a point within the circuit.
CO2	Apply modern modelling software for drafting different electronic circuits.
CO3	Analyze modern electronic circuits and systems.
CO4	Formulate mathematical descriptions and procedures in designing new electronic systems and technically present

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1														
CO2			2												
CO3			2												
CO4	2		2												
Avg.	1.5		2												

SYLLABUS

UNIT-1 **[12 Hours]**

Semiconductor Devices:- Classification of material, Energy band diagram, properties of semiconductors, Types of semiconductors, Semiconductor diode (no bias, forward, reverse),temperature effects, diode equivalent circuit, zener diode, LED , Half wave rectifier, full wave rectifier, clippers ,clampers.

UNIT-2 **[12 Hours]**

Bipolar Junction Transistors (BJTs):- Introduction, transistor operation, Simplified structure and physical operation of n-p-n and p-n-p transistors in the active region, Common–Base configuration, Common–emitter configuration, Common-collector configuration Current-voltage characteristics of BJT, BJT as an amplifier and as a switch.

Field Effect Transistors (FETs):- Introduction, construction and characteristics of JFETs, transfer characteristics, D-MOSFET, E –MOSFET.

UNIT-3 **[12 Hours]**

Communication systems: - Analog and digital signals, block diagram of basic communication system, need for modulation, methods of modulation,AM/FM transmitters & receivers (Block diagram description only)

Electronic Instruments:- Basic principle of Oscilloscope, Function of the sweep generator, Block diagrams of oscilloscope, Measurement of frequency and phase by Lissajous method, Application of oscilloscope for measurement of voltage, period and frequency, Block diagram of standard signal generator, AF sine and square wave generator, and Function generator.

UNIT-4[14 Hours]

Digital systems and binary numbers:-Digital systems, Binary numbers, number system conversion, octal &hexa decimal number, 1's& 2's compliments, signed binary numbers, binary codes, binary logic.

Logic Gates and Boolean Algebra:- The inverter, The AND, OR, NAND NOR, Exclusive-OR and Exclusive-NOR gate, Boolean operations and expressions, Laws and Rules of Boolean algebra, DeMorgan's theorem, Boolean analysis of logic circuits, Standard forms of Boolean expressions, Boolean expression and truth table Combinational Logic and Their Functions: Basic combinational logic circuits, Implementation of combinational logic, The universal properties of NAND and NOR gates, Basic adders

Teaching Methods: Chalk& Board/ PPT

Text Books:

1. Electronic Devices (Seventh Edition), Thomas L. Floyd, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092 (Selected Portions).
2. Digital Fundamentals (Eighth Edition), Thomas L. Floyd and R.P. Jain, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.
3. Electronic Instrumentation, H.S. Kalsi, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books:

1. Microelectronic Circuits (Fifth Edition), Adel S. Sedra and Kenneth C. Smith, Oxford University Press, YMCA Library Building Jai Singh Road, New Delhi – 110 001.
2. Electronic Devices and Circuit Theory (Ninth Edition), Robert L. Boylestad and Louis Nashelsky, Pearson Education, 482 FIE, Patparganj, Delhi – 110 092.
3. Electronics Principles (7th Edition), Albert Malvono and David J. Bates, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Course Code	Course Title	L	T	P	C	QP
BBSES1050	**Programming for Problem Solving**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To formulate algorithm, translate into program and then execute the programs for verifying its correctness.

CEO2: To analyze a problem for knowing its efficiency and decompose it into functions using divide and conquer approach.

Course Outcome

CO1	To formulate simple algorithms for arithmetic and logical problems and translate into programs.
CO2	To develop programs, understand and analyze its complexity.
CO3	To understand and develop programs using functions and recursions
CO4	To develop programs using pointers and structures and understand their functionality.

UNIT- I **(11 Hours)**

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

Idea of Algorithm: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo-code with examples.

From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

Arithmetic expressions and precedence. Conditional Branching. Writing and evaluation of conditionals and consequent branching.

UNIT- II **(11 Hours)**

Loops: writing programs and evaluation of loops

while, do-while and for loop, break, continue, nested loop

Arrays: Arrays (1-D, 2-D)

Basic Algorithms: Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

UNIT- III **(11 Hours)**

Character arrays and Strings: String handling operations, programs on strings, string handling functions.

Functions: Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference.

Recursion: Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series

UNIT- IV **(11 Hours)**

Pointers: Idea of pointers, Defining pointers, dynamic memory allocation, Use of Pointers in self-referential structures, notion of linked list (no implementation)

Structure: Structures, Defining structures and Array of Structures.
Teaching Methods: Chalk& Board/ PPT
Text Books: 1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill 2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill
References: 1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Subject Code	Name of the Subject	L	T	P	C	QP
BBSES1042	**Basics of Electrical Engineering**	3			3	A

Course Educational Objectives

CEO1	Impart a basic knowledge of electrical quantities such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
CEO2	This course provides comprehensive idea about DC & AC circuit analysis, magnetic circuit analysis, working principles of machines and common measuring instruments.
CEO3	Emphasize the effects of electric shock and precautionary measures. Improve the ability to function on multi-disciplinary teams.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand basics of Electrical Engineering and to solve complex electrical networks mathematically
CO2	Demonstrate basic laws and techniques to develop a working knowledge of the network theorems of analysis used.
CO3	Understand elementary knowledge of electromagnetism
CO4	Differentiate between DC and AC circuits and analyse them
CO5	Understand the elementary knowledge of Electrical machines
CO6	Extrapolate on basic laws and techniques to develop a working knowledge on generating stations and measuring instruments

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1											2	-	
CO2	3	2											2		
CO3	3	2											1		
CO4	3	3											1		
CO5	2	2											1		
CO6	2	1											1		
Avg.	2.6	2											1.33		

SYLLABUS

Unit – I : ***DC Circuits*** ***(8 hours)***

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Unit - II: ***AC Circuits*** ***(8 hours)***

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Unit – III: Transformers (6 hours)

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Unit – IV: ***Electrical Machines*** ***(8 hours)***

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque-speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Unit – V: ***Power Converters*** ***(6 hours)***

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Unit – VI: ***Electrical Installations*** ***(6 hours)***

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books &Reference Books: :

1. *D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill,2010.*
2. *D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.*
3. *L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press,2011.*
4. *E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.*
5. *V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.*

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Subject Code	Name of the Subject	L	T	P	C	QP
BBSHS 1060	**Communicative English-I**	**2**	**0**	**0**	**2**	A

Course Educational Objectives

CEO1	To develop the communication skills and soft skills of the students
CEO2	To enhance the ability of the students to develop employability and entrepreneurial skills
CEO3	To enable students to develop intrapersonal and interpersonal communication skills
CEO4	To enable students to participate in group discussions without stage dear
CEO5	To make students understand corporate communication

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the importance of effective communication for personal and professional development
CO2	Use correct vocabulary and grammar for effective communication in English
CO3	Apply ICT for professional communication
CO4	Develop a positive attitude towards people, organization, and life.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1						1				2					
CO2										2					
CO3						1				2					
CO4						2				2					
Avg.						1.33				2					

SYLLABUS

UNIT -1Importance of English for Communication in the 21st Century (10 hours)

1.1 Role of English in enhancing employability and entrepreneurial skills 1
1.2 The Nature and Scope of Communication 1
1. 3 Objectives of Communication: Information, advice, suggestion, order, motivation, persuasion, warning, negotiation, decision-making, etc. through English Language skills, i.e., LSRW skills1 + 1
1.4 The process of communication and factors that influence communication: Sender, receiver, channel, code, topic, message, context, feedback, noise, filters and barriers (steps such as Ideation, Encoding, Transmission, Decoding, etc. need to be dealt with); Audience and purpose 1 + 1+ 1.
1.5 Types of Communication: General and Professional Communication; Formal and Informal Communication; Verbal and Non-verbal communication; Intrapersonal and Interpersonal communication; Written communication and Spoken communication. 1 + 1+ 1.

UNIT-2. English Vocabulary, Grammar & Usage (16 hours)

2.1 Synonyms and Antonyms 1 + 1
2.2 Words often confused 1
2.3 Technical terms and one word substitutes 1 + 1
2.4 Idioms and Phrasal Verbs 1 + 1
2.5 Correct Usage of Nouns, Pronouns, Verbs, Adverbs, Adjectives 1+1+1+1+1
2.6 Communicative use of the Passive Voice 1 + 1

2.7 Communicative use of Punctuation marks 1 + 1

UNIT-3. Introduction to Corporate Communication (15 hours)

1. Communication and Corporate structure:Organigraph; Communication network: Formal Communication network and Informal Communication network / Grapevine 1 + 1+ 1
2. Corporate Communication – Direction of Communication:Downward Communication, Upward Communication, Horizontal/Lateral Communication, Diagonal Communication1 + 1+ 1
3. Communication challenges in today's work place: Advances in technology; culturally diverse workforce; Team-based organizational Settings; how to overcome these challenges1 + 1+ 1
4. Information and Communication Technology (ICT) and the Corporate world:
Power point presentation using multimedia; Internet and Intranet; Fax; Teleconferencing; Videoconferencing; LaTeX 1 + 1+ 1
5. Corporate/Business etiquette:Good listening skills, proper dressing and grooming; proper handshake, mobile etiquette, table manners 1 + 1+ 1

UNIT:4 Soft skills for corporate readiness (7 hrs)

4. 1 Importance of soft skills in personal and professional life 1hrs
4.2 Are we hardwired for success? 1hrs
4.3 Importance of developing a positive attitude 1hrs
4.4 Lateral Thinking 1hrs
4.5 Teamsmanship 1 hrs
4.6 Emotional intelligence 1 hrs
4.7 Leadership Skills 1 hrs

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *An Introduction to Professional English and Soft Skills by B. K. Das et al., Cambridge University Press.*
2. *Communicative English for Engineers and Professionals by NitinBhatnagar and MamtaBhatnagar. Published by DK/Pearson.*
3. *Communication Skills by Sanjay Kumar &PushpLata , Oxford University Press*

Reference Books:

1. *Technical Communication , Principle and Practice by Meenakshi Raman &Sangeeta Sharma, Oxford University Press*
2. *Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.*
3. *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success by Gopalaswamy Ramesh and Mahadevan Ramesh. Pearson.*
4. *Oxford Guide to English Grammar by John Easthood. Oxford University Press.*
5. *365 Ways to Change Your World by Norman Vincent Peale by Orient Paperbacks.*

Lab Code	Name of the Lab	L	T	P	C	QP
BBSBS 1120	**Engineering Physics Laboratory**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	Students will understand the basic principles of physics and their mathematical description.
CEO2	Students will be able to use the laws of physics and calculus to solve problems
CEO3	Students will be able to work together in collaborative groups to perform experiments, gather data and reach conclusions.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the uses of various Basic Instruments for different Physical measurements.
CO2	Apply the Physical Laws and verify those using standard Experiments.
CO3	Organize experiments to determine different Physical quantities and analyze those for different application to Physical Systems.
CO4	Evaluate the magnitudes of Physical quantities systematically through experiments and design new experiments with the theoretical knowledge

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2													
CO2	1	1													
CO3	1	1													
CO4	1	1													
Avg.	1	1.25													

List of Experiments:

1. Determination of Rigidity modulus of a material of a wire using Barton's apparatus (Static method)
2. Determination of Young's modulus of a material of a wire using Searle's apparatus
3. Determination of surface tension of water by capillary rise method.
4. Determination of acceleration due to gravity by using Bar/ Kater's pendulum.
5. Verification of laws of transverse vibration by using Sonometer
6. Determination of Young's modulus of a material by bending of beam method.
7. Study the characteristics of PN junction diode.
8. Study the characteristics of RC circuit.
9. Study the characteristics of BJT / FET.
10. Determination of grating element of a plane diffraction grating
11. Determination of wavelength of light by Newton's Rings apparatus.
12. Determination of dielectric constant by Leacher wire method.
13. Study of photoemission
14. Determination of wavelength of laser by Michelson Interferometer
15. Determination of coefficient of viscosity by Stoke's method.

Lab Code	Name of the lab	L	T	P	C	QP
BBSBS1121	**Engineering Chemistry Laboratory**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO	To train the students about the applications of chemical sciences in the field of engineering and technology

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the basic methods of chemical analysis and instrumentations involved
CO2	Standardize of Chemicals
CO3	Estimate the hardness, ions in salts and compositions in ores.
CO4	Synthesizes the drugs and know about their applications

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			1			1									
CO2			2			2									
CO3			2			2									
CO4			2			2									
Avg.			1.75			1.75									

SYLLABUS

List of Experiments:

1. Determination of total hardness of water by using EDTA.
2. Determination of amount of NaOH and Na_2CO_3 present in mixture of two.
3. Standardization of $KMnO_4$ using sodium oxalate.
4. Determination of ferrous ion in Mohr's salt by standardised $KMnO_4$.
5. Determination of % of dissolved oxygen in given water sample.
6. Estimation of available chlorine in bleaching powder solution.
7. Determination of rate constant of acid catalyst Hydrolysis reaction.
8. Preparation of aspirin
9. Estimation of Zinc in brass.
10. To determine the strength of HCl and acetic acid from the mixture of acid by strong alkali (NaOH) by Conductrometry.
11. Preparation of nanoparticle.
12. Determination of partition coefficient of iodine in benzene and water.
13. Preparation and determination of pH of buffer solution.
14. To determine the molecular weight of polymer by viscosity measurement.

Lab Code	Name of the Lab	L	T	P	C	QP
BBSES1140	**Basics of Electronics Laboratory**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To know the basic concepts of electronics application's
CEO2	To know the characteristics of basic electronics components

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Test electronic components and devices with multi meter
CO2	Demonstrate the measuring quantities of Oscilloscopes, Signal generators
CO3	Evaluate the characteristics of transistors, MOSFETs etc.,
CO4	Classify various logic gates and Adder circuits

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	1												
CO2		2	2												
CO3		1	1												
CO4		2	2												
Avg.		1.5	1.5												

SYLLABUS

List of Experiments:

1. Familiarization of electronic components and devices (Testing of semiconductor diodes and transistors using digital multi meter)
2. Study and use of Oscilloscope, signal generator to view waveforms and measure amplitude and frequency of a given waveform.
3. V-I characteristics of semiconductor diode
4. Studies on half-wave and full-wave rectifier circuits without and with capacitor filter; recording of the waveforms and measurement of average and rms values of the rectifier output.
5. Studies on clipper circuit.
6. Studies on clamper circuit.
7. V-I characteristic of an n-p-n or p-n-p transistor, DC biasing the transistor in common-emitter configuration and determination of its operating point (i.e., various voltages and currents).
8. MOSFET I-V characteristics
9. Studies on Logic gates (Truth table verification of various gates).
10. Studies and experiments using ADDER CIRCUITS ICs

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Lab Code	Name of the Lab	L	T	P	C	QP
BBSES 1141	**Basics of Electrical Engineering Laboratory**	0	0	2	1	

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Illustrate the transformers and single phase motors constructional features
CO2	Analyse various electrical quantities with combination of loads
CO3	Examine the characteristics of AC and DC machines
CO4	Distinguish the methods of speed control of DC motors

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1		1	2												
CO2		2	2												
CO3		1	2												
CO4		2	2												
Avg.		1.5	2												

SYLLABUS

List of experiments/demonstrations:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
3. Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
4. Transformers: Observation of the no-load current waveform on an oscilloscope (non sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
5. Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
6. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).
7. Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
8. Demonstration of cut-out sections of machines: DC machine (commutator- brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
9. Torque Speed Characteristic of separately excited dc motor.
10. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections.
11. Torque-Slip Characteristic of an induction motor.
12. Generator operation of an induction machine driven at super synchronous speed.
13. Synchronous Machine operating as a generator: stand-alone operation with a load Control of voltage through field excitation.
14. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Course Code	Course Title	L	T	P	C	OP
BBSES1150	**Programming for Problem Solving Laboratory**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite:

Course Educational Objective

CEO1: To develop programs for problems on different applications of array, functions, pointers and structure.

CEO2: To analyze different problems by comparing and implementing in programming.

Course Outcome

CO1	To understand operating system and its simple commands, writing programs, compilation, debug and execution process.
CO2	To develop programs using loop controls, arrays and understand the complexity using different programs.
CO3	To develop programs using functions and recursive function by decomposing a problem and analyze them.
CO4	To understand numerical problems, develop programs using pointers , structures and understand their functionality.

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
1) Introduction to OS: Before starting experiments explain the facilities and operations of OS.
2) Introduction to the C compiler, Compilation and Execution Process & writing simple programs.

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
1) WAP to input radius of a circle and Find the area, perimeter of it.
2) WAP to input two numbers and swap them without using intermediate variable.
3) Write a program to accept Fahrenheit and calculate its equivalent Celsius.

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
1) Write a program to input principle amount, no. of terms and rate of interest. Find simple interest.
2) WAP to input three unequal numbers and find the greatest using conditional operator.
3) Write a program to input a float value and display its integer part & fractional part separately.

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

1) Write a program to find the real roots of a quadratic equation when three co-efficient values are given.
2) Write a program to input a lower case alphabet and test whether it is vowel or consonant.
3) Write a program to find the greatest among three numbers.

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

1) Write a program to generate Fibonacci series of N numbers.
2) Write a program to find the greatest common divider of two positive numbers given.
3) Write a program to accept a positive integer and test it for palindrome or not.
4) Write a program to calculate the following sum:
Sum = 1-(x^2)/2! +(x^4)/4! – (x^6)/6! + (x^8)/8! – (x^10)/10!
5) Write a program to generate the following pyramid.

```
        1
      1 2 3
    1 2 3 4 5
  1 2 3 4 5 6 7
```

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

1) Write a program to accept 10 integers in to an array and find largest and smallest integers present in them.
2) Write a program to apply binary search on an array having elements in sorted order.
3) Write a program to accept 10 numbers in to an array and sort it using insertion sort in ascending order.

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

1) Write a program to input elements 4x4 matrix. Find the principal diagonal of them.
2) Write a program to input values into two matrices A(3x4), B(4x3). Perform matrix multiplication and display the resultant matrix.
3) Write a program to accept a string and test whether it is palindrome or not using string handling functions.

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

1) Write a C program which contains three UDF's namely add(), subtract() and multiply(). Each function accepts two integers as their arguments and calculate and return the results
2) Write a program to create an UDF and test a number is prime or not.
3) Write a program to find the factorial of a given number using UDF.

Tutorial 8: Recursion, structure of recursive calls
Lab 8: Recursive functions

1) Write a program to find greatest common divisor of two integers using recursive functions.
2) Write a program to accept 10 elements into an integer array. Find the largest element present using recursive function.
3) Write a program to generate Fibonacci series using a recursive function.

Tutorial 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 9: Programming for solving Numerical methods problems

1) Write a program to implement Newton-Raphson Method.
2) Write a program to implement Euler's method.

Tutorial 10: Pointers, structures and dynamic memory allocation
Lab 10: Pointers and structures

1) Write a program to create user defined function called swap having two integer pointers as its arguments and it has no return value. Call this function using call-by-address.

2) Write a program to store 'n integers using dynamic memory allocation. Find the average value of the integers using a user defined function.

3) Write a program to input 11 cricket players' details using a structure array having member's player name, team name, batting average. Create a function which will display the player name whose batting average is >=30.

4) Write a program to create a structure for product having members like product code, price and quantity. Store N product details using dynamic memory and display them.

Teaching Methods: Chalk& Board/ PPT/Video Lecture

Text Books:

3. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
4. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

References:

2. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Lab Code	Name of the Lab	L	T	P	C	QP
BBSHS 1160	**Communicative English Laboratory-I**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To develop the vocabulary and usage skills of students by practice.
CEO2	To develop the communication skills of the students, especially Listening and Speaking skills.
CEO3	To enable students to participate in group discussions through proper listening and speaking.
CEO4	To enable students eliminate grammatical mistakes in speech and writing.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Memorize and explain a good range of vocabulary and usage.
CO2	Use grammar for effective speaking in GD and other formats of speaking
CO3	Able and defend in conversational and public speaking competencies.
CO4	Develop active listening and speaking skill in different real life situation

CO-PO & PSO Mapping

	PROGRAMME OUTCOMES												PSOs		
COs	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1										2					
CO2										2					
CO3										2					
CO4										2					
Avg.										2					

SYLLABUS

Phonetics &Listening Skills16 hours = 8 classes [2 listening tests x 10 marks = 20 marks]
Vowels, diphthongs, consonants, consonant clusters; The International Phonetic Alphabet (IPA); phonemic transcription; Problem sounds; Syllable division and word stress; Sentence rhythm and weak forms; Contrastive stress in sentences to highlight different words; Intonation: falling, rising, and falling-rising tunes; Listening to Newspaper reading/Video, etc.
Listening with a focus on pronunciation (ear-training): segmental sounds, stress, weak forms, intonation & Listening for comprehension. Reading of English daily newspapers and self-development books be integrated listening and speaking activities.

Speaking skills 16 hours = 8 classes [4 speaking tests x 10 = 40 marks]

- Topics for 1 minute, 2 minutes, and 5 minutes speaking
- Pictures, Quotations, Attitude-testing Questions may be used.
- Summarizing/responding to handouts, articles, books, magazines and newspapers.

Individual/Group presentations/discussion on given topics

Soft skills development 14 hours = 7 classes [4 assignments x 10 = 40 marks]

- Positive thinking (Teachers to engage game/activity-oriented classes)

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text/Reference Books:

1. *Business and Corporate Soft skills developed by Rai Tech. University (PDF available)*
2. *Spoken English (with CD). Sasikumar V and P V Dhamija. New Delhi: Tata McGraw-Hill Education Pvt. Ltd. (2nd Ed.)*

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Lab Code	Name of the Lab	L	T	P	C	QP
BBSES 1170	**Engineering Drawing Lab**	**0**	**0**	**2**	**1**	-

Course Educational Objectives

CEO1	To know the basics of Engineering drawing
CEO2	To Practice different projection planes

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Prepare Orthographic projections of Lines
CO2	Construct Isometric Scale
CO3	Interpret Sections of various Solids including Cylinders
CO4	Draw projections of lines

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			2												
CO2			2												
CO3			2												
CO4			1												
Avg.			1.75												

SYLLABUS

Unit 1

1. **Introduction**: Introduction to Standards for Engineering Drawing practice, Line work and Dimensioning. **[1 – Sheets]**
2. **Co-ordinate system and reference planes:**Definitions of HP, VP, RPP & LPP. Selection of drawing size and scale. Representation of point and line. **[1 – Sheets]**

Unit -2

3. **Orthographic Projections :** Introduction, Definitions - Planes of projection, reference line, Projections of points in all the four quadrants, Projections of straight lines (located in First quadrant/first angle only),True and apparent lengths, True and apparent inclinations to reference planes. **[1 – Sheets]**
4. **Orthographic Projections of Plane Surfaces (First Angle Projection Only):** Introduction, Definitions–projections of plane surfaces–triangle, square, rectangle, hexagon and circle. **[1 – Sheets]**
5. **Projections of Solids (First Angle Projection Only):** Introduction, Definitions – Projections of right regular tetrahedron, hexahedron (cube), prisms, cylinders and cones in different positions.

Unit -3

6. **Sections and Development of Lateral Surfaces of Solids :** Introduction, Section planes, Sections, Section views, Sectional views, Apparent shapes and True shapes of Sections of right regular prisms, pyramids, cylinders and cones resting with base on HP. **[2 – Sheets]**

Unit -4

7. **Isometric Projection (Using Isometric Scale Only):**Introduction, Isometric scale, Isometric projection of tetrahedron, cones and spheres. **[1 – Sheets]**

Teaching Methods: Chalk& Board/ PPT/Video Lectures

TEXT BOOKS

1. *Engineering Drawing - N.D. Bhatt & V.M. Panchal, Charotar Publishing House, Gujarat.*
2. *Computer Aided Engineering Drawing - S. Trymbaka Murthy, -I.K. International Publishing House Pvt. Ltd., New Delhi*
3. *Engineering Drawing by N. S. Parthasarathy and Vela Murali Oxford University Press.*

Lab Code	Name of the Lab	L	T	P	C	QP
BBSES 1171	**Engineering Workshop Lab**	**0**	**0**	**2**	**1**	**-**

Course Educational Objectives

CEO1	To practice engineering workshop tools
CEO2	Usage of workshop tools and applications

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Follow various safety precaution and use of various hand tools
CO2	Demonstrate the process configuration and basic mechanism of different machines like Lathe
CO3	Identify and apply suitable tools for machining process including facing
CO4	Prepare a job with a given dimension with the help of machining, welding practice.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1			1												
CO2			1												
CO3			1												
CO4			2												
Avg.			1.25												

SYLLABUS

Unit -1

1. **Safety Precaution:** To study the various Safety precautions in workshop.
2. **Fitting :**

(i) Study of different hand tools and Machine tools used in fitting.
(ii) Preparation of a male and female fitting job by using different hand tools.

Unit -2

3. **Machining:**

(i) Study of various components and working principle of lathe machine
(ii) Preparation of a cylindrical job by lathe (turning, Thread-cutting, knurling)
(iii) Study on Shaper and Milling Machine

Unit -3

4. **Welding Practice :**

(i) Hand on practice on Electric Arc Welding to prepare Lap Joint, Butt Joint, T- Joint and Corner Joint.
(ii) Study of Oxyacetylene Gas welding and Gas cutting.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Reference:

1. *Elements of Workshop Technology, Vol. I and II by Hajrachoudhary, Khanna Publishers*
2. *Workshop Technology by WAJ Chapman, Viva Books*

3. Workshop Manual by Kannaiah / Narayana, ScitechPublicaitons(P) Ltd.

II Semester

Subject Code	Title of the subject	L	T	P	C	QP
BBSBS 2011	**Engineering Mathematics-II**	**3**	**1**	**0**	**4**	A

Course Educational Objectives

CEO1	To apply Laplace Transform methods to solve initial value problems for constant coefficient linear ODEs.
CEO2	To calculate the gradients and directional derivatives of functions of several variables
CEO3	To introduce the concept of Vector differentiation and integration that finds applications in various fields like solid mechanics, fluid flow, heat problems and potential theory
CEO4	To apply Laplace Transform methods to solve initial value problems for constant coefficient linear ODEs.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Solve Ordinary differential and partial differential equation by using Laplace transform and its application in Network theory, wave equation etc
CO2	Execute the technique of Fourier Integral and transform for learning in advanced Engineering Mathematics
CO3	Relate gradient, curl and divergence and its application in electromagnetic theory
CO4	Evaluate multiple integrals by using Green's, Stokes' and divergence theorem to give physical interpretation of the curl and divergence of a vector field

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2													
CO2	2	2													
CO3	2	2													
CO4	2	2													
Avg.	2	2													

SYLLABUS

UNIT:1 Laplace Transforms **[15 Hours]**

Laplace Transforms: Definition, existence of Laplace Transform, Properties of Laplace Transform, Evaluation of integrals by Laplace Transforms, Inverse transforms, convolution theorem, transforms of unit step function, unit impulse function, and periodic function.

UNIT:2 **[12 Hours]**

Introduction of Fourier transform and Fourier Integral, Simple application to ordinary differential equations by Laplace Transform,

UNIT:3 **[10 Hours]**

Vector differential calculus: vector and scalar functions and fields, Derivatives, Curves, tangents and arc Length, gradient, divergence, curl and their applications.

UNIT:4 **[16 Hours]** Definition and evaluation of double integration and triple integration. Vector integral calculus: Evaluation of line integral, Surface integral and volume integral and their application, Greens theorem, stokes theorem, Gauss theorem (without proof)
Teaching Methods: Chalk& Board/ PPT/Video Lectures
Text Books: *Advanced Engineering Mathematics by E. Kreyszig, John Willey & Sons Inc. 10th Edition*
Reference Books: 1. *Higher Engineering Mathematics by B. V. Ramana ,McGraw Hill Education.* 2. *Higher Engineering Mathematics by BS Grewal: Khanna Publishers, New Delhi.* 3. *Advanced Engineering mathematics by H. K. Das.*

Subject Code	Title of the subject	L	T	P	C	QP
BBSHS 2061	**Communicative English-II**	**2**	**0**	**0**	**2**	A

Course Educational Objectives

CEO1	To develop the communication skills and soft skills of the students
CEO2	To enhance the ability of the students to develop employability and entrepreneurial skills
CEO3	To enable students to successfully participate in GDs and Pis
CEO4	To make students communicate effectively using technologies and techniques
CEO5	To inculcate a sense of professionalism in students

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Understand the nature and scope of corporate communication and try to be industry ready
CO2	Able to use language skills for professional growth
CO3	Distinguish fact from opinion in reading passages from different text books
CO4	Create professional documents like Resume, Job Application letter for their career needs

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1										2					
CO2										2					
CO3										2					
CO4										2					
Avg.										2					

SYLLABUS

UNIT-1 Introduction to Technical Communication **[7 hours]**

1.1 Essence of Technical Communication 1

1.2 Nature and Scope of Technical Communication: 1 +1 +1

Technical Communication -- Interactive and Adaptable; Technical Communication -- Reader Centered; Technical Communication and teamwork; Technical Communication Has Ethical, Legal, and Political Dimensions; Technical Communication – its International and Cross-Cultural nature; Technical communication and use of ICT.

1.3 Need of Technical communication for career development 1

1.4 Computer Assisted Language Learning (CALL) – Self learning through use of technology, Effectiveness of CALL for developing English Language Skills; Use of Internet 1 +1

UNIT - 2 Career Communication **[17 hours]**

2.1. Career making: Setting Goals, SWOT analysis 1

2.3 Preparing a Résumé: Elements of a Résumé; Types of Résumés: Chronological Résumé, Functional Résumé; Use of job portals 1 +1 +1

2.4 Effective Job Application Letter/Cover letter 1 +1
2.5 Group Discussion 1 +1
2.6 Job Interview 1 +1 +1+1 +1
2.7 Effective Oral Presentation 1+1
2.7 Handling a Meeting 1+1

UNIT-3 Technical Approach to Reading **[8 Hours]**
3.1 Know your Reading speed; Advantages of speed reading 1
3.2 SQ4R Techniques of Reading 1+1
3.3. Techniques of Rapid reading: skimming, scanning 1+1
3.4 Understanding coherence and cohesion 1
3.5 Note taking, Mind maps 1+1

UNIT-4 Technical Writing **[14 hours]**
4.1 Writing a technical paper 1+1
4.2 Writing business letters – significance, purpose, structure and elements, layout; types of business letters 1+1+1+1
4.3 Memos 1+1
4.4 Business Reports and Technical proposals 1+1+1+1
4.5 Using the Social media for better communication 1+1

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.*
2. *Technical Communication Today by Richard Johnson-Sheehan. Edition 5. Pearson.*
3. *Communicative English for Engineers and Professionals by NitinBhatnagar and MamtaBhatnagar. Published by DK/Pearson.*

Reference Books:

1. *Basic Communication Skills for Technology by Andre J. Rutherford, Pearson Education Asia, Patparganj, New Delhi.*
2. *Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers.*
3. *A Textbook of English Phonetics for Indian Students by T. Balasubramanian*
4. *Technical Communication, Principle and Practice by Meenakshi Raman &Sangeeta Sharma, Oxford University Press.*
5. *How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell.*

Course Code	Course Title	L	T	P	C	QP
BBSES 2050	**Data Structures**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: Understand the object oriented concepts and to develop C++ programs for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications.

CEO2: Understand different searching and sorting methods and compare them in terms of performance and applications.

Course Outcome

CO1	Develop algorithms for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand different applications.
CO2	Understand different searching and sorting methods, Linked lists and them compare them in terms of performance and applications.
CO3	Understand the Binary Tree and its memory representation; analyze Binary search Tree and its applications, compare the BST with AVL Tree and examine the advantages.
CO4	Design Heap Tree, observe its applications in sorting. Understand the memory representation of graph; analyze traversal methods and applications of graph. Analyze the Hashing techniques in compare with other sorting techniques.

Unit I **[11 hours]**

Basic concepts: Data abstraction, Algorithm specification, Memory Representation of 1D and 2D Array. Stack: Introduction to stack, basic operations and implementation of stack using arrays

Queue: Introduction to linear queue, basic operations and implementation of linear queue using arrays, circular queue, basic circular queue operations& Representation of Double ended Queue.

Applications on stack – Recursion, infix to postfix conversion, Evaluation of postfix

Unit II **[11 hours]**

Searching: Linear search and Binary search using linear array

Sorting: Bubble sort, Insertion sort, Selection sort, Quick sort, Bucket Sort using linear array.

Linked Lists: Basic operations of singly, doubly and circular linked lists, implementation of stack and queue using singly linked list.

Unit III **[11 hours]**

Trees: Introduction, Terminology, Binary Trees, Representation of Binary Trees using arrays and linked lists, Binary tree traversals, Creation of binary tree from in-order & pre-order sequences - Creation of binary tree from in-order & post-order

Binary Search Trees: definition, basic operations of BST (Searching, Insertion and deletion)

Introduction to AVL trees, Height of an AVL Tree, Balancing AVL tree by rotations after insertions and deletions of a data node.

Unit IV **[11 hours]**

Heaps: Introduction to binary heaps, definition of a Max-heap, Min-heap, creating Max-Heap, Applications: Heap sort, Priority queue.

Graphs: Definitions, Graph representation - Adjacency matrix, Incidence Matrix, adjacency lists, Graph Traversals (BFS & DFS), Single source shortest path algorithm (Dijkstra's Algorithm) Topological Sorting.

Hashing: Hashing Functions, Open hashing (chaining), closed hashing (Open addressing – linear probing, quadratic probing, double hashing), rehashing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books:

1. Gilberg and Forouzan: "Data Structure- A Pseudo code approach with C" by Thomson Publication.
2. "Data structure in C" by Tanenbaum, PHI publication / Pearson publication.
3. Pai: "Data Structures & Algorithms; Concepts, Techniques & Algorithms "Tata McGraw Hill.

Reference Books:

1. "Fundamentals of data structure in C" Horowitz, Sahani & Freed, Computer Science Press.
2. "Fundamental of Data Structure" (Schaums Series) Tata-McGraw-Hill.

Subject Code	Name of the Subject	L	T	P	C	QP
BBSHS 2161	**Communicative English Laboratory-II**	**0**	**0**	**2**	**1**	

Course Educational Objectives

CEO1	To enable students to successfully participate in GDs and PIs
CEO2	To make students communicate effectively by classroom practice.
CEO3	To inculcate a sense of professionalism in students

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Memorize and explain a good range of vocabulary and usage
CO2	Use grammar for effective speaking in GD and other formats of speaking
CO3	Able and defend in conversational and public speaking competencies
CO4	Develop active listening and speaking skill in different real life situation

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1										2					
CO2										2					
CO3										2					
CO4										2					
Avg.										2					

SYLLABUS

1. Writing an Effective Job Application Letter/Cover letter	[4 hours]
2. Writing a winning resume and posting in job portals	[4 hours]
3. Group Discussion	[8 hours]
4. Job Interview	[8 hours]
5. Oral presentation	[6 hours]
6. Organizing a Meeting	[4 hours]
7. Note making and Note taking	[4 hours]
8. Memo writing	[2 hours]
9. Profiling a company	[4 hours]
10. Summarizing books/research paper/news report.	

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Books:

1. *Business Communication Today by Bovee, Courtland L., Thill, John V. Prentice Hall.*
2. *Technical Communication Today by Richard Johnson-Sheehan. Edition 5. Pearson.*
3. *Communicative English for Engineers and Professionals by NitinBhatnagar and MamtaBhatnagar. Published by DK/Pearson.*

Reference Books:

(i)	*Basic Communication Skills for Technology by Andre J. Rutherford, Pearson Education Asia, Patparganj, New Delhi.*
(ii)	*Business Communication by Varinder Kumar and Bodh Raj. Kalyani Publishers.*
(iii)	*A Textbook of English Phonetics for Indian Students by T. Balasubramanian*
(iv)	*Technical Communication, Principle and Practice by Meenakshi Raman &Sangeeta Sharma, Oxford University Press.*
(v)	*How to Read better and Faster by Norman Lewis. 4th Edition. Publisher: Crowell.*

Course Code	Course Title	L	T	P	C	QP
BBSES 2150	**Data Structures using 'C++' Laboratory**	0	0	2	1	

Pre -Requisite:

Course Educational Objective

CEO1: Develop algorithms for performing different operations on arrays, stack, Queue, linked list. Analyze the difference between them and understand different applications.

CEO2: Understand different searching and sorting methods and compare them in terms of performance and applications. Understand and analyze Binary search Tree, AVL Tree, Heap Tree and their applications.

CEO3: Understand the memory representation of graph, its traversal methods and applications. Analyze the Hashing techniques in compare with other sorting techniques.

Course Outcome

CO1	Understand and implement the object oriented concepts by in developing the programs for different operations.
CO2	Develop programs for performing different operations on 1D array, matrix, stack, Queue, analyze the difference between them and understand their applications.
CO3	Design code for different searching and sorting methods and analyze their performance.
CO4	Develop the codes for different operations on Linked lists and compare with other data structures.

Lab1: introduction to OOPs (C++ features), cin, cout, object, class, Simple programs.

Lab2: Access Specifiers, inline, private, public, arrays of objects, programs on them.

Lab3: Experiment No.1

1) Write a C++ program to create a class called student to store your rollno, name, age. Create an array of object to input 5 students data and then display where age>=20.
2) Write a C++ program to create a class having methods for operations insertion, deletion and display to perform operations on 1D array of elements.

Lab4: Experiment No.2

Write a C++ program to create a class having methods: insertion, multiply and display for performing multiplication on a matrix of elements.

Lab5: Experiment No.3

Write a program using C++ to create a stack using class and perform:
(i) push operation (ii) pop operation (iii) display operation

Lab6: Experiment No.4

Write a C++ program that uses Stack operations to converting an infix expression into equivalent postfix expression.

Lab7: Experiment No.5

Write a C++ program to create a linear queue and perform the following operations: (i) insertion ii) deletion and iii) Traversal

Lab8: Experiment No.6 Write C++ programs that use both recursive and non-recursive functions to perform the linear & binary search operation for a Key value in a given list of integers.
Lab9: Experiment No.7 Write a C++ menu driven program to implement bubble sort, selection sort and insertion sort for a given list of integers in increasing order.
Lab10: Experiment No.8 Write a C++ program to implement quick sort to a given list of integers to sort in ascending order.
Lab11: Experiment No.9 Write a C++ program that uses functions to perform the following operations on linear linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal
Lab12: Experiment No.10 Write a C++ program that uses functions to perform the following operations on Double linked list: i) Creation ii) Insertion iii) Deletion iv) Traversal.

SECOND YEAR

III SEMESTER

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	BS	BBSBS3010	Engineering Mathematics-III	3	1	0	4
2	PC	BBTPC3020	Basics of Biology	3	0	0	3
3	PC	BBTPC3030	Biochemistry	3	0	0	3
4	PC	BBTPC3040	Microbiology	3	0	0	3
5	ES	BCSES3050	Object Oriented Programming through JAVA	3	0	0	3
6	BS / HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
PRACTICAL / SESSIONAL							
7	PC	BBTPC3120	Basics of Biology Lab	0	0	2	1
8	PC	BBTPC3130	Biochemistry Lab	0	0	2	1
9	PC	BBTPC3140	Microbiology Lab	0	0	2	1
10	ES	BCSES3150	JAVA Programming Laboratory	0	0	2	1
TOTAL				**18**	**1**	**8**	**23**

Course Title						
Subject Code	Title of the subject	L	T	P	C	QP
BBSBS3010	**Engineering Mathematics-III**	**3**	**1**	**0**	**4**	**A**

Course Educational Objectives:

Prerequisite: Fundamentals of complex numbers, probability and calculus

CEO1: To test the nature of complex function

CEO2: To identify the different methods for complex integration

CEO3: To analyze error by using different methods.

CEO4: To know about different types of probability distributions.

Course Outcomes (Towards the end of the course students will be able to :

CO1	To know Analytic function and their properties.
CO2	To Evaluate Real Integrals by using residue integration method.
CO3	To apply numerical methods in Engineering Mathematical Problems
CO4	To investigate Probability distribution problems andleast square method to fit a curve and to evaluate the correlation coefficient and regression lines for the data.

UNIT I
(12 Hours)
Complex Analysis:
Analytic function, Cauchy-Riemann equations, Harmonic Function, Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula.

UNIT II (8 Hours)
Taylor's series, Laurent's series, Singularities and zeros, Residues, Cauchy Residue theorem, Evaluation of real integrals .

UNIT-III

(10 Hours)

Numerical methods:

Errors, Solving of algebraic and transcendental equations by using fixed point iteration and Newton-Raphson's method. : Newton divided differnterpolation,Lagrange interpolation ,Newton's forward and backward interpolation.NumericalDifferentiation,Numericalintegration:The trapezoidal rule, The simpson's rules, Ordinary differential equation: Modified Euler's method, Runge-kutta methods.

UNIT-1V (18

Hours)

PROBABILITY:

Random variables, Probability distributions, Mean and variance of distribution, Binomial, Poisson and uniform distributions, Normal distribution, Random sampling, Estimation of Parameters (maximum likely hood method),Confidence intervals, Testing of hypothesis ,Acceptance sampling ,Regression and correlation analysis, fitting of straight line by least square method.

Prescribed Books:

1. Advanced Engineering Mathematics by E. Kreyszig, Tenth Edition, Willey
2. Numerical Methods by jain and Iyengar.

Reference:-

1. Higher Engineering Mathematics by BS Grewal : Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by B.V.Ramana, McGraw Hills Education
3. Numerical Methods by Dutta and jena.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	2	-	-	-	-	-	-	-	-			
CO2	2	-	1	1	-	-	-	-	-	-	-	-			
CO3	2	-	-	2	-	-	2	1	-	-	-	-			
CO4	1	-	2	2	-	-	1	-	-	-	-	1			
Avg.	2.4	2.4													

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3020	**Basics of Biology**	**3**	**1**	**-**	**4**	**A**

Course Educational Objective

CEO1: To introduce the basic knowledge of biology and its application

CEO2: To understand the functions of cell , cell division and principle of inheritance in living system

Course Outcomes: On successful completion of the course students will be able to:

CO1	Students will obtain knowledge of cell structure, function of cellular organelles, membranes, and biological molecules.
CO2	The undergraduate will understand the inter and intra molecular communication
CO3	Student have an idea about genetic diseases
CO4	Student will know the developmental aspects of plant and animals

UNIT:1 **15 Hours**

Structure & Chemical composition of cells: ultra structure of Cell (Prokaryotic and Eukaryotic), Cell Wall & Cell Membrane, Cell organelles: structure and function, Nucleus, cell inclusions, Molecular organization of chromosome (Nucleosome concept).

UNIT:2 **15 Hours**

Cell Cycle, Cell Divisions- Mitosis and Meiosis, Membrane transport & trafficking, mechanisms of protein sorting and targeting, intercellular communication and associated signaling pathways, cancer cell Biology (Cause, Cell Characteristics).

UNIT:3 **15Hours**

Principles of Inheritance: Chromosome theory of Heredity, Mendelism, Non-Mendelian Gene Interactions (Epistasis, Lethality, Pleiotropy), Polygenes and multiple allele, Allelic Complementation, Cytoplasmic Inheritance, Linkage and Crossing over, Chromosome mapping, Mutation and Chromosomal Aberration, Transposable elements, Genetic diseases in Human(Colour blindness, Haemophillia).

UNIT:4 **15 Hours**

Origin, evolution and diversification of life, natural selection, Types of selection (stabilizing, directional etc), Principles breeding in plants and animals. Population Genetics: Hardy-Weinberg's law, Genetic Equilibrium, Changes in gene frequency, gene flow, Genetic Drift, Effect of evolutionary forces on genetic equilibrium of a population. Developmental genetic with reference to Arabidopsis and Drosophila.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books : 1. Cell Biology, Genetics, Molecular Biology, Evolution & Ecology by P S Verma and VK Agrawal, S. Chand
2.Cell biology and Genetics by P K Gupta Rastogi Publication

Ref. Books :
1. Molecular Biology of the Cell 4th Edition Bruce Alberts

2.The Cell A Molecular Approach Geoffrey M Cooper. Boston University 2nd edition

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3030	**Biochemistry**	**3**	**1**	**-**	**4**	**A**

Course Educational Objective

CEO1: To provide the knowledge on macromolecules present in the cell.

CEO2: To have an idea about enzymes and their functions.

Course outcomes: At the end of the course, the student will be able to:

CO1	Obtain knowledge about the structure/function of biomolecules such as Carbohydrates, Proteins, Amino acids and Lipids.
CO2	Learn the basic structure of nucleic acidsandprinciple of bioenergetics.
CO3	Demonstrate the fundamentals of biochemical principles such as cellular metabolism, metabolic pathways and the regulation of biological/biochemical processes.
CO4	understand the different types of enzymes, hormones, vitamins, minerals and their functions.

UNIT:1 **11 Hours**

Structure and Function of Carbohydrates: Monosaccharide, Oligosaccharides, Polysaccharides (Starch, Glycogen, Cellulose), Optical Isomerism, Structure and Function of Lipids: Saturated and Unsaturated Fatty Acids, Triacylglycerols, Phosphoglycerides, Sphingolipids, Waxes and Sterol. Structure and Function of Proteins: Amino acids, Peptide bond, Hierarchy of protein architecture, Ramachandran Plot.

UNIT:2 **11 Hours**

Structure and Function of Nucleic Acids: DNA, RNA, Double Helix Model of DNA, Denaturation and Renaturation of DNA. Structure and function of Hormones, Minerals and Vitamins. Principle of Bioenergetics: Bioenergetics and Thermodynamics, Phosphoryl group transfer and energy currency-ATP; Biological Oxidation and reduction reactions.

UNIT:3 12 Hours

Metabolism-I: Introduction to metabolic processes; Metabolism of Carbohydrates: Glycolysis, TCA Cycle, ETS and Oxidative Phosphorylation, Gluconeogenesis,Metabolism of Lipids: Anabolism (Saturated), Catabolism (α- Oxidation, β-Oxidation) and Energetics of lipid metabolism; Metabolism of Nucleic Acids: Catabolism and anabolism of purine and pyrimidine nucleotides. Photosynthesis: Light reaction and dark reaction.

UNIT:4 11 Hours

Metabolism-II: Metabolism of proteins: Biosynthesis of amino acids (role of precursors);
Enzymes: Properties of Enzyme, Classification of Enzymes, Mechanism of enzyme action,

Kinetics of enzyme action, Activation energy, Enzyme Inhibition, Coenzymes
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books: 1. Principle of Bio-Chemistry – Lehinger, Nelson and Cox 2. Biochemistry of Biochemistry by L. Stryer 3. Fundamentals of Biochemistry by A.C Deb
Ref. Books 1 Fundamentals of Biochemistry – Voet&Voet 2 Biochemistry, Rastogi, Tata McGraw Hill. 3 Fundamental of Biochemistry, Jain and Jain

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	2	-	-	-	-	-	-	-	-			
CO2	1	2	1	1	-	-	-	-	-	-	-	-			
CO3	2	-	2	3	-	-	-	-	-	-	-	1			
CO4	2	1	-	2	1	-	-	-	-	-	-	-			
Avg.	2.4	2.4													

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC3040	**Microbiology**	**3**	**-**	**-**	**3**	**A**

Course Educational Objective	
CEO1: To make the student learn about origin and evolution of microbes	
CEO2: To make the student understand regarding structure and function of different microbial groups	
Course outcomes: At the end of the course, the student will be able to:	
CO1	Gain the knowledge about classifications, culture and identification of important microorganisms.
CO2	Understand the microbial growth, reproduction and process of nitrogen fixation.
CO3	Obtain the knowledge about food microbiology, human pathogens and their life cycle.
CO4	Learn about the antibiotics and microbiology of different environment.

UNIT:1 11 Hours

Discovery of microorganisms,Theory of spontaneous generation, Identification of Microorganisms - A general account,Introduction to Microbial Kingdom- Bacteria, Viruses, Fungi,Classical and Modern approaches of microbial taxonomy; Classification of bacteria, fungi and Viruses; Methods of Microbiology- Culture media, Sterilization, Establishment of pure culture, Staining of bacteria (Gram's, Acid Fast, Capsule),

UNIT:2 12 Hours

Microbial growth and metabolism: Pattern of bacterial growth, Growth kinetics, Monod's Equation, Synchronous Growth and its Kinetics, Continuous culture and its growth kinetics, Cyanobacteria and nitrogen fixation, Microbial genetics: Organization of bacterial and viral genome, Plasmids ,Genetic recombination in bacteria (Transformation, Conjugation and Transduction), DNA repair mechanisms in bacteria, Transposons, Mutation in Microorganisms, Ames test for Mutagenesis

UNIT:3 12 Hours

Food Microbiology: Microbiology of foods, Types of microbes associated with food spoilage, Food preservation methods, Food poisioning, Microbiology of Milk and dairy products.Medical Microbiology: disease causing bacteria, virus and fungi; Basic concepts, action of pathogens, human pathogenic viruses and bacteria, Gram-positive and Gram- negative Bacilli of medical importance. Miscellaneous bacterial agents of disease; DNA and RNA viruses and their diseases, Fungal diseases. Life cycle of some important pathogens like- Malaria, hepatitis, filaria,

UNIT:4 10 Hours

Antibiotics-classification & mode of action, Therapeutic index. Environmental Microbiology: Microbiology of water, Microbiology of Air, Baceriological analysis of water, Microbiology of extreme environments (Halobacteria, Methanogens, Thermofiles).

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1.A text book by Micro biology by R.C.Dubey and D.K. Maheshwari, .S.Chand
2. A text book by Micro biology by Naveen Kango, I.K.International Publishing House Pvt. ltd.

Ref. Books1. Prescott's Micro biology by Michael J.Pelczar, JR, E.C.S.Chan, Noel R.Krieg. Indian edition
2. Prescott's Micro biology by JoanneM.Willey, Linda M.Sherwood and Christopher J. Woolverton

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	2	1	-	-	2	-	-	-	-	-			
CO2	2	-	2	2	-	-	-	-	-	-	-	1			
CO3	1	2	-	1	1	-	-	-	-	-	-	-			
CO4	2	-	-	-	2	-	2	2	-	-	-	-			
Avg.	2.4	2.4													

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Subject Code	Name of the Subject	L	T	P	C	QP
BCSES3050	**OOPS Through JAVA**	3	0	0	3	A

Course Educational Objectives

CEO1	The model of object oriented programming: abstract data types, encapsulation, inheritance and polymorphism
CEO2	Fundamental features of an object oriented language like Java: object classes and interfaces, exceptions and libraries of object collections
CEO3	How to take the statement of a business problem and from this determine suitable logic for solving the problem; then be able to proceed to code that logic as a program written in Java.
CEO4	How to test, document and prepare a professional looking package for each business project using java doc.

Course Outcomes: ***Upon successful completion of this course, students should be able to:***

CO1	Analyze ,formulate and model problems using concepts of object oriented analysis and design and implement using Java.
CO2	Write programs using basic data types and strings, using loops, Array.
CO3	Analyze the problems and resolve run-time errors with Multithreading and Exception Handling techniques
CO4	Understand the power of generics and Collections Framework and Java.io package

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1											1		
CO2	3	2	2										1		
CO3	2	2	2										2		
CO4	2	1	2										1		
Avg.	2.4	2.4											1		

SYLLABUS

Unit – I **[12Hours]**

An introduction Object Oriented Programming, Features of Object Oriented Programming Introduction to Java. Difference between C/C++ and Java, Features of Java, First Java Program, Writing the java program, Compiling the program, JVM and its significance in executing a program?, Architecture of JVM. Understanding, Java Tokens, Datatypes, Operators, Control Structures and Arrays, Conditional Statements, Loops/ Iterators, Jumping Statements, Java Arrays, Multidimensional Arrays, Taking Input from keyboard, Command Line Arguments, Using Scanner Class, Using Buffered Reader class.

Unit - II **[12Hours]**

Laplace Transform & its Application: Introduction to Laplace Transform, Laplace transform of some basic functions, Laplace transform of periodic functions, Inverse Laplace transform, Application of Laplace transform: Circuit Analysis (Steady State and Transient).

Two Port Network Functions& Responses: z, y, ABCD and h-parameters, Reciprocity and Symmetry, Interrelation of two-port parameters, Interconnection of two-port networks.

Network Functions: Significance of Poles and Zeros, Restriction on location of Poles and Zeros, Time domain behaviour from Pole-Zero plots.

Unit – III [12 Hours]

Fourier Series& its Application: Fourier series, Fourier analysis and evaluation of coefficients, Steady state response of network to periodic signals, Fourier transform and convergence, Fourier transform of some functions.

Passive Filter: Brief idea about network filters (Low pass, High pass, Band pass and Band elimination) and their frequency response

Unit – IV **[12 Hours.]**

Network Synthesis: Realizability concept, Hurwitz property,
positive realness, properties of positive real functions, Synthesis of R-L, R-C and L-C driving point functions in Foster and Cauer forms.

Network Topology: Graph of a network, Concept of tree, Incidence matrix, Tie-set matrix, Cut-set matrix, Formulation and solution of network equilibrium equations on loop and node basis

Teaching Methods: Chalk& Board/ PPT/Video Lectures

Text Book:

1. *Programming in Java. Second Edition. Oxford Higher Education. (Sachin Malhotra/ Saurav Choudhary)*
2. *Core Java For Beginners. (Rashmi Kanta Das), Vikas Publication*

Reference Book:

3. *JAVA Complete Reference (9th Edition) HerbaltSchelidt*

Title of the subject						
Subject Code		L	T	P	C	QP
BBSBS3061	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	**A**

Course Educational Objective

CEO1: Graduates can pursue higher education and Research and Development for solving real world problems

CEO2: Graduates will have leadership qualities with social consciousness and ethics.

Course outcomes: At the end of the course, the student will be able to:

CO1	Explain the structure and function of ecosystem and realize its importance for maintaining ecological balance.
CO2	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO3	Describe the major pollutants environmental problems and control devices for environmental management and sustainable development
CO4	Analyze different types of environmental hazards and their management
CO5	Describe the importance of environmental safety.

UNIT:1 **14 Hours**

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control.

UNIT:2 **14 Hours**

Waste Water Treatment: DO and BOD, Waste water treatment process: pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

Air Pollution: Air pollution and pollutants, criteria pollutants, non-criteria pollutants, Acid deposition, Global climate change –greenhouse gases, Air pollution meteorology, Atmospheric dispersion, Industrial Air Emission Control, Flue gas desulphurization, NOx removal, Fugitive emissions.

UNIT:3 **8 Hours**

Solid Waste Management, Source, classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, transportation and treatment: Incinerators, Inorganic waste treatment. E.I.A., Environmental auditing.

UNIT:4 **8 Hours**

Occuptional Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials, Corrosive Substances, Hydrocarbons and Wastes. Personal Protective Equipments.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely
2.Environmental Engineering , Prof. B.K. Mohapatra, Seven Seas Publication, Cuttack
3. Environmental Engineering and Safety , Raut & Sen, Scientific Publishers.

Ref. Books 1. Environmental Engineering, Arcadio P. Sincero&Gergoria A. Sincero PHI Publication
2 Environmental Science, Curringham&Saigo, TMH

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	4	5	6	7	8	9	10	11	12	1		
CO2						1	2						1		
CO3						2	2						2		
CO4						1	2						1		
Avg.						2	2						1		

Title of the subject						
Subject Code		L	T	P	C	QP
BMSHS3062	**Engineering Economics & Costing**	**3**	**0**	**0**	**3**	**A**

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course outcomes: At the end of the course, the student will be able to:

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenueconcepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indianfinancial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

UNIT:1 **10 Hours**

Engineering Economics –Meaning,Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.Demand and Supply Analysis -Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).Theory of Production - Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 **10 Hours**

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis - Linear approach (Simple numerical problems to be solved). Depreciation- Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT: 3 **12 Hours**

Time value of money -Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of

engineering projects-
Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.

UNIT:4 **8 Hours**

Overview of Indian financial system. Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank. Inflation- Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national income.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India

Principles of Economics, DevigaVengedasalam; KarunagaranMadhavan , Oxford University Press.

Ref. Books 1. Engineering Economy by William G.Sullivan, ElinM.Wicks, C. PatricKoelling, Pearson R.PaneerSeelvan, " Engineering Economics", PHI

Ahuja,H.L., "Principles of Micro Economics" , S.Chand& Company Ltd

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	4	5	6	7	8	9	10	11		1		
CO2											2		1		
CO3											2		2		
CO4											2		1		
Avg.											1		1		

GIET MAIN CAMPUS (AUTONOMOUS), GUNUPUR 765022

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Subject Code	Course Title	L	T	P	C	
BBTPC3120	**Basics of Biology Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to study about microscope and its parts

analyse the different stage of cell division, both mitosis and meiosis

Course outcomes: At the end of the course, the student will be able to:

CO1	understand the operation of microscope for the analysis of cells
CO2	understand the cell counting techniques
CO3	Gain the knowledge on different types of blood cells.
CO4	can understand the working principle of SEM.

LIST OF EXPERIMENTS

1. Study of different parts of microscope and its use.
2. Preparation of Mitosis from Onion Root-tip cells and observation of permanent slides.
3. Preparation of meiotic cell division in grasshopper's testis
4. Cell Counting and viability study
5. To isolate the pigments from plant leaf.
6. To identify the blood cell types in human blood smear.
7. To identify the different types cells present in the leaf cross section.
8. To prepare permanent slides using the given sections like Plant and animal samples.
9. Separation of lymphocytes and granulocytes from blood sample
10. To study cellular fractionation of a homogenized rat liver via a technique called differential centrifugation.
11. Demonstration of principles underlying Scanning Electron Microscopy (SEM).

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	2	1	3	-	-	-	-	-	-	-	-	-	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	3	1	-	-	-	-	-	-	-	-	-			
CO3	2	2	1	-	-	-	-	-	-	-	-	-			
CO4	2	1	3	-	-	-	-	-	-	-	-	-			
Avg.															

Subject Code	**Course Title**	L	T	P	C	
BBTPC3130	**Biochemistry Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to do the analysis of different biomolecules through 74lectrophoretic74y and chromatographic techniques

Analysis of different Enzymatic activity and assay

Course outcomes: At the end of the course, the student will be able to:

CO1	Student can 74lectro the protein and carbohydrate by spectrophotometry
CO2	Student can be determined the quality and quantity of nucleic acid.
CO3	The undergraduate will separate the biomolecules by chromatography techniques
CO4	Students can extract and study the activity and assay of enzymes

LIST OF EXPERIMENTS

1. Estimation of Protein using Lowry's Method
2. Estimation of carbohydrates
3. Estimation of DNA using DPA method
4. Estimation of RNA using Orcinol Method
5. Estimation of Saponification value of fatty acids/Oil
6. Separation of Amino acids by Paper Chromatography
7. Separation of Sugars by Thin Layer Chromatography
8. Separation of Proteins by 74lectrophoretic method.
9. Extraction of enzymes from bacterial culture.
10. Assay of Enzyme activity: Amylase/Protease

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	3	2	2	-	-	-	-	-	-	-	-	-	1	2	3
CO1	2	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	2	1	-	-	-	-	-	-	-	-	-			
CO3	3	2	1	-	-	-	-	-	-	-	-	1			
CO4	3	2	2	-	-	-	-	-	-	-	-	-			
Avg.															

Subject Code	**Course Title**	L	T	P	C	
BBTPC3140	**Microbiology Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to learn the sterilization and staining techniques

know about the preparation of culture media, bacteria culture methods.

Course outcomes: At the end of the course, the student will be able to:	
CO1	understand the micrometry and different staining techniques
CO2	do the preparation of media and its various method of sterilization
CO3	Isolate the microbes from natural sources and study the growth and culture technique.
CO4	Learn the antibiotic assay of microbes and different kinds of microscopy

LIST OF EXPERIMENTS

1. Micrometry: calibration of stage and ocular micrometer and measurement of dimension of microbial cells.
2. Staining of microbial sample (Gram's Staining, Endospore staining, Fungal staining)
3. Media preparation and sterilization (Slant, Stab and Broth culture)
4. Isolation of micro organisms from natural habitats (Air, Water, Soil & Milk)
5. Establishment of pure culture by streak plate and serial dilution method.
6. Study the bacterial growth curve using spectrophotometer and viability assessment.
7. Antibiotic assay and estimation of Zone of inhibition.
8. Chemical assay and MIC determination of antibiotics.
9. Biochemical assay of microorganisms (Starch Hydrolysis, Casein Hydrolysis and IMVIC test).
10. Microscopy: Study of Compound, Phase contrast and Fluorescence Microscopes.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	3	2	2	-	-	-	-	-	-	-	-	-	1	2	3
CO1	2	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	3	1	-	-	-	-	-	-	-	-	-			
CO3	2	2	3	-	-	-	-	-	-	-	-	1			
CO4	3	2	2	-	-	-	-	-	-	-	-	-			
Avg.															

Subject Code	Name of the Laboratory	L	T	P	C	QP
BCSPC3150	**JAVA PROGRAMMING LAB.**			2	1	

Pre -Requisite:

Course Outcomes

CO1	Apply the object-oriented concepts through Java language.
CO2	Demonstrate the concepts of polymorphism and inheritance.
CO3	Write Java programs to implement error handling techniques using exception handling
CO4	Develop solution for a real problem using Java programming.

CO-PO & PSO Mapping: ***Upon successful completion of this course, students should be able to:***

Cos	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1												
CO2	3	3													
CO3	3	2													
CO4	3	3	3												
Avg.															

List of Experiments

1. Introduction, Compiling & executing a java program.
2. Data types & variables, decision control structures: if, nested if etc.
3. Loop control structures: do, while, for etc.
4. Classes and objects.
5. Data abstraction & data hiding, inheritance, polymorphism.
6. Threads, exception handlings and applet programs
7. Interfaces and inner classes, wrapper classes, generics

IV SEMESTER [SECOND YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC4010	Molecular Biology	3	1	0	4
2	PC	BBTPC4020	Biostatistics	3	0	0	3
3	PC	BBTPC4030	Bio-analytical Techniques	3	0	0	3
4	PC	BBTPC4040	Biochemical Reaction Engineering	3	0	0	3
5	ES	BMEES3050	Fluid Mechanics and Hydraulic Machine	3	0	0	3
6	BS / HS	BBSBS3061	Environmental Engineering and Safety	3	0	0	3
		BMSHS3062	Engineering Economics and Costing				
PRACTICAL / SESSIONAL							
7	PC	BBTPC4110	Molecular Biology Laboratory	0	0	2	1
8	PC	BBTPC4120	Biostatistics Laboratory	0	0	2	1
9	PC	BBTPC4130	Bio-analytical Techniques Laboratory	0	0	2	1
10	PC	BMEES3150	Fluid Mechanics and Hydraulic Machine Lab	0	0	2	1
TOTAL				**18**	**1**	**8**	**23**

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4010	**Molecular Biology**	**3**	**1**	**-**	**4**	A

Course Educational Objective

CEO1: To provide the general knowledge on cell, cell cellular organs, and their function.

CEO2: To provide detailed knowledge about gene expression.

Course outcomes: At the end of the course, the student will be able to:

CO1	understand the organization and complexity of genome.
CO2	understand the mechanism of DNA replication, DNA repair and DNA recombination.
CO3	emphasize the molecular mechanism of transcription, protein synthesis and gene regulation in various organisms.
CO4	articulate applications of molecular biology in the modern world.

UNIT:1 **15 Hours**

Genome Organization: Prokaryotes and Eukaryotes, Nuclear genome and Organellar genome, DNA as the genetic material, Central dogma of molecular biology, Genome complexity, C-value Paradox, Cot curve analysis, Repetitive DNA, satellite DNA;Cistron, Recon, Muton; Variants of gene- Split genes, pseudo genes, Overlapping genes and selfish DNA.

UNIT:2 **15 Hours**

DNA Replication: Models of DNA replication, Enzymology of DNA replication, Process of DNA replication, DNA replication at the telomere, Replication of Mitochondrial and Chloroplast genome, DNA repair, Homologous recombination and Holliday junction.

UNIT:3 **15 Hours**

Transcription: Transcription machinery (prokaryotes and eukaryotes), Transcription factors, Transcription process, m-RNA processing (Pre and Post transcriptional processing), m-RNA stability and nuclear transport, m-RNA editing.

UNIT:4 **15 Hours**

Translation: Genetic code, Translation machinery (t-RNA, Aminoacyl t-RNA synthetase, Ribosome), Translation process, Post translational modification of protein. Regulation of Gene expression: Constitutive and Induced gene expression, Operon model (Lac-operon and Trp- operon), Gene silencing, DNA methylation, Introduction to recombinant DNA technology.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books: 1.Molecular Biology of CellByLodish and Baltimore

2. Molecular Biology by Frefelder.
3. Gene VII by Benjamin Lewin

Ref. Books 1MolecularBiology. By Turner.

2.Molecular "Biology of Gene" – Watson
3. Genome by T.A Brown

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	2	-	-	-	-	-	-	-	-			
CO2	3	2	2	1	-	-	-	-	-	-	-	-			
CO3	2	-	2	3	-	-	-	-	-	-	-	2			
CO4	1	2	1	2	-	-	-	-	-	-	-	-			
Avg.	2.4	2.4													

Title of the subject

Subject Code		L	T	P	C	QP
BBTPC4020	**Biostatistics**	3	1	-	4	A

Course Educational Objective

CEO1:To provide the basic knowledge on importance of biostatistics

CEO2:Analyses of biological data with various biostatistical tools to draw relevant conclusion

Course outcomes: At the end of the course, the student will be able to:

CO1	Get the concept on biological variables
CO2	learn the technique of analysis of data
CO3	have an idea about the distribution of data in natural condition
CO4	Design of experiment and draw samples without any biasness

UNIT:1 **15 Hours**

Introduction and definition of Biostatistics; Concept of variables in biological systems. Collection, Classification, tabulation graphical and diagrammatic representation of numerical data; Measures of central tendency: Mean, Median and Mode and their relationship; Measures ofdispersion: Range, Quartile deviation, Mean deviation, Standard deviation, Concept of standarderror, Coefficient of variation, Skewness and Kurtosis.

UNIT:2 **15 Hours**

Probability: Random experiment, events, sample space, mutually exclusive events, independentand dependent events; Various definitions of probability, addition and multiplication theoremsof probability, Random variables (discrete and continuous), Probability density functions andits properties; Probability distributions: normal, Binomial, Poisson and their application.

UNIT:3 **15 Hours**

Concept of populations and sample. Simple random sampling without replacement. Definition ofSimple random sample; Designing of Experiments-Random block design and Split plot design;Correlation and Regression, linear regression.

UNIT:4 **15 Hours**

Analysis of variance: One- way and two-way classifications with single observation per cell. Duncan's multiple range test; Tests of significance: Chi-square, student's t, z and f-distributions, their properties and uses.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Biostatistics by P.N.Arora and P.N. Malhan, Himalaya Publishing house
2Introduction to biostatistics by P.K.Banerjee, S.Chand

Ref. Books 1Introduction to Biostatistics and Research methods by P.S.S SundarRao and J. Richard, PHI publication
2 Biostatistics BY MunjuPandey , Euro span Publisher.

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	-	3	-	-	-	-	-	-	-	2		
CO2	2	2	-	3	-	-	-	-	-	-	-	1	2		
CO3	3	-	2	2	1	-	-	-	-	-	-	-	3		
CO4	1	2	2	1	-	-	-	-	-	-	-	-	1		
Avg.	2.4	2.4													

Title of the subject

Subject Code		L	T	P	C	QP
BBTPC4030	**Bio-analytical Techniques**	**3**	**-**	**-**	**3**	A

Course Educational Objective

CEO1: To provide knowledge about bio instruments and their working principle.

CEO2: To learn the use of instruments and their application in research.

Course outcomes: At the end of the course, the student will be able to:

CO1	understand the working principle of spectroscopic and microscopic techniques like Mass s spectroscopy, NMR, IR, ESR and Electron microscopy..
CO2	acquire knowledge on various analytical techniques and instruments used for the separation and analysis of bimolecules.
CO3	learn and design different chromatographic techniques for separation of biological products.
CO4	understand the application of radioactivity in the analysis of biomolecules

UNIT:1 **11 Hours**

Spectroscopic techniques: Spectroscopic methods to study physicochemical properties ofBiomolecules,UV-Vis, IR, FTIR, Fluorescence, Mass Spectroscopy, NMR, ESR and X-ray crystallography. Principles of electron microscopy, preparation of samples, TEM and SEM.

UNIT:2 **12 Hours**

Electrophoresis: General principle of electrophoresis, support media (agarose and polyacrylamide gels), Agarose gel electrophoresis electrophoresis of proteins by SDS-PAGE, native PAGE, gradient gels, isoelectric focusing, two dimensional PAGE, Blotting Techniques: Southern, Northern and Western blot analysis. Polymerase Chain Reaction (PCR).Centrifugation: Basic principles of sedimentation (RCF), Types of centrifuge and centrifugation

UNIT:3 **12 Hours**

Chromatography: Principles of chromatography, distribution coefficient, retention time, Chromatographic methods for macromolecular separation- Paper, TLC and column chromatography, Partition chromatography, ion exchange chromatography, gel exclusion chromatography, affinity chromatography, normal phase and reversed phase chromatography, HPLC, Gas Chromatography

UNIT:4 **10 Hours**

Radioisotope Techniques: Radioactivity activity detection methods based on ionization (Geiger- Muller monitor), excitation (solid and liquid scintillation counting), autoradiography, safety aspects of handling radioactive material.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Principles and Techniques of Biochemistry and Molecular Biology, Wilson K. and Walker
J., Cambridge University Press (2005) 6th ed.

2. Biochemical Method-A Concise guide for students and researchers, Pingoud A., UrbankeC., Hoggett J. and Jeltsch A. Wiley-VCH Publishers.

Ref. Books 1Bioseparations: Science and Engineering, Harrison, R.G., Todd, P., Rudge, S.R. andPetrides, B.B. Oxford University Press (2006).

2. Molecular Spectroscopy, McHale, J.L., Prentice Hall (1998).

3. Microscopy and Microtechniques. Marimuthu, R., MJP Publishers (2008).

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	2	-	1	-	-	-	-	-	-	-			
CO2	3	-	-	2	2	1	-	-	-	-	-	-			
CO3	1	2	2	-	3	-	-	-	-	-	-	-			
CO4	2	1	-	2	-	-	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC4040	Biochemical Reaction Engineering	3	-	-	3	

Course Educational Objective
CEO1:To imbibe the knowledge on different reaction and their theory
CEO2: To have an idea about different reactor and their application in production

Course outcomes: At the end of the course, the student will be able to:	
CO1	Develop rate laws for homogeneous reactions
CO2	Design of ideal reactors for single and complex reactions
CO3	Explain non-isothermal reactors and the heat exchange.
CO4	Distinguish between various RTD curves and predict the conversion from a Non-ideal reactor using tracer information.

UNIT:1 10 Hours

Material Balance & Energy Balances: Mathematical requisites – use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance; enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

UNIT:2 **12 Hours**

Kinetics of homogeneous reactions: classification of reactions, reaction rate, speed of reaction, rate equation, concentration-dependent term of rate equation, rate constant, order and molecularity, representation of elementary and nonelementary reactions, kinetic models for nonelementary reactions, temperature-dependent term of a rate equation, activation energy and temperature dependency.

UNIT:3 **10 Hours**

Kinetic analysis of batch reactor data: Integral and differential methods for analyzing kinetic data, interpretation of constant volume batch reactor, data for zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, auto catalytic reaction. Kinetic interpretation of batch reactor data for single reactions: interpretation of variable volume batch reaction data for zero, first and second order reactions, Ideal batch reactor, steady state CSTR and plug flow reactors and their use for kinetic interpretation. Design for single reaction: size comparison of single reactors, plug flow reaction in series and/or parallel, equal and different size of mixed reactor in series, finding the best system for given conversion, recycle reactor, Design of multiple reactions in batch, CSTR and PFR.

UNIT:4 **10 Hours**

Biochemical reaction systems: Cell and enzyme fermentation, Monod's model of growth kinetics. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes. – derivation of Michaelis-Menten equation, Briggs-haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitiveMichaelish-Menten

kinetics, inhibition by foreign substances, kinetics of competitive and noncompetitive inhibitions, microbial fermentation, batch fermentor and mixed flow fermentor, kinetic expressions of fermentation.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1: Ievenspiel O. Chemical Reaction Engineering, Wiley International 2:Fogler H. S., Chemical Kinetics and Reactor Calculation.
Ref. Books 1: Smith J. M., Chemical Engineering Kinetics, McGraw Hill. 2: Wales J. M., Kinetics for Chemical Engineering, McGraw Hill.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	-	1	-	-	-	-	-	-	-			
CO2	1	2	-	2	2	-	-	-	-	-	-	-			
CO3	1	1	3	2	-	-	-	-	-	-	-	-			
CO4	-	-	1	-	3	2	-	-	-	-	-	2			
Avg.	2.4	2.4													

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	C	QP
BMEES3050	**FLUID MECHANICS & HYDRAULIC MACHINES**	**3**	**0**	**0**	**3**	**A**

Pre -Requisite: Physics, Thermodynamics, Mechanics, Mathematics

Course Educational Objectives

CEO1	To know the concept of fluid and its properties, manometer, hydrostatic forces acting on different surfaces and also problem solving techniques.
CEO2	To relate the basic laws of fluids, flow patterns, viscous flow through ducts and their corresponding problems.
CEO3	To analyze the hydrodynamic forces acting on vanes and their performance evaluation
CEO4	To evaluate of the importance, function and performance characteristics of hydro machinery

Course Outcomes: Upon successful completion of this course, students should be able to:

CO1	Understand the basic properties and characteristics of incompressible fluid.
CO2	Apply basic fundamental theorems governing fluid flows i.e., continuity, energy and momentum.
CO3	Compare the concept of measurement of different fluid properties using various types of equipments like measurement of flow, pressure velocity and head loss.
CO4	Analyze the working of hydraulic machines and evaluate the performance of turbines and pumps

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2												
CO2	3	3												
CO3	2	2												
CO4	2	3												
Avg.														

SYLLABUS

UNIT:1 (10 Hours)

Scope of fluid mechanics and its development as a science Physical property of Fluid: Density, specific gravity, specific weight, specific volume, surface tension and capillarity, viscosity, compressibility and bulk modulus, Fluid classification.

Fluid statics: Pressure, Pascal's Law, Pressure variation for incompressible fluid, atmospheric pressure, absolute pressure, gauge pressure and vacuum pressure, manometer. Hydrostatic process on submerged surface, force on a horizontal submerged plane surface, force on a vertical submerged plane surface. Buoyancy and floatation, Archimedes' principle, stability of immersed and floating bodies, determination of metacentric height.

UNIT:2 (14 Hours)

Fluid kinematics:

Introduction, description of fluid flow, classification of fluid flow. Reynolds number, Acceleration of fluid particles, flow rate and continuity equation, differential equation of continuity, Mathematical definitions of irrotational and rotational motion. Circulation, potential function and stream function. Flow net

Fluid dynamics :

Introduction, Euler's equation along a streamline, energy equation, Bernoulli's equation and its application to siphon, venturimeter, orificemeter, pitot tube. Flow in pipes and ducts: Loss due to friction, Minor energy losses in pipes Flow through nozzles.

UNIT:3 (13 Hours)

Impact of Jet: Introduction, Force exerted by the jet on a stationary and movable plate (vertical, inclined, curved) Hydraulic turbines: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Impulse turbine, Pelton wheel, bucket dimensions, number of buckets in Pelton wheel, efficiency and performance curves.

Reaction Turbines: Francis turbine and Kaplan turbine, velocity triangle and efficiencies, performance curve. Function of draft tube and casing cavitation

UNIT:4 (8 Hours)

Centrifugal Pump: constructional features, vane shape, velocity triangles, Efficiencies, Pump Characteristic, NPSH and Cavitation. Positive displacement pumps: Reciprocating Pump, Working principle, Discharge, work done and power requirement, Slip, Indicator diagram

Teaching Methods: Chalk& Talk/ PPT/Video Lectures/Demonstration

Text Books

1. Fluid Mechanics - Frank M. White ll
2. Fluid Mechanics - YunusCengel and John Cimbala
3. Introduction To Fluid Mechanics And Fluid Machines - S Chakraborty
4. Fluid Mechanics and Hydraulic Machines, Modi & Seth

Ref. Books

1.Fluid Mechanics and Fluid Machines by A.K.Jain, Khanna Publishers

2.Introduction to Fluid Mechanics and Fluid Machines, S.K. Som and G. Biswas, TMH

3. Fluid Mechanics and Hydraulic Machines ,Dr. R K Bansal, Laxmi Publication

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3061	**ENVIRONMENTAL ENGINEERING & SAFETY**	**3**	**0**	**0**	**3**	

Course Educational Objective

CEO1: Graduates can pursue higher education and Research and Development for solving real world problems

CEO2: Graduates will have leadership qualities with social consciousness and ethics.

Course Outcome

CO1	Explain the structure and function of ecosystem and realize its importance for maintaining ecological balance.
CO2	Identify environmental problems arising due to engineering and technological activities and the science behind those problems.
CO3	Describe the major pollutants environmental problems and control devices for environmental management and sustainable development
CO4	Analyze different types of environmental hazards and their management
CO5	Describe the importance of environmental safety.

UNIT:1 (14 Hours)

Ecological Concepts: Biotic components, Ecosystem Process: Energy, Food Chain, Water cycle, Oxygen cycle, Nitrogen cycle etc., Environmental gradients, Tolerance levels of environment factor, Indian Environmental Law. Chemistry in Environmental Engineering: Atmospheric chemistry, Soil chemistry. Noise pollution- Noise standards, measurement and control.

UNIT:2 (14 Hours)

Waste Water Treatment: DO and BOD, Waste water treatment process: pretreatment, primary and secondary treatment of waste water, Activated sludge treatment: Anaerobic digestion, Reactor configurations and methane production.

Air Pollution: Air pollution and pollutants, criteria pollutants, non-criteria pollutants,Acid deposition, Global climate change –greenhouse gases, Air pollution meteorology, Atmospheric dispersion, Industrial Air Emission Control, Flue gas desulphurization, NOx removal, Fugitive emissions.

UNIT:3 (8 Hours)

Solid Waste Management, Source, classification and composition of MSW: Separation, storage and transportation, Reuse and recycling, Waste Minimization Techniques. Hazardous Waste Management, Hazardous waste and their generation, transportation and treatment: Incinerators, Inorganic waste treatment.

E.I.A., Environmental auditing.

UNIT:4 (8 Hours)

Occuptional Safety and Health Acts, Safety procedures, Type of Accidents, Chemical and Heat Burns, Prevention of Accidents involving Hazardous substances, Human error. Hazard Control Measures in steel industry, Petroleum Refinery, Pharmaceutical industry. Fire Prevention -Detection, Extinguishing Fire, Safety Management- Safety Handling and Storage of Hazardous Materials,

Corrosive Substances, Hydrocarbons and Wastes. Personal Protective Equipments.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1 Environmental Engineering, Irwin/ McGraw Hill International Edition, 1997, G. Kiely 2.Environmental Engineering , Prof. B.K. Mohapatra, Seven Seas Publication, Cuttack 3. Environmental Engineering and Safety , Raut & Sen, Scientific Publishers.
Ref. Books 1. Environmental Engineering, Arcadio P. Sincero&Gergoria A. Sincero PHI Publication 2 Environmental Science, Curringham&Saigo, TMH

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	4	5	6	7	8	9	10	11	12			
CO2						1	2								
CO3						2	2								
CO4						1	2								
Avg.						2	2								

Title of the subject						
Subject Code		L	T	P	C	QP
BMGHS3062	**Engineering Economics & Costing**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: to understand the significance of the economic aspects of engineering and to become proficient in the evaluation of engineering proposals in terms of worth and cost

CEO2: to help students to grasp various economics concepts and theories towards making economic decision.

Course Outcome

CO1	Understanding the fundamentals of economic theory in general- concept of demand & supply, theories of production-Laws of returns
CO2	Overview of cost and revenueconcepts: Understood the nature and behavior of cost, cost sheet, Break-even analysis- linear approach and understanding of depreciation with its measurement.
CO3	Acquainted with evaluation of engineering proposals(Private and public) by learning the concept of Time-value of Money, Determination of economic life of an asset, Replacement of existing asset with a new asset etc.
CO4	Familiar with Indianfinancial system and banking structure, idea about concept of national income –its measurement and inflation.
CO5	Ultimately learners of the subject get the benefits of understanding the diverse situation happening in the economy and able to make rational decision in the field of engineering.

UNIT:1 (10 Hours)

Engineering Economics –
Meaning,Nature, Scope, Basic problems of an economy, Micro economics and Macro Economics.
Demand and Supply Analysis -Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Elasticity of demand &its measurement (Simple numerical problems to be solved) Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).
Theory of Production -Production function, Laws of returns: Law of variable proportion, Law of returns to scale

UNIT:2 (10 Hours)

Cost and revenue concepts, Elements of costs, Preparation of cost sheet, Segregation of costs into Fixed and variable costs. Basic understanding of different market structures, Price and output Determination under perfect competition (Simple numerical problems to be solved), Break Even Analysis -Linear approach (Simple numerical problems to be solved). Depreciation- Causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method)

UNIT:(12 Hours)

Time value of money -Interest Analysis - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.Evaluation of engineering projects- Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects. Replacement Analysis- Determination of economic life of an asset, Replacement of existing asset with a new asset.3

UNIT:4 (8 Hours) Overview of Indian financial system. Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank. Inflation-Meaning of inflation, types, causes, measures to control inflation. National Income - Definition, Concepts of national income, Method of measuring national income.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Riggs, Bedworth and Randhwa, "Engineering Economics", McGraw Hill Education India Principles of Economics, DevigaVengedasalam; KarunagaranMadhavan , Oxford University Press.
Ref. Books 1. Engineering Economy by William G.Sullivan, ElinM.Wicks, C. PatricKoelling, PearsonR.PaneerSeelvan, " Engineering Economics", PHI Ahuja,H.L., "Principles of Micro Economics" , S.Chand& Company Ltd

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	4	5	6	7	8	9	10	11	12			
CO2											2				
CO3											2				
CO4											2				
Avg.											1				

GIET MAIN CAMPUS (AUTONOMOUS), GUNUPUR 765022

Approved by AICTE, Govt. of Odisha and Affiliated to BPUT, Rourkela, Odisha
Accredited by NAAC with a CGPA of 3.28/4 at *A Grade* and Accredited by NBA
Dist. - Rayagada, Odisha, INDIA
www.giet.edu

Subject Code	Course Title	L	T	P	C	
BBTPC4110	**Molecular Biology Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to isolate the nucleic acids from various organisms.

Students can estimate the amount of DNA and RNA isolated by spectrophotometry

Course outcomes: At the end of the course, the student will be able to:

CO1	Isolatethe nucleic acid from different organisms.
CO2	Learn the separation of macromolecule using electrophoresis.
CO3	Know the quantification of biomolecules.
CO4	Understand the restriction digestion and molecular mapping.

LIST OF EXPERIMENTS

1. Isolation, purification of DNA from plant sample and its yield estimation.
2. Isolation, purification of DNA from blood sample and its quantification using UV spectrophotometer.
3. Isolation, purification of DNA from bacterial sample and its quality assessment.
4. Isolation of plasmid DNA from bacteria and estimation its size using agarose gel electrophoresis.
5. Effect of gel concentration on solidification and migration of DNA sample
6. Restriction digestion of supplied DNA sample and estimate the molecular weight of the fragments resulted.
7. Elution of the DNA from the supplied gel and assess the integrity of the fragments.
8. Isolation and purification of RNA from plant/yeast sample and its quantification using UV spectrophotometer..
9. Isolation and purification of protein from the supplied sample and its quantification using UV spectrophotometer.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	3	2	-	-	-	-	-	-	-	-		1			
CO3	1	2	3	-	-	-	-	-	-	-	-	-			
CO4	2	1	3		-	-	-	-	-	-	-	-			
Avg.															

Subject Code	Course Title	L	T	P	C	QP
BBTPC4120	**Biostatistics Lab**	**0**	**0**	**2**	**1**	**A**

Course Educational Objective

In this laboratory, students will to study the important of Biostatistics in various biotechnological experiments

Student can analysis and decision making in biological experiment.

Course outcomes: At the end of the course, the student will be able to:

CO1	Understand the importance and application of biostatistics.
CO2	learn how to represent the biological data for analysis
CO3	Know the comparison of data and application of null hypothesis.
CO4	Gain the practical knowledge on ANOVA and correlation of coefficient.

LIST OF EXPERIMENTS

1. Introduction to biostatistics and measurement.
2. Construct and interpret graphical displays such as histograms, bar charts, ogive etc.
3. Collection of sample data and opening sample data sets.
4. Measures of central tendency
5. Measures of dispersion.
6. Hypothesis testing; Students t-test and interpreting confidence level.
7. Hypothesis testing; Chi-square test and interpreting confidence level.
8. Analysis of variance (ANOVA)
9. analysis of biological data with correlation coefficient

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	2	3	2	-	-	-	-	-	-	-	-	-			
CO3	2	2	3		-	-	-	-	-	-	-	2			
CO4	3	1	3	-	-	-	-	-	-	-	-	-			
Avg.															

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Subject Code	Course Title	L	T	P	C	QP
BBTPC4130	**Bio-analytical Techniques Lab**	**0**	**0**	**2**	**1**	

Pre -Requisite: Mechanics of Solid

Course Educational Objective

In this laboratory, students will have the opportunity to study the various bioinstruments.

Separation and quantification of biomolecules using various biophysical methods.

Course outcomes: At the end of the course, the student will be able to:

CO1	study the spectrophotometric analysis of DNA and protein
CO2	learn the denaturation of protein and nucleic acid and their estimation.
CO3	understand the techniques of electrophoresis.
CO4	have basic idea on operation of HPLC, GC, DSC, FTIR and Electron microscopy (SEM/TEM).

LIST OF EXPERIMENT

1. UV-Visible spectroscopy: UV – spectrophotometric analysis of DNA and protein samples/
2. Determine λmax of DNA, protein, bromophenol blue solutions by wavelengthscan
3. Denaturation of proteins and nucleic acids.
4. chromatographic analysis of chlorophyll
5. 2D-TLC analysis of amino acids
6. Use of viscometer in protein analysis
7. Comparison of Coomassie brilliant blue and silver staining methods for visualizing protein bands in SDS-PAGE
8. Comparison of ethidium bromide and silver staining methods for visualisation of small DNA fragments analyzed by native PAGE
9. Fluorescence spectroscopy (demonstration)
10. GC & HPLC (demonstration)

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	-	-	-	-	-	-	-	-	-			
CO2	3	2	2	-	-	-	-	-	-	-	-	-			
CO3	2	3	3	-	-	-	-	-	-	-	-	-			
CO4	3	2	2	-	-	-	-	-	-	-	-	-			
Avg.															

V SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC5010	Genetic engineering and r- DNA Technology	3	1	0	4
2	PC	BBTPC5020	Immunology and Immunotechnology	3	0	0	3
3	PC	BBTPC5030	Upstream Process Engineering	3	0	0	3
4	PE	BBTPE5041	Industrial Microbiology and Enzyme Technology	3	0	0	3
		BBTPE5042	Fermentation Technology				
		BBTPE5043	Bio kinetics and Thermodynamics				
5	OE	BAEOE5051	Process Dynamic and Control	3	0	0	3
		BCHOE5052	Process Utility and Industrial Safety				
		BEEOE5053	IOT for Engineering Applications				
		BAEOE5051	Process Dynamic and Control				
PRACTICAL / SESSIONAL							
6	PC	BBTPC5110	Genetic engineering and r- DNA Technology Laboratory	0	0	2	1
7	PC	BBTPC5120	Immunology and Immunotechnology Laboratory	0	0	2	1
8	PC	BBTPC5130	Upstream Process Engineering Laboratory	0	0	2	1
9	EC	BBTEC5150	*Skill Development Project and Hands on Training	0	0	2	1
10	EC	BBTEC5170	Summer Internship-I	0	0	2	1
TOTAL				**15**	**1**	**10**	**21**

*College should conduct at least one NSDC program under this category.

^ Four (4) weeks duration summer internship either in industry or in an R&D organization, including educational institutes with excellent research culture. The student is expected to submit a formal report at the end of the programme.On-line MOOC courses may contribute upto 20% of the credits, with in-house examination being conducted.

Title of the subject

Subject Code		L	T	P	C	QP
BBTPC5010	**Genetic Engineering and r-DNA Technology**	**3**	**1**	**-**	**4**	**-**

Course Educational Objective

CEO1: To introduce the basic of Genetic Engineering and its application

CEO2: To understand the functions gene transfer to organisms

Course outcomes: At the end of the course, the student will be able to:

CO1	obtain knowledge in digestion of DNA, vector system for cloning and expression.
CO2	understand the cloning strategies and expression of recombinant molecules
CO3	aware of gene, genome sequencing and DNA finger printing techniques.
CO4	acquire knowledge in molecular markers, genome mapping and apply genetic engineering principles for biotechnological and biomedical applications.

UNIT:1 **15 Hours**

Basic principle of DNA isolation and purification; Restriction endonuclease, Ligase and other modifying enzymes; DNA& RNA Markers, Linker, Adapter and MCS; Gene cloning vectors-Plasmid, bacteriophage, cosmid, BAC, YAC; Expression vectors: basic concept, bacteria and yeast based expression vector.

UNIT:2 **13 Hours**

Basic concept of gene cloning;Gene library- genomic and c-DNA, contig library; Polymerase Chainreaction, Cloning of interacting gene: two hybrid and three hybrid assay;Cloning of differentially expressed gene; DNA micro arrays and Chips - principle andManufacturing process.

UNIT:3 **12 Hours**

DNA finger printing and DNA foot printing; DNA Sequencing; Site-directed mutagenesis; Expression of heterologous gene; In vitro transcription and translation; Gene knock out strategies; RNA interference: Antisense RNA, si RNA and mi RNA; RibozymeTechnology.

UNIT:4 **15 Hours**

Molecular markers- Types (RFLP, RAPD, AFLP, SCAR, SSR, SNP, EST), Principle and methodology; Application of molecular markers: in diagnostics, gene tagging, gene mapping, Physical mapping of the genome. Genome analysis using 16S rRNA typing/ sequencing, Genome. Projects: Human, Rice; Gene therapy and its applications; DNA vaccines and rDNAproducts;Genetic engineering regulations and safety guidelines.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Principles of Mol. Biology - OS Prim Rose
2. Genetic Engineering by B D Singh, Rastogi Publication

Ref. Books Molecular Biology. By Turner.
2.Molecular "Biology of Gene" – Watson

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	-	2	1	-	-	-	-	-	-	-			
CO2	-	1	2	2	3	-	-	-	-	-	-	-			
CO3	-	-	3	2	1	-	-	1	-	-	-	-			
CO4	2	-	-	1	-	-	2	-	-	-	-	2			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC5020	**Immunology &Immuno technology**	**3**	**-**	**-**	**3**	**-**

Course Educational Objective

CEO1: To study about the process of immunity and organs and cells of lymphoid system.

CEO2: To study about complement system, major histocompatibility Hybridoma technology and various immune responses.

Course outcomes: At the end of the course, the student will be able to:

CO1	Obtain knowledge in immunology, the structure and function of lymphoid organs and cells.
CO2	Have knowledge in Major histocompatibility, antibody diversityand complement response in the blood.
CO3	understand immune response,hypersensitive reactions, and organ transplantations and also obtain knowledge in various auto immune diseases.
CO4	Know in the development of vaccines and immunological techniques.

UNIT:1 **11 Hours**

Basic concepts of immunology: Immunity, types of immunity, humoral and cell mediated immunity, Cells of immune system and Haematopoiesis, Lymphoid organs, Primary and secondary lymphoid organs, antigen-properties of antigen,antigenity,immunogencity, immunoglobulin and antibodies.

UNIT:2 **13 Hours**

Major Histocompatibility Complex (MHC), Antigen processing and presentation, synthesis and secretion of antibody, Molecular basis of antibody diversity, polyclonal, monoclonal antibody and Hybridoma Technology, complement system, antigen-antibody reaction.

UNIT:3 **11 Hours**

Immuneresponseand tolerance: Regulation of immune response, immune tolerance, Hypersensitivity, autoimmunity,Transplantationimmunology,Immuno- deficiency and immuno- proliferate diseases. Dysfunctions of immune system and their modulation, Approaches for correcting immune dysfunction, Vaccinology.

UNIT:4 **10 Hours**

Immunobiotechnology: Vaccines, viral, bacterial peptides, genetically engineered production of lymphokines, second generation generation antibodies. Immunological techniques: immunodiffusion, immunoprecipitation, agglutination and ELISA

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Immunology: Lydyard, P.M., Whelan, A., Fanger, M.W., 1st Ed., Viva Books.
2. Essential Immunology: Roitt, I.M., 9th Ed.(1997) Blackwell Scientific, Oxford, UK.

Ref. Books 1 Immunology: Kuby, J. 3rd Ed. (1997) Freeman W. H., oxford.

4. Immunotechnology by A Khan, Pearson Publication

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	-	2	-	-	-	-	-	-	-	-			
CO2	-	2	-	1	-	3	-	-	-	-	-	-			
CO3	-	-	-	2	1	3	-	-	-	-	-	-			
CO4	-	-	-	3	-	2	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC5030	**Upstream Process Engineering**	**3**	**-**	**-**	**3**	**A**

Course Educational Objective

CEO1: To provide the knowledge on fluid mechanics and their properties

CEO2: To understand the basic law of heat transfer

Course outcomes: At the end of the course, the student will be able to:

CO1	Describe the operation, as well as constriction and exploitation characteristics of machines for mechanical operations.
CO2	Solve simple radiation heat transfer problems
CO3	Make use of empirical equations to solve forced and natural convection heat-transfer problems
CO4	Design the distillation column

UNIT:1 **10 Hours**

Processing of particulates Properties and handling of particulate solids, size reduction equipments-working principles of crusher, grinder and pulveriser, screening and particle size distribution.

UNIT:2 **10 Horus**

Methods of analysis and description - fluid as a continuum, Classification of fluid. Fluid statics – basic equation - equilibrium of fluid element – Hydrostatic Pressure, Pressure measuring Devices. Flow in boundary layers. Its formation & growth in tubes & plates. Basic equations of fluid flow continuity, momentum & Bernoulli's equation. Flow measuring devices; Venturi, Orifice, Pitot tube &Rotameter.

UNIT:3 **10 Hours**

heat transfer, basic laws of heat transfer, Conduction: The Fourier heat conduction equation, Steady-state one dimensional heat conduction through plane wall, cylindrical wall, spherical wall and composite structures. Heat transfer from extended surfaces, critical insulation of thickness. Introduction to convection: Natural and forced convection, Natural Convection: Grashoff number, natural convection from vertical and horizontal surfaces. Forced convection, The convective heat transfer coefficient, Types of heat exchangers, log-mean temperature difference, energy balances, overall heat transfer coefficients

UNIT:4 **12 Hours**

Introduction to Mass transfer operations, moleculardiffusion in fluids, binary solutions, Fick's law, equation of continuity, steady state equimolal counter current diffusion, Stefan-Maxwell equation, diffusivity of gases and liquids,application of molecular diffusion, mass transfer coefficients, in laminar and turbulent flow, Interphase mass transfer, Film theory, Penetration theory, surface-renewal theories, analogy between mass, heat and momentum transfer. relative volatility, ideal solutions, azeotropes, enthalpy concentration diagrams, flash vaporization, partial condensation, differential distillation steam distillation, azeotropic and extractive distillation. Continuous distillation

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1:.McCabe, Smith and Harriot, Unit Operations of Chemical Engineering

2.Foust et al, Principles of Unit Operations.

Ref. Books 1: Badger and Banchero. Introduction to Chemical Engineering.
2:Foust, Wenzel, Clump, Maus and Andersen, Principles of Unit Operations.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	-	2	1	-	-	-	-	-	-	-			
CO2	1	-	2	3	-	1	-	-	-	-	-	-			
CO3	-	2	2		3	-	-	-	1	-	-	-			
CO4	-	-	3	2	1	-	-	-	-	-	-	2			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE5041	**Industrial Microbiology and Enzyme Technology**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1:To study about fermentation process and to study the culturing of micro organisms and maintenance of cultures.

CEO2:To study about the preparation of alcohol using yeast cells and sugars by fermentation process.

Course outcomes: At the end of the course, the student will be able to:

CO1	obtain knowledge in microbial growth, kinetic and fermentation technology.
CO2	obtain knowledge in the production of commercially important products by using fermentation technology.
CO3	learn the formulation and selection of media, strain development and improvement.
CO4	obtain knowledge in themethods of enzyme stabilization and its applications

UNIT:1 12 Hours

Microbial Processes and fermentation technology: Introduction to fermentation technology, Microbial growth and product formation kinetics in batch, continuous and feed batch fermentation, Large scale production: submerged, solid and semi-solid fermentation,

UNIT:2 15 Hours

A brief outline of microbial processes for the production of some commercially important Organic acids (e.g. citric acid); Amino acid (Glutamic acid); and Alcohol (ethanol, 2, 3-butanediol). Antibiotics (beta-lactams, penicillin's,andcephalosporin's),enzymes(Proteases, Lipases),polysaccharides(cellulose, starch**)**; lipids(Triglycerides,Steroids); recombinant protein (Insulin), production of vaccines (Hepatitis-B).

UNIT:3 12 Hours

Commercial media and strain development: Media selection and development for industrial production, Isolation, selection, characterization of microorganisms, stock culture, development of inoculum, strain improvement: induced mutation, over producing decontrolled mutants, genetically engineered strain and fermentation.

UNIT:4 14 Hours

Stability of enzyme: Enzyme stabilization by selection and genetic engineering, protein engineering. Application of enzymes in industry, analytical purpose and medical therapy. Application of Biocatalyst, Group transfer redox, Elimination, isomarization and rearrengement, C-C bond cleavage, Reaction environment rebuilding, chemical modification, intramolecular cross linking and immobilization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Principle of Fermentation Technology , P.F. Stanbury, A. Whitaker and S.J. Hall, Elsevier

2. Industrial Microbilogy, Prescot and Dunn,

Ref. Books 1. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.
2. Biochemical Engineering Fundamentals, Bailey &Olis. MGH.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	2	1	1	-	-	-	-	-	-	-			
CO2	2	1	2	3	-	-	-	-	-	-	-	-			
CO3	-	2	3	2	2	-	-	-	-	-	-	-			
CO4	-	-	1	3	2	-	2	-	-	-	-	2			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE5042	**Fermentation Technology**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1: To provide knowledge on different of fermentation process

CEO2:To have theory and practicle knowledge on purification of products

Course outcomes: At the end of the course, the student will be able to:

CO1	get idea on different fermentation technologies
CO2	understand the importance on enzyme in fermentation process
CO3	Know Importance of microorganism in fermentation processes.
CO4	get knowledge of downstream processing

UNIT:1 **8 Hours**

Range of Fermentation processes, Microbial growth kinetics, Microbial biomass, Microbial enzymes, Microbial metabolites, Recombinant products, Batch culture, continuous culture, Microbial culture selection for fermentation processes. Media formulation and process optimization.

UNIT:2 **10 Hours**

Industrial production of proteases, cellulases, amylase, lipase; Process parameters that influence enzyme production during submerged and solid state fermentation, production of biofuel.

UNIT:3 10 Hours

Isolation, preservation and improvement of industrial microorganism, development of media for industrial fermentation. Development of inoculums for yeast and bacterial processes.

UNIT:4 **10 Hours**

Removal of microbial cells, Precipitation, filtration, centrifugation. Cell disruption, extraction and chromatography, Drying and crystallization.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Principles of Fermentation Technology by P.F. Stanbury, A. Whitaker, and S.J Hall, Pergamon
2 Basic Fermentation Technology by S.M.Reddy, New Age International Pvt.ltd.s

Ref. Books 1Bioprocess Engineering by Bjorn K. Lydersen, et. al ,Wiley India Edition
22 Bioprocess Engineering by M.L. Shuler and F.Kargei Person

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	-	2	-	-	-	-	-	-	-			
CO2	-	2	2	1	2	-	-	-	-	-	-	-			
CO3	-	-	2	3	2	1	-	-	-	-	-	-			
CO4	-	-	-	2	1	2	2	-	-	-	-	1			
Avg.															

Subject Code	Title of the subject	L	T	P	C	QP
BBTPE5043	**Bio kinetics and Thermodynamics**	**3**	**-**	**-**	**3**	A

Pre -Requisite:

Course Educational Objective	
CEO1: To introduce the basic of Biokinetics and its application	
CEO2: To understand the functions gene transfer to energy	
Course outcomes: At the end of the course, the student will be able to:	
CO1	understand the theoretical concepts of thermodynamics and how it applies to energy conversion and applications in biological systems.
CO2	learn about biothermodynamics of energy used by plants and animals and thermodynamics of proteins.
CO3	understand the concept of Gibbs free energy and energy transfer in various metabolism processes.
CO4	have the idea on free energy in chemical reaction and its effect on enzyme kinetics and metabolism.

UNIT:1 **10 Hours**

Basic concepts of thermodynamics: First Law of Thermodynamics, Second law of thermodynamics, Zeroth Law and Third Law of thermodynamics, Laws of thermodynamics and biology, Thermodynamics of macromolecular processes in cells, Thermodynamics of energy interactions in ecosystems, Conservation of energy.

UNIT:2 **12 hours**

Distribution of energy; Carbon, energy and life – Molecular level energy storage, Bio-thermodynamics of energy use by plant and animals, Methods for measuring the thermodynamic stability of membrane proteins, Protein folding, Modeling the native state ensemble of proteins using statistical thermodynamics, Energetic profiles of proteins derived from thermodynamics of the native state ensemble.

UNIT:3 **10 Hours**

Theory and derivation of Gibbs free energy, Free energy of reactions, Lipid membrane phase transitions, Thermodynamics of cellular metabolism, Sugar metabolism, Energy transport in ATP and NAD, Substrate recycling, DonnanEquilibrium, Enzyme-substrate interaction, Free energy of transfer of amino acids, Differences between heat engines and biological energy processes, Temperature regulation in organisms, Humidity and temperature effects on organisms, Non-equilibrium thermodynamics and life.

UNIT:4 10 Hours

Free energy analysis of chemical reactions, Chemical coupling to drive reactions in biological systems, First order and second order reactions, Collision theory, Transition state theory, Free energy of activation, Temperature and concentration effects on enzyme kinetics, Reaction mechanism of lysozyme, Kinetic identification of reaction intermediates, Sequential enzyme reactions in metabolism and analysis.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books: 1. D. J. Haynie, Biological thermodynamics, Cambridge, 2008.

2. Johnson, M.L., Holt, J.M. and Ackers, G.K., "Bio thermodynamics", Part 1, Academic Press, 2009
3. Timasheff, S.N., "Protein Hydration, Thermodynamic Binding, and Preferential Hydration, Biochemistry", 13473-13482, 2002.

Ref. Books 1. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.

3. Biochemical Engineering Fundamentals, Bailey &Olis. MGH.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	-	1	1	1		-	-	-	-	-			
CO2	2	-	2	-	2	-	-	-	-	-	-	1			
CO3	-	2	3	2	2	-	-	-	-	-	-	-			
CO4	-	-	2	3	1	1	-	-	-	-	-	-			
Avg.															

Subject code	Title of the subject	L	T	P	C	QP
BCHOE5052	**PROCESS UTILITY AND INDUSTRILA SAFETY**	3	0	0	3	

Course Educational Objective

CEO1: This course will provide effective use of chemical industries utilities.

CEO2: Emphasize on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis, toxicology and personal proactive equipments.

Pre-Requisites (If any)-FluidMechanics,Chemistry,Chemical Process Technology

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Explain the different types of safety precaution to be taken in working environment.
CO2	Describe the various safety rules and regulation.
CO3	Developed new safety methods during processing of materials.
CO4	Study the different hazardous effect of accident inside the plant.

Unit:1 **10hrs**

Hard and Soft water, Requisites of Industrial Water and its uses. Methods of water Treatment such as Chemical Softening and Demineralization, Resins used for Water Softening and Reverse Osmosis. Effects of impure Boiler Feed Water.

Unit:2 **10hrs**

Properties of Steam, problems based on Steam, Types of Steam Generator such as Solid Fuel Fired Boiler, Waste Gas Fired Boiler and Fluidized Bed Boiler. Scaling and Trouble Shooting. Steam Traps and Accessories.

Unit:3 **10hrs**

Refrigeration Cycles, Methods of Refrigeration used in Industry and Different Types of Refrigerants such as Monochlorodifluro Methane, Chlorofluro Carbons and Brins. Refrigerating Effects and Liquefaction Processes.Compressedair:Classification of Compressor, Reciprocating Compressor, Single Stage and Two Stage Compressor, Velocity Diagram for Centrifugal Compressor, Silp Factor, Impeller Blade Shape. Properties of Air –Water Vapors and use of Humidity Chart. Equipments used for Humidification, Dehumidification and Cooling Towers.

Unit:4 **10hrs**

History of Safety movement–Evolution of modern safety concept-general concepts of management–planning for safety for optimization of productivity-productivity, quality and safety-line and staff functions for safety-budgeting for safety-safety policy. Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety

Teaching Mentod (s):Chalk& Board/PPT/Video Lectures

Text Books 1: Eckenfelder, W. W, Jr. “Industrial Water Pollution Control” McGraw-Hill: New York, 1966.

2: P. L. Ballaney, "Thermal Engineering", Khanna Publisher New Delhi, 1986.
Ref. Books 1: P. N. Ananthanarayan, "Basic Refrigeration & Air conditioning", Tata McGraw Hill, New Delhi,2007

CO-PO MAPPING MATRIX

PROCESS UTILITY AND INDUSTRIAL SAFETY	V	CO1	-	-	2	-	-	2	1	-	-	-	-	-
		CO2	-	-	1	-	-	2	3	-	-	-	-	-
		CO3	-	-	1	-	-	2	2	-	-	-	-	-
		CO4	-	-	1	-	-	1	1	-	-	-	-	-

GIET MAIN CAMPUS (AUTONOMOUS), GUNUPUR 765022

Approved by AICTE, Govt. of Odisha and Affiliated to BPUT, Rourkela, Odisha
Accredited by NAAC with a CGPA of 3.28/4 at *A Grade* and Accredited by NBA
Dist. - Rayagada, Odisha, INDIA
www.giet.edu

Subject Code	Course Title	L	T	P	C	QP
BBTPC5110	Genetic Engineering and r-DNA Technology Lab	**0**	**0**	**2**	**1**	

Course Educational Objective
In this laboratory, students will have the opportunity to study the techniques of gene cloning
Understand the basic principle and techniques of PCR and hybridization of DNA and Protein

Course outcomes: At the end of the course, the student will be able to:	
CO1	know the isolation of plasmid DNA and its importance in gene cloning.
CO2	do the various ligation methods and transformation techniques.
CO3	learn the screening techniques of recombinant cells.
CO4	know the basic principle of PCR and hybridization techniques.

LIST OF EXPERIMENT

1. Isolation and Restriction enzyme digestion of bacterial genomic DNA
2.Isolation and Purification of plasmid DNA
3.Purification of digested DNA-column purification
4. Preparation of target DNA by linker/adapters/alkaline phosphatase treatment for cloning
5. Ligation of DNA fragment with cloning vector
6. Preparation of competent cells
7. Transformation in *E.coli* with recombinant vector
8. Isolation of recombinants and confirmation of insert DNA in vector
9. Preparation of DNA probe by nick translation /PCR
10. Amplification of DNA sample by PCR
11. Southern Hybridisation
12. Western Hybridisation
13. DNA profiling by RAPD

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	3	3	2	-	-	-	-	-	-	-	-	-			
CO3	1	2	3	-	-	-	-	-	-	-	--	-			
CO4	2	1	3	-	-	-	-	-	-	-	-	-			
Avg.															

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Subject Code	Course Title	L	T	P	C	QP
BBTPC5120	**Immunology &Immunotechnology Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective
In this laboratory, students will have the opportunity to learn the various techniques of Immunology
Various kinds of immunoprotein present in blood and their interactions with relate to disease analysis.

Course outcomes: At the end of the course, the student will be able to:	
CO1	study the morphology and structure of nucleus of various blood cells.
CO2	Antigen and antibody reaction study by diffusion techniques
CO3	Blotting of blood proteins
CO4	understand the technique and mechanism of identification of blood group.

LIST OF EXPERIMENTS

1. Preparation of blood film and identification of different leucocytes
2. Ouchterlony double diffusion technology
3. Radial immunodiffusion technology
4. Rocket immuno-electrophoresis
5. Immunoelectrophoresis
6. Dot ELISA and Sandwich ELISA
7. Immunoblotting
8. Purification of immunoglobulin from blood serum by column chromatography
9. Determination of blood group by agglutination
10. Localization of specific antigen by immunocytochemistry

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	2	3	-	-	-	-	-	-	-	-	-			
CO2	3	2	2	-	-	-	-	-	-	-	-	-			
CO3	2	2	3	-	-	-	-	-	-	-	-	-			
CO4	3	1	3	-	-	-	-	-	-	-	-	-			
Avg.															

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Subject Code	**Course Title**	L	T	P	C	QP
BBTPC5130	**Upstream Process Engineering Lab**	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to know the techniques of upstream processing.

The machines and equipment used to determine experimental data include closed conduit using Venturimeter, Orifice meter, Rotameter.

Course outcomes: At the end of the course, the student will be able to:

CO1	understand the flow regime and construction of friction factor.
CO2	know the Pressure drop for flow by various theories.
CO3	Determine the various heat and mass transfer coefficient.
CO4	understand the operation of various reactors.

LIST OF EXPERIMENT (Minimum 8 experiments)

1. Experiments on Reynold's Apparatus-Determination of flow regime and construction of friction factor against NRe.
2. Experiments on flow measuring devices - in closed conduit using (a) Venturimeter, (b) Orifice meter (c) Rotameter.
3. Study and verification of conservation of energy of a flowing liquid in a Bernoulli's apparatus.
4. Determination of Pressure drop for flow through packed bed & verification of Ergun Equation, Kozeny-Karman equation, Blake-Plummer Equation.
5. To Determine the Overall heat transfer coefficient of a concentric pipe heat exchanger based on the inside diameter of the tube.
6. To calculate the heat loss in a lagged pipe made of various insulating materials.
7. Determination of volumetric mass transfer coefficient (Kla) of gas-liquid system.
8. Determination of mixing time in stirred tank reactor.
9. To determine the coefficient of absorption/adsorption in packed bed columns.
10. To separate the solute from one phase to another (aqueous to solvent) phase by liquid-liquidextraction.
11. Double Pipe Heat Exchanger.
12. Shell and Tube Heat Exchanger.

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	1	3	-	-	-	-	-	-	-	-	-			
CO2	3	3	2	-	-	-	-	-	-	-	-	-			
CO3	2	3	2	-	-	-	-	-	-	-	-	-			
CO4	3	3	2	-	-	-	-	-	-	-	-	-			
Avg.															

VI SEMESTER [THIRD YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC6010	Plant Biotechnology	3	1	0	4
2	PC	BBTPC6020	Bioinformatics	3	0	0	3
3	PC	BBTPC6030	Downstream Process Engineering	3	0	0	3
4	PE	BBTPE6041	Environmental Biotechnology	3	0	0	3
		BBTPE6042	Bioprocess Engineering				
		BBTPE6043	Proteomics and Genomics				
5	OE	BCHOE6051	Biochemical Reaction Engineering	3	0	0	3
		BAEOEE6052	Industrial Instrumentation				
		BCVOEE6053	AIR & Noise Pollution				
PRACTICAL / SESSIONAL							
6	PC	BBTPC6110	Plant Biotechnology Laboratory	0	0	2	1
7	PC	BBTPC6120	Bioinformatics Laboratory	0	0	2	1
8	PC	BBTPC6130	Downstream Process Engineering Laboratory	0	0	2	1
9	PC	BBTPC6140	Advanced Laboratory-I	0	0	2	1
10	EC	BBTEC6160	#Soft Skill and Employability Skill	0	0	2	1
TOTAL				**15**	**1**	**10**	**21**

#To be conducted by the Training & Placement Department of the College

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC6010	**Plant Biotechnology**	3	1	-	4	

Course Educational Objective	
CEO1: To provide the practical oriented theory on plant tissue culture	
CEO2: To have knowledge on gene transfer to plants	
Course outcomes: At the end of the course, the student will be able to	
CO1	acquire knowledge in various types of plant tissue culture techniques and various components of plant tissue culture media, e.g. minerals, growth factors and hormones.
CO2	understand the importance of Micro propagation and somatic hybridization.
CO3	learn the technology of plant transformation including vector and vector less gene transfer methods.
CO4	acquire knowledge in biosynthesis of plant primary and secondary metabolites and their importance.

UNIT:1 **10 Hours**

Concept of totipotency and plasticity of plant cell; Tissue culure media- preparation, composition and plant growth regulators; Initiation and establishment of culture: Explant preparation, Callus culture, Single cell culture, Suspension culture, Microspore culture, Embryo rescue.

UNIT:210 Hours

Micropropagation: Organogenesis, Somatic embryogenesis, Artificial seed; Protoplast technology: Isolation and culture of protoplast, Somatic hybridization, Screening and selection of somatic hybrid.

UNIT:3 **15 Hours**

Concept of genetic transformation: Vector based (*Agrobacterium*, Virus) and Direct transformation (Gene gun, Electroporation, Microinjection, etc.); Application of genetic transformation: promoter tagging, activation tagging, herbicide resistance, insect resistance, disease resistance, terminator seed technology; Products of genetic transformation: Case studies for golden rice, Bt cotton and FlavrSavr tomato.

UNIT:4 **12 Hours**

Primary and secondary metabolities in plant. Alkaloids and its importance. Prducction of secondary metabolities through tissue culture, bioreactor based production and optimization of biotransformation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Introduction to Plant Biotechnology by H S Chawal, Science Publisher Inc.
2. Plant Biotechnology by Adrian Slater, Oxford press

Ref. Books 1Introduction to Plant Biotechnology by M.K.Razdan, Science Publisher Inc.
2 Plant Biotechnology by Agnes Ricroch ,S.Chopra, S.J.Fleisher, Springer

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	-	2	2	-	1	-	-	-	-	-			
CO2	-	-	1	2	1	-	-	-	1	-	-	-			
CO3	-	2	3	2	-	-	-	-	-	-	-	1			
CO4	-	-	2	2	1	-	2	2	-	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC6020	**Bioinformatics**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1: Providing fundamental knowledge of different computational tools to find sequential analysis using various software.

CEO2: To familiar with different Bio-informatics algorithms for prediction of structure of protein and DNA..

CEO3: Providing knowledge on use of different biological database.

CEO4: Creating the computational programming for data analysis.

Course outcomes: At the end of the course, the student will be able to

CO1	Understand and analyze the concept of use of various biological databases.
CO2	Analysis ofvarious algorithms for structural study of DNA & protein.
CO3	Design different molecular modeling using software.
CO4	Develop of different computational program for drug design.

UNIT:1 15 Hours

Sequence data banks- Introduction to sequence data banks- protein sequence data bank. NBFR-PIR, SWISSPORT, Signal peptide data bank, Nucleic acid sequence data bank –Gen bank, EMBL nucleotide sequence data bank, AIDS Virus sequence data bank. RRNA data bank, structural data banks- protein Data bank (PDB), The Cambridge Structural Database (CSD) : Genome data bank – Metabolic pathway data : Microbial and Cellular Data Banks.

UNIT:2 **12 Hours**

systems of microbes, Hybridoma data Bank Structure, Virus Information System, Cell line Information system; other important Data Banks in the area of Biotechnology/life sciences/biodiversity.

Sequence Analysis : Analysis Tools for Sequence Data Banks: Pair wise alignment-NEEDLEMAN AND Wunsch algorithm, Smith Waterman, BLAST, FASTA algorithms to analyze sequence data: Sequence patterns motifs and profiles

UNIT:3 **13 Hours**

Secondary Structure Predictions prediction algorithms, Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

Tertiary Structure predictions: prediction algorithms, Chao-Fasman algorithm, Hidden-Markov model, Neural Networking.

UNIT:4 **10 Hours**

Protein classifications, Fold libraries, Protein structure prediction; Fold recognition (threading), Protein structure predictions: Comparative Modeling (Homology, Advanced topics: Protein folding, Protein-ligand interactions, Molecular Modeling & Dynamics, Drug Designing.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Bryan Bergeron, Bioinformatics computing, Prentice Hall Inc.

2. Baxevanis AS and Ouellette BF, Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, Wiley International Science.

Ref. Books

1. Tao Jiang, Ying Xu, Michael Q. Zhang, Current Topics in Computational Molecular Biology, MIT press.
2. Thomas lengauer,Bioinformatics from genome to drug .WILLEY-VCH press.
3. Mount DW, Bioinformatics: Sequence and Genome Analysis, Spring Harbor Press.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	2	-	3	-	-	-	-	-	-	-			
CO2	2	2	-	3	-	-	-	-	-	-	-	1			
CO3	-	-	2	2	1	-	-	-	-	-	-	-			
CO4	-	2	2	1	3	-	-	-	-	-	-	-			
Avg.															

Subject Code	Title of the subject	L	T	P	C	QP
BBTPC6030	**Downstream processing Engineering**	3	-	-	3	

Course Educational Objective

CEO1:. Learn the fundaments of downstream processing

CEO2: Understand the principle, working and application of major unit operations in Bioprocessing of industrially important products.

Course outcomes: At the end of the course, the student will be able to

CO1	understand the principles of major downstream operations used in a bioprocess industry such as filtration, centrifugation, extraction and chromatography.
CO2	design and optimize the cost effective biosepation techniques.
CO3	understand techniques such as precipitation, coagulation and flocculation in downstream processing.
CO4	learn product recovery and product polishing methods.

UNIT:1 **12 Hours**

Introduction; An overview of bioseparation. Role and importance of Bioseparation process in biotechnological processes. Problems and requirements of bioproduct purification. Cost-cuttingstrategies Characteristics of biological mixtures – Process of Classification of Bioproducts -Biological activity Analysis of purity-Process economics-Capital and operating cost analysis

UNIT:2 **14 Hours**

Separation of cells and other insolubles from fermented broth. Foam separation, Precipitation, Filtration and microfiltration, centrifugation (batch, continuous, basket).Chromatography in bioseparation.

UNIT:3 **10 Hours**

Cell disruption: Physical methods (osmotic shock, grinding with abrasives, solid shear, liquid shear), Chemical methods (alkali, detergents), Enzymatic methods, RO, Ultra-filtration: Semipermeablemembranes, membrane geometry and ultrafiltration module configuration.

UNIT:4 **14 Hours**

Separation of soluble bio-products: Liquid-liquid extraction, Distillation, Absorption, Adsorptionprecipitation,.Other bioseparation techniques like Dialysis, electro-dialysis, LiquidElectrophoresis. Products polishing : Crystallization and drying.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1. Roger G. Harrison, Paul W. Todd, Scott R. Rudge, and DemetriPetrides, Bioseparations
Science and Engineering, Oxford University Press, USA (October 31, 2002)
2. Heinemann, Product Recovery in Bioprocess Technology, Butterworth Publication.

Ref. Books 1. Wankat P.C, " Rate controlled separations ", Elsevier, 1990

2. Asenjo J.M., " Separation processes in Biotechnology " Marcel Dekker Inc. 1993.
3. Belter PA and Cussler E, " Bioseparations ", Wiley 1985

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	1	1	-	-	-	-	-	-	-			
CO2	-	1	2	3	2	-	-	-	-	-	-	-			
CO3	-	-	2	2	3	-	-	-	1	-	-	-			
CO4	-	-	2	3	-	2	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE6041	**Environment Biotechnology**	3	-	-	3	A

Pre -Requisite:

Course Educational Objective

CEO1: To introduce the environmental biotechnology and its importance

CEO2: To have knowledge on biodegradation processes

Course outcomes: At the end of the course, the student will be able to

CO1	acquire the basic knowledge in environmental pollution and source of pollution.
CO2	learn on biological treatment of waste water.
CO3	understand the types of Xenobiotic compounds and their adverse effect on environment.
CO4	learn about the pollution control mechanisms by the application of Biotechnology.

UNIT:1 **10 Hours**

Introduction to environmental biotechnology, Environmental monitoring bioreporter, biomarker.Bioprospecting, Biomicroelectronics and biosensor technology; Introduction to environmental pollutants: Water, Soil and Air: their sources and effects. Removal ofSpecific Pollutants: Sources of Heavy Metal Pollution, Microbial Systems for Heavy Metal accumulation, Biosorption& detoxification mechanisms.

UNIT:2 **12 Hours**

Microbiology and biochemistry of wastewater treatment: Biological Treatment of anaerobic and aerobic; methanogenesis, methanogenic,acetogenic, and fermentative bacteria- technical process and conditions; Use of GeneticallyEngineered Organisms. emerging biotechnological processes in waste - water treatment; Applications include treatment of municipal and industrial wastewaters.

UNIT:3 **14 Hours**

Biodegradation of xenobiotic compounds: Xenobiotic compounds: Aliphatic, Aromatics, Polyaromatic Hydrocarbons, Polycyclic aromatic compounds, Pesticides, Surfactants and microbialtreatment of oil pollution. Biotransformation and biocatalysts: Basic organic reaction mechanism, Common prejudices against Enzymes. Advantages & Disadvantages of Biocatalysts, Isolated enzymes versus whole cell systems. Mechanistic Aspects and Enzyme Sources. BiocatalyticApplication, Catalytic Antibodies; Stoichiometry, kinetics, and thermodynamics of microbialprocesses for the transformation of environmental contaminants

UNIT:4 **12 Hours**

Bio-oxidation& microbial leaching: Biooxidation – Direct and Indirect Mechanisms, Recovery ofmetals from solutions; Microbes in petroleum extraction; Microbial desulfurization of coal.Clean technologies: Composting Technology and Organic farming, biofertilizers, biopesticides,microbial polymer production and bio plastic technology. Biotechnology of fossil fuels:Desulfurization of coal, oil shales, microbial enhanced oil recovery (MEOR). Biofuels: Biogastechnology, biohydrogen, bioethahnol production.

Biotechnology of mineral processing. Ethicalissues in environmental biotechnology and regulatory framework.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1 Text book of Environmental Biotechnology byP.K.Mohapatra, I.K.International 2. of Environmental Biotechnology concept and application by Hans Joachim, Jordening, J.winter, Wiley- Vch
Ref. Books 1 Advanced Environmental Biotechnology by S.K. Agarwal, A P H Publishing corporation 2 Environmental Biotechnology by D.K.Markandey and. Rajvaidya A P H Publishing Corporation

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	-	1	-	1	2	-	-	-	-	-			
CO2	-	2	1	-	-	2	-	-	-	-	-	-			
CO3	-	-	2	2	-	1	3	-	-	-	-	-			
CO4	-	-	2	1	-	2	2	-	-	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE6042	**Bioprocess Engineering**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1: To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.

CEO2: To understand the mechanism of enzyme action, their kinetics and about stoichiometry of microbial growth.

Course outcomes: At the end of the course, the student will be able to

CO1	learn the screening, culture, preservation and applications of microorganismin bioprocess engineering.
CO2	understand the design and principle of different bioreactors used in biotechnology industries.
CO3	acquire knowledge in optimization of growth parameters of microorganisms.
CO4	understand techniques such as precipitation, coagulation, flocculation and crystallization used inproduct purification.

UNIT:1 **14 Hours**

Introduction to bioprocess technology: Screening preservation and improvement of industrially important micro organisms, raw material and media formulation for formentation process, air and media sterilization, primary and secondary metabolites. Influence of environmental facts on growth and product formation.

UNIT:2 **13 Hours**

Concept of bioprocess, bioreactor designing, mixing and residence time distribution in bioreactor,,Anlysis of batch , fed-batch and continuous bio reactions, pulse bioreactors, fluidized bioreactors and photo bioreactors, pneumatic and hydro dynamic fermentations, solid substrate, surface, submerged fermentations, fermentations economics. Bioreactor design for animal cell culture and for waste treatment, growth models.

UNIT:3 **10 Hours**

Growth kinetics: Microbial growth cycle, measurement of growth, control of process parameters: measurement of process parameters likes' pH, temperature, dissolved oxygen, foam. Scale up and scale down process.

UNIT:4 **12 Hours**

Downstream processing: cell separation, cell disintegration, foam separation, precipitation, centrifugation, drying, crystallization and product purification, effluent treatment. Bioprocess economics. Use of microorganism in mineral beneficiation and oil recovery, microbial leaching of minerals.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Bailey and Ollis, "Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.). 1986. Press.
Scragg.A.H "Bioreactors in Biotechnology"- A Practical approach

Ref. Books 1. Bailey &Olis, Biochemical Engg. Fudamentals, MGH.,1990
2Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	1	-	1	-	-	-	-	-	-			
CO2	2	1	2	1	-	-	-	-	-	-	-	-			
CO3	-	2	3	2	2	-	-	-	-	-	-	-			
CO4	-	-	1	2	2	-	-	-	-	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE6043	**Proteomics and Genomics**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1: To understand the protein interaction, tools and application of Proteomics

CEO2: To know about the tools and techniques of genomics

Course outcomes: At the end of the course, the student will be able to

CO1	learn protein interaction and various tools used inproteomics
CO2	understand the 2-D electrophoresisand Peptide fingerprinting
CO3	acquire knowledge in application of proteomics
CO4	understand techniques such as Genome sequencing , accessing and retrieving genome and functional genomics and comparative genomics .

UNIT:1 **14 Hours**

Mapping protein interaction and applications: Global expression profiling, comprehensive mutant libraries, mapping protein interactions, applications of genome analysis and genomes. Introduction and tools of proteomics: Proteomics and Proteomes, Various tools used in proteomics (N-terminal sequencing of proteins, 2-D electrophoresis Differential display proteomics, Yeast two hybrid and three hybrid system, phage display, isoelectrofocusing, Peptide fingerprinting. LC/MS-MS for identification of proteins and modified proteins, SAGE,Protein micro array).

UNIT:2 **12 Hours**

Applications of proteomics: Mining proteomes, protein expressionprofiling, identifying protein – protein Interactions and protein complexes, mapping- proteinidentification, new directions in proteomics, structural proteomics; Proteomics and Drug delivery. Transcriptomics.

UNIT:3 **10 Hours**

Introduction to genomics: Orientation and structure of genomes, subdividing the genome, assembling a physical map of a genome. Sequencing methods and strategies, genome annotationand information from web, bioinformatics.

UNIT:4 **10 Hours**

Genome sequencing projects- Microbes, plants and animals; Accessing and retrieving genomeproject Reverse genetics, Structural genomics, Functional genomics and Comparative genomics;High throughput screening in genome for drug discovery identification of gene targets,Pharmaco-genomics and drug development.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books : 1. Voet D, Voet JG & Pratt CW, Fundamentals of Biochemistry, 2nd Edition. Wiley

3. Introduction to Genomics by Lesk AM, Oxford University Press (2008)
4. Proteomics: from protein sequence to function by Pennington, S.R. and Dunn, M. J., Viva Books (2001)

Ref. Books :1. Brown TA, Genomes, 3rd Edition. Garland Science
2. Campbell AM &Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	2	-	-	-	-	-	-	-	-			
CO2	1	-	1	3	-	-	-	-	-		-	2			
CO3	-	2	3	2	1	-	-	-		-	-	-			
CO4	-	-	2	1	2	1	-	-	-	-	-	-			
Avg.															

Subject code	Title of the subject	L	T	P	C	QP
BCHOE6051	**Bio-chemical REACTION ENGINEERING**	3	0	0	3	

Course Educational Objective

CEO1:To enhance skills in the areas of biochemical processes, to provide the fundamental background of biological systems, bio

CEO2:To provide the fundamental background of biological systems, bio-chemical engineering, environmental engineering, advanced bioprocess engineering, biologically mediated processes and waste treatment.

Pre-Requisites (If any)-Chemical Engg Process caluculation, Matchmatics, Chemical Engg. Reaction Engg

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Describe the bioprocess monitoring/control.
CO2	Design of ideal reactors for single and complex reactions and non-isothermal reactors.
CO3	Illustrate operation and choice of bioreactor.
CO4	Explain heat & mass transfer and scale up of bioprocesses.

Unit:1 **10hrs**

Material Balance & Energy Balances: Mathematical requisites – use of log-log and semi-log graph paper, triangular diagram, graphical differentiation and graphical integration, material balance without chemical reaction, material balance with chemical reaction, energy balance; enthalpy changes, heat of reaction and its temperature dependence, heats of solution and mixing, adiabatic flame temperature, use of psychometric charts.

Unit:2 **10hrs**

Kinetics of homogeneous reactions: classification of reactions, reaction rate, speed of reaction, rate equation, concentration-dependent term of rate equation, rate constant, order and molecularity, representation of elementary and nonelementary reactions, kinetic models for nonelementary reactions, temperature-dependent term of a rate equation, activation energy and temperature dependency.

Unit:3 **13hrs**

Kinetic analysis of batch reactor data: Integral and differential methods for analyzing kinetic data, interpretation of constant volume batch reactor, data for zero, first, second and third order reactions, half life period, irreversible reaction in parallel and series, auto catalytic reaction. Kinetic interpretation of batch reactor data for single reactions: interpretation of variable volume batch reaction data for zero, first and second order reactions, Ideal batch reactor, steady state CSTR and plug flow reactors and their use for kinetic interpretation. Design for single reaction: size comparison of single reactors, plug flow reaction in series and/or parallel, equal and different size of mixed

reactor in series, finding the best system for given conversion, recycle reactor, Design of multiple reactions in batch, CSTR and PFR.
Unit:4 **12hrs** Biochemical reaction systems: Cell and enzyme fermentation, Monod's model of growth kinetics. Kinetics of Enzyme catalyzed reactions for free and immobilized enzymes. – derivation of Michaelis-Menten equation, Briggs-haldane relationship, the determination and significance of kinetic constants, Lineweaver-burk and Eadie-Hofstee plot, principles of enzyme inhibition – Competitive, noncompetitive and uncompetitiveMichaelish-Menten kinetics, inhibition by foreign substances, kinetics of competitive and noncompetitive inhibitions, microbial fermentation, batch fermentor and mixed flow fermentor, kinetic expressions of fermentation.
Teaching Mentod (s):Chalk& Board/PPT/Video Lecture
Text Books 1:Chemical process Principles (Part I & II), Houge, Watson & Ragatz, Asian Student Edition Asia Publishing House 2.Basic Principles and Calculations in Chemical Engineering, Himmelbalu, Prentice Hall (l) 6th Ed.
Ref. Books 1: Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd. 2:Smith& Vanes, Thermodynamics for Chemical Engineers, MGH.

CO-PO MAPPING MATRIX

BIO-CHEMICAL REACTION ENGINEERING	VI	CO1	3	1	0	0	-	-	-	-	-	-	-	-
		CO2	1	3	2	0	-	-	-	-	-	-	-	-
		CO3	2	1	3	0	-	-	-	-	-	-	-	-
		CO4	0	1	0	3	-	-	-	-	-	-	-	-

Title of the Course						
Subject Code	**Industrial Instrumentation**	L	T	P	C	QP
BAEOEE6052		**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To solve technical problems implementation instrumentation thereby utilizing appropriate software and hardware tools and devices.

CEO2: To utilize PLC, DCS and supervisory control systems for control of manufacturing and processing systems.

CEO3: To Conduct, analyze, and interpret experimental results to improve process.

Course Outcome

At the end of the course, students will be able to:

CO1	Describe the process of measuring different environmental factors.
CO2	Apply PLC, DCS and supervisory control systems to operate manufacturing & processing systems.
CO3	Test the measurement results and minimize any possible error by checking various available techniques available.
CO4	Contrast the coordination between a modern power generation plant with the industrial scenario.

UNIT:1 **(8 Hours)**

INTRODUCTION: Functional Units, Classification, and performance characteristics, Dynamic Calibration, Errors: An Overview, Statistical Error Analysis, Reliability.

UNIT:2 **(14 Hours)**

INSTRUMENTS FOR ANALYSIS: Introduction, Gas Analyzers, Liquid Analyzers, X-ray Methods, Chromatography**.**

UNIT:3 **(10 Hours)**

TELEMETRY: Introduction, Pneumatic Means, Electrical Means, Frequency Telemetring, Multiplexing, Modulation, Modulation of Digital Data, Transmission Channels, Briefing of a Telemetry System in Operation, Wireless I/O**.**

UNIT:4 **(8 Hours)**

POWER PLANT INSTRUMENTS: Introduction, The Power Plant Scheme, Pressure, Temperature, Flow and Level, Vibration and Expansion, Analysis, Flue Gas Analysis.

HAZARD AND SAFETY: Initial consideration, Intrinsic Safety, Prevention of Ignition, Methods of Production, Analysis Evaluation and Construction.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert.

Text Books:

Principles of Industrial Instrumentation, Third Edition, D Patranabis, Tata McGraw Hill Education Private Limited, New Delhi

Reference Books:

Process/Industrial Instruments and Controls Handbook, Gregory K. Mc Millian Editor-in-Chief, Douglas M. Considine Late Editor-in

CO – PO & PSO mapping of Industrial Instrumentation

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C1	-	3	-	-	-	-	-	-	-	-	-	-	3	-	-
C2	-	3	-	1	-	-	-	-	-	-	-	-	2	-	-
C3	3	-	-	3	-	-	-	-	-	-	-	-	-	-	1
C4	2	3	-		-	-	-	-	-	-	-	-	-	2	-
Average	1.25	2.25	-	2	-	-	-	-	-	-	-	-	1.25	.5	.25

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC6110	Plant Biotechnology Lab	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to understand the techniques of plant tissue culture and establishment of plantlet.

The establishment of plant tissue culture laboratory for micropropagation and generation of transgenic plants.

Course outcomes: At the end of the course, the student will be able to:

CO1	learn about the preparation of various plant tissue culture media and their sterilization.
CO2	know about the establishment of callus culture.
CO3	learn about agrobacterium mediated gene transfer technique.
CO4	acquire the skill for protoplast isolation and somatic hybridization.

LIST OF EXPERIMENTS

1. Media preparation, sterilization technique explant preparation 2 establishment of meristem culture
2. Study of organogenesis
3. multiple shoot generation
4. Somatic embryogenesis in carrot and encapsulation somatic embryo
5. Anther culture of Datura
6. Establishment of suspension culture
7. Agrobacterium mediated transformation (Demonstration)
8. Embryo/Endosperm Culture
9. Isolation of protoplasts

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1												
CO2	3	3	1												
CO3	3	1	1												
CO4	2	3	2												
Avg.															

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC6120	Bioinformatics Lab	**0**	**0**	**2**	**1**	

Pre –Requisite: mathematics, computer, biology

Course Educational Objective

In this laboratory, students will have the opportunity to understand the biological database used in Bioinformatics for biotechnological analysis.

Study of various bioinformatics tools to designing of genome, protein for biological applications.

Course outcomes: At the end of the course, the student will be able to:

CO1	understand about the various genome and protein database and its applications in biotechnology.
CO2	learn to design the phylogenetic tree for genome analysis.
CO3	familiar with various bioinformatics software.
CO4	learn the technique of molecular docking, receptor analysis and Molecular Dynamics simulation.

LIST OF EXPERIMENT

1. Retrieving Human genome data, OMIM, SNP databases to understand genetic and metabolic disorders. (At least 2 each)
2. Mining genomic data to identify genomic features: codon usage, repeats, Homologous sequences etc.
3. Making Phylogenetic tree of given sequences by using ClustalW and PHYLIP.
4. Gene and promoter prediction for Prokaryotes and eukaryotes (comparative analysis by using different tools: at least 3)
5. Learning about molecule visualisation software like Rasmol, Pymol etc.
6. Primary Structural databases: pdb, ndb, csd and Derived databases of structures: DSSP, FSSP, CATH & SCOP.
7. Prediction of secondary structures of proteins: at least 3 methods
8. Prediction of Tertiary structure of proteins and Validation of model protein structure: Energy minimization, Procheck, verify 3D, Prosa II, ERRAT etc.
9. Molecule drawing. Conversion of 2D structure to 3D structure.
10. Molecular docking and analysis of receptor with ligand
11. Molecular Dynamics simulation

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	-											
CO2	2	1	3												
CO3	3	3	3												
CO4	3	2	3												
Avg.															

VII SEMESTER [FOURTH YEAR]

Sl. No.	Course Category	Course Code	Course Title	L	T	P	Credits
THEORY							
1	PC	BBTPC7010	Bioreactor Design and Analysis	3	0	0	3
2	PC	BBTPC7020	Medical and Phamaceutical Biotechnology	3	0	0	3
3	PE	BBTPE7031	Food Biotechnology	3	0	0	3
		BBTPE7032	Animal Biotechnology				
		BBTPE7033	Biosystem Engineering				
4	PE	BBTPE7041	Biomaterial	3	0	0	3
		BBTPE7042	Molecular modeling and Drug Designing				
		BBTPE7043	Nanobiotechnology				
5	OE	BCHOE7051	Green Technology	3	0	0	3
		BCVOE7052	Municipal Solid Waste Management				
		BCHOE7053	Fuel and Energy Technology				
		BCHOE7051	Green Technology				
PRACTICAL / SESSIONAL							
6	PC	BBTPC7110	Bioreactor Design and Analysis Laboratory	0	0	2	1
7	PC	BBTPC7140	Advanced Laboratory-II	0	0	2	1
8	EC	BBTEC7150	Mini Project / Projects on Internet of Things	0	0	4	2
10	EC	BBTEC7170	Summer Internship-II	0	0	2	1
TOTAL				**15**	**0**	**10**	**20**

##Meeting with the global requirements, to inculcate the habit of self-learning and in compliance with UGC guidelines, Massive Open Online Course (MOOC) have been introduced as electives and it can be selected with the latest industrial requirement.

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC7010	**Bioreactor Design and Analysis**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1:To understand the importance of bioprocess engineering and the role of bioprocess engineer and the importance of regulatory constraints.

CEO2:To understand the instrumentation and control of bioreactors their scale up aspects etc.

Course outcomes: At the end of the course, the student will be able to

CO1	learn the principle and operation of different types of bioreactors.
CO2	understand the conditions for both ideal and non-ideal bioreactors.
CO3	know about mass transfer in biochemical processes carried out in different bioreactors.
CO4	acquire basic concept in bioreactor design and modeling and simulation of fermentation process.

UNIT:1 **12 Hours**

Principles and concepts: Recapitulation of the principles of Kinetics for chemical and Bio-chemical Reactions. Fundamentals of homogeneous reactions for batch / semi-batch, plug low reactor (PFR), continuous stirred rank reactors (CSTR), fluidized bed reactor, bubble column, air lift fermenteretc, stirred tank/mixed reactors, adiabatic and programmed reactors. Unconventional bioreactors: Hollow fiber reactor, membrane reactor, perfusion reactor for animal and plantcell culture

UNIT:2 **14 Hours**

Bioreactor Analysis: Analysis of ideal bioreactors: Fed-Batch reactors, Enzyme catalyzed reactions in CSTRs, CSTR reactors with Recycle and wall growth, Ideal Plug-Flow Tubular reactor. Analysis of Non-ideal Reactor. Concept of ideal and non-ideal reactor; residence time distribution;models of non-ideal reactors – plug flow reactor for microbial processes.

UNIT:3 **13 Hours**

Mass transfer in biochemical processes; Multiphase bioreactors – packed bed with immobilized enzymes or microbial cells; three – phase fluidized bed trickling bed reactor; Design and analysis of the above reactor systems; Gas liquid reactors, Reactor stability.

UNIT:4 **12 Hours**

Bioreactor Design: Design considerations: oxygen transfer, heat transfer, rheology, mixing. Scale up and scale down concepts. Bioprocess control and computer coupled bioreactors; Growth and product formation by recombinant cells. Mechanical fittings in a bioreactor: vessel, agitation system materials, piping and valves for biotechnology. Instrumentation and control of

bioprocesses: Bioreactor sensor, online sensors for cell properties, off-line analytical methods; Biosensors. Bioreactor design calculation.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Bailey and Ollis, "Biochemical Engineering Fundamentals", McGraw Hill (2nd Ed.). 1986. Press.
2. Scragg.A.H "Bioreactors in Biotechnology"- A Practical approach

Ref. Books

1. Bailey &Olis, Biochemical Engg. Fudamentals, MGH.,1990
3. Levenspiel, O., Chemical Reaction Engineering, Wiley Eastern Ltd.
4. Lydersen, D'Elia, Nelson, Bioprocess engineering: Systems and equipment.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	2	1	-	-	-	-	-	-	-			
CO2	-	2	2	2	1	-	-	-	-	-	-	-			
CO3	-	-	2	3	2	-	-	-	-	-	-	1			
CO4	-	-	-	2	1	2	-	-	2	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPC7020	**Medical and Pharmaceutical Biotechnology**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1: To provide knowledge on drug development and new generation antibiotics.

CEO2:To provide theory and practical knowledge on diagnosis technique.

Course outcomes: At the end of the course, the student will be able to

CO1	understand the drug development in pharmaceutical process
CO2	understand the recent disease and diagnosis and their therapy
CO3	learn about the role of proteomics assay in drug development
CO4	know about the control of different pharmaceutical products.

UNIT:1 **13 Hours**

Production of pharmaceuticals by genetically engineered cells (hormones, interferons), Microbial transformation for production of important pharmaceuticals (steroids and semi-synthetic antibiotics), Techniques for development of new generation antibiotics. Protein engineering, drug design, drug targeting.

UNIT:2 **13 Hours**

ELISA and hybridoma technology, Use of enzymes in clinical diagnosis, Use of biosensors for rapid clinical analysis, Diagnostic kit development for microanalysis, Genetic diseases and DNA based diagnoses, DNA vaccine, Gene Therapy, Toxicogenomics

UNIT:3 **11 Hours**

Role of Proteomics in Drug Development, Diagnosis of disease by Proteomics Development of antibody based protein assay for diagnosis.Separation and identification techniques for protein analysis, Development of antibody based protein array for diagnosis

UNIT:4 **8 Hours**

Pharmaceutical products and their control, Therapeutical categories such as laxatives, vitamins, analgesics, non-steroid contraceptives, antibodies and Biologicals Hormones.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Stanbury.P.F, Whitaker.A and Hall.S.J, “Principles of Fermentation Technology”, 2nd Edition, Aditya Books (P) Ltd, 1995.
2. Molecular Diagnosis of Infectious Diseases (Methods in Molecular Medicine) by Jochen Decker, U. Reischl
3. Gary Walsh, “Pharmaceutical Biotechnology-Concepts and Applications,” Wiley, 2007

Ref. Books

1. EpenetosA.A.(ed), Monoclonal antibodies: applications in clinical oncology, Chapman and Hall Medical, London

2. Text book of industrial pharmacy by S R Hiremath, Orient Black Swan publication.
3. Leon and Lachman et al- Theory and Practice of Industrial pharmacy.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	2	1	-	-	-	-	-	-	-	-			
CO2	-	-	2	3	1	1	-	-	-	-	-	-			
CO3	-	3	2	-	2	-	-	-	-	-	-	2			
CO4	-	-	-	2	-	3	2	1	-	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE7031	**Food Biotechnology**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1:To provide knowledge on food production technology

CEO2: To have idea on food preservative technologies

Course outcomes: At the end of the course, the student will be able to

CO1	understand the composition of major food products ,analysis of food quality and food production technology.
CO2	understand the role of beneficial enzymes in food processing and preservation.
CO3	understand the causes of food spoilage and technology used to control or destroy micro organism commonly found in food.
CO4	understand the role of beneficial micro organisms in food processing and preservation.

UNIT:1 **10 Hours**

Food quality and Production technology Analysis of food, major ingredients present in different product, Food additives colour, flavour, vitamins, Single cell protein, mushroom, Fermentative production of food, Pickling and alcoholic beverages, Genetically manipulated crop based food, oriental foods, probotics/ prebiotics in food products.

UNIT:2 **10 Hours**

Technology for improved process Enzyme in bakery, fermented cereal products, Enzymes in fat/oil industries, Protease in cheese making, enzymes in beverage production, Utilization of food waste for production of value added products, enzymes in sugar syrup, genetically modified food.

UNIT:3 **14 Hours**

Food spoilage and control Spoilage of food, Microbiology of water, meat, milk, vegetables, Microbial safety of food products, Chemical safety of food products, heavy metal, fungal toxins, pesticide and herbicide contamination, Food preservatives and additives, Post-harvest technology for food preservation. Technology – canning, dehydration, ultrafiltration, sterilization, irradiation etc.

UNIT:4 **15 Hours**

Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary. Microbiology of milk & milk products like cheese, butter, ice-cream, milk powder; Microbiology of meat, fish, poultry & egg and their products.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Food Biotechnology by V K. Joshi and R.S. Singh, I K International Publishing House. 2. Food Biotechnology by Rita Singh , Global vision publishing house
Ref. Books 1. Fundamental of food biotechnology by Byong H. Lee, Wiley-BCH. 2. Food biotechnology by S.C. Bhatia, WPI Publishing

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	-	2	1	1	-	-	-	-	-	-			
CO2	-	2	1	-	2	2	-	-	-	-	-	-			
CO3	-	-	-	1	3	2	-	-	-	-	-	1			
CO4	-	1	-	2	-	1	2	-	-	-	-	-			
Avg.															

Title of the subject

Subject Code		L	T	P	C	QP
BBTPE7032	**Animal Biotechnology**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1: To provide a basic knowledge on animal cell culture.

CEO2: To provide the knowledge on application of cell culture for pharmaceutical purposes.

Course outcomes: At the end of the course, the student will be able to

CO1	understand the basics of animal cell culture and culture conditions.
CO2	acquire knowledge in optimization of media, scaling up animal cell culture, characterization and maintenance of cell lines.
CO3	Students will understand the stem cell culture and its applications in tissue engineering and animal cloning.
CO4	Students will learn molecular biology techniques like PCR, hybridization and RFLP.

UNIT:1 (12 Hours)

Animal Biotechnology Equipments and materials for animal cell, culture technology, Brief discussion on the chemical, physical and metabolic functions of different constituents of culture medium, Development of primary culture. Development of cell line by enzymatic disaggregation, Biology and characterization of the cultured cells, measuring parameters of growth

UNIT:2 (15 Hours)

Different type of cell culture media, growth supplements, serum free media, balanced salt solution, other cell culture reagents, culture of different tissues and its application.Behavior of cells in culture, division, their growth pattern, metabolism of estimation of cell number. Measurement of viability and cytotoxicity; Scaling up the cell culture to large scale/industrial level production.Development of cell lines, characterization and maintenance of cell lines, cryopreservation, common cell culture contaminants. Culture of cells for production of various biologicals.

UNIT:3 (10 Hours)

Application of animal cell culture, stem cell cultures, embryonic stem cells and their applications. Hybridoma technology, Organ culture technology, Transfection of animal cells, Future tissue engineering, animal cloning.

UNIT:4 (10 Hours)

Bacterial and viral diseases in animals; monoclonal antibodies and their use in diagnosis; molecular diagnostic techniques like PCR, insitu hybridization; northern and southern blotting; RFLP.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Animal cell culture by R.I. Freshney
2. Animal Biotechnology by P.Ramadas

Ref. Books
1. In vitro cultivation of Animal cells by Dr.C.K.Leach,Butterworth and Heinnmamm Ltd.1994.
2. Hand book of Animal Husbandry by Gopalakrishnan .
3. A Text Book of Biotechnology R C Dubey, S Chand publication

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	1	-	2	-	-	-	-	-	-			
CO2	3	-	2	2	1	-	-	-	-	-	-	-			
CO3	-	-	2	3	2	-	-	-	-	-	-	2			
CO4	-	-	-	1	2	-	2	1	-	-	-	-			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE7033	**Bio system Engineering**	**3**	**0**	**0**	**3**	A

Course Educational Objective	
CEO1: student will know a range of advanced design methods and be able to apply a structural design method to a typical biosystems engineering design problem;	
CEO2: student will have some skill in recognizing and describing biosystems design problems;	
Course outcomes: At the end of the course, the student will be able to	
CO1	familiar with the theory on technology development and systems innovation and be able to apply this to a typical biosystems engineering design case
CO2	have developed skill in redefining and redesigning a biosystem
CO3	be able to evaluate and reflect on a design from a technical, biological and sustainability point of view
CO4	have developed competence in functioning in and contributing to design teams

UNIT:1 **14 Hours**

Introduction to Biosystems Engineering : An introductory series of lectures will introduce students to various elements of the degree programme in Biosystems Engineering. The course will also include topics of current developments and case studies in the area. Essays in selected topics will be required.

UNIT:2 **15 Hours**

Introduction to Biosystems : Definitive properties and levels of organization of living systems. Chemical composition of living systems. Cell metabolism. Origin of life-metabolic evolution. Diversity of life forms. Animal and plant tissues and organs. Physiological systems. Protists. Nutrient requirements of organisms. Populations, communities and ecosystems. Biogeochemical cycles. Emergence of man. Impact of man on the biosphere.Social implications of recent advances in biology.

UNIT:3 **14 Hours**

Biosystems Modelling : Numerical and computer modeling of biological engineering processes including the drying of solid and liquid biomaterials.Numerical modeling systems using finite element and finite difference methods including practical examples as well as analytical solutions.

UNIT:4 **13 Hours**

Biosystems Engineering : Modes of heat transfer in biological materials. Heat exchangers. Mass balances, mass transfer. Separation processes including: distillation, filtration, membrane processes, centrifugation, chromatography. Reactor design, Psychrometrics in biological systems. Process laboratory.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books Biosystems Engineering I: Creating Superior Biocatalysts (Advances in Biochemical Engineering/Biotechnology Book 120) 10th Edition, Kindle Edition

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	1	1	2	-	-	-	-	-	-	-	-			
CO2	1	-	2	2	-	1	-	-	-	-	-	-			
CO3	-	2	2	2	1	-	-	-	-	-	-	-			
CO4	-	-	-	1	2	2	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE7041	**Biomaterial**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To provide Knowledge on biomaterial and biomedical engineering.

CEO2: To provide knowledge on different types of composite materials.

Course outcomes: At the end of the course, the student will be able to

CO1	Students will able to Classify and understand the properties of biomaterials
CO2	Student will also acquire knowledge on various types of biomaterials and use of novel biomaterials in biomedical engineering.
CO3	Students will understand the concepts for developing new materials for tissue engineering and bio-implant applications.
CO4	Students will be able to know biocompatibility of materials using in vivo and in vitro techniques.

UNIT:1 (10 Hours)

Introduction to biomaterials, Types and properties (mechanical, structural, thermal, optical, electrical and surface) of biomaterials, Synthetic polymer, Natural polymer.

UNIT:2 (12 Hours)

Novel Biomaterials and uses in Biomedical engineering: Hydrogels, self-assembling peptides. Implants materials: metallic implant materials, stainless steels, Co-based alloys, Ti- based alloys; ceramic implant materials, aluminum oxides, hydroxyapatite glass ceramics carbons. Polymeric implant

UNIT:3 (14 Hours)

Polymers for drug delivery: types of polymer, pharmaceutical polymers, physicochemical properties of polymers and relationship with structure, properties, kinetics, mechanisms and applications. , Biomaterials for ophthalmology, orthopaedic and dental implants, Biologically functional biomaterials

UNIT:4 (14 Hours)

Biocompatibility and blood compatibility, Biomaterials: its foreign body response in a body. Biological interface, interaction with biomaterials and adhesion, Biological response to implants, 2D and 3D matrices (scaffolds) of biomaterials for tissue engineering, Soft tissue and hard tissue replacement, cardiovascular implants. Characterization techniques of biomaterials.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1. Buddy D. Ratner Allan S. Hoffman Frederick J. Schoen Jack E. Lemons. Biomaterials Science, Second Edition: Wiley Science 2004.
2. Bhatt SV, Biomaterial, Narosa publishing house

Ref. Books

1. Park J and R. S. Lakes R S, Biomaterials: An Introduction, Springer 2009

CO-PO & PSO Mapping															
COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	-	1	1	-	1	-	-	-	-	-	-			
CO2	2	-	2	1	2	-	-	-	-	-	-	-			
CO3	-	2	1	3	2	-	-	-	-	-	-	-			
CO4	-	-	2	1	2	-	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE7043	**Nanobiotechnology**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1: To provide the knowledge on importance on nano biotechnology and its application.

CEO2: To have an idea about the application of nano biotechnology in industry and allied sciences at the end of course, student will be able.

Course Outcome

CO1	Learn the concept of "nanotechnology" and its interdisciplinary aspects.
CO2	Students will learn various approaches to synthesize characterized their advantages and limitations.
CO3	To understand the importance of engineered nonmaterial's for biomedical, therapeutic and environmental applications.
CO4	To evaluate the potential toxic effects of nanotechnology on living organisms and the environment.

UNIT:1 (10 Hours)

Basic Concepts of Nanoscience: Importance of "Nano" dimension, size matters: bulk vs nanomaterials, nanotechnology exists in nature, brief history of nanotechnology, applications of nanotechnology, challenges and future prospects, effect of 'nano' scale on material properties (electrical, thermal, mechanical, optical, chemical), quantum structures, quantum confinement, classification of nanostructured materials, surface effects of nanomaterials

UNIT:2 (10 Hours)

Synthesis and Characterization of Nanomaterials: Bottom-up and bottom-down approaches: milling, arc discharge, laser ablation, spray pyrolysis, chemical vapor deposition, physical vapor deposition, wet chemical synthesis of nanoparticles, self-assembled monolayer, Characterization of nanostructures, Spectroscopy: UV-Vis, FTIR; Electron microscopy: Scanning electron microscopy, EDX, Transmission electron microscopy, Atomic force microscopy.

UNIT:3 (10 Hours)

Engineered Nanomaterials for Biological Applications: Current status of nanobiotechnology, biogenic synthesis of nanoparticles: microbial and plant mediated, surface functionalization of nanomaterials, biological applications of functionalized nanomaterials, Biological nanomachines: ribosomes, photosynthesis systems, Bionanomotors, Nano-antimicrobials, Immobilized nanoparticles for water disinfection and biopesticides delivery applications.

UNIT:4 (12 Hours)

Biomedical Applications and Nanotoxicity: Biopolymers, Polymeric biomaterials, lipid nanoparticles for drug delivery applications, magnetic nanoparticles based hyperthermia treatment of cancer, DNA

nanotechnology, Nano-biosensors: fabrication, functionalization, applications, Cytotoxic and genotoxic effects of nanomaterials, toxic effects on environment, impact of nanotechnology on society and industry.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Gabor L. Hornyak., H.F. Tibbals, Joydeep Dutta, John J. Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2008. 2. "Nanostructures and Nanomaterials: Synthesis, Properties and Applications", G. Cao, Imperial College Press (2004) 3. Nanobiotechnology; Concepts, Applications and Perspectives", C. M. Niemeyer, C. A. Mirkin, Wiley-VCH (2004)
Ref. Books 1. Stuart M. Lindsay, Introduction to Nanoscience, Oxford University Press, 2009. 2. Poole C., and Owens F., Introduction to Nanotechnology, John Wiley, New Jersey, 2003.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	-	-	1	-	2	-	-	-	-	-			
CO2	-	-	1	2	1	2	-	-	-	-	-	-			
CO3	-	2	2	1	1	-	-	-	-	-	-	1			
CO4	-	-	2	2	3	2	-	-	-	-	-	-			
Avg.															

Subject code	Title of the subject	L	T	P	C	QP
BCHOE7051	**GREEEN TECHNOLOGY**	3	0	0	3	

Course Educational Objective

CEO1: To make students aware of how chemical processes can be designed, developed and operated in a sustainable way

CEO2: To facilitate the growth of the Green Technology industry and enhance its contribution to the national economy

CEO3: To increase public awareness and education on green technology and encourage its widespread use Green Technology.

Pre-Requisites (If any)-Chemical process Technology, Environment Engg and Safety

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Explain the industrial ecology in green technology
CO2	Understand the material and energy balance
CO3	Compare benefit of non conventional energy over conventional energy
CO4	Apply the knowledge for utilization of non conventional energy

Unit:1 **10hrs**

Green Technology – definition- Importance – Historical evolution – advantages and disadvantages of green technologies-factors affecting green technologies- Role of Industry, Government and Institutions – Industrial Ecology – role of industrial ecology in green technology.

Unit:2 **12hrs**

Definition – Importance – Historical evolution – Principles of Cleaner Production–Benefits–Promotion – Barriers – Role of Industry, Government and Institutions – clean development mechanism, reuse, recovery, recycle, raw material substitution-Wealth from waste, case studies. Overview of CP Assessment Steps and Skills, Process Flow Diagram, Material Balance, CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – CP Financing – Preparing a Program Plan – Measuring Progress- ISO 14000.

Unit:3 **10hrs**

Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement, carbon credit, carbon sequestration, carbon trading, Life Cycle Assessment – Elements of LCA – Life Cycle Costing – Eco Labelling.

Unit:4 **13hrs**

Availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Solar Energy-solar energy conversion technologies and devices, their principles, working andapplication. Definition-benefits and challenges – comparison of green fuels with conventional fossil fuels with reference to environmental, economical and social impacts- public policies and market-driven

initiatives. Biomass energy: Concept of biomass energy utilization, types of biomass energy, conversion processes.
Teaching Mentod (s):Chalk & Board/PPT/Video Lectures
Text Books 1: Pollution Prevention: Fundamentals and Practice' by Paul L Bishop (2000), McGraw Hill International. 2:Pollution Prevention and Abatement Handbook – Towards Cleaner Production' by World Bank Group (1998), World Bank and UNEP, Washington D.C.
Ref. Books 1:Handbook of Organic Waste Conversion' by Bewik M.W.M 2:Non-conventional Energy Sources' by Rai G.D.

CO-PO MAPPING MATRIX

GREEEN TECHNOLOGY	VI	CO1	2	1	0	-	-	-	-	-	-	-	-	-
		CO2	2	3		-	-	-	-	-	-	-	-	-
		CO3	2	3	3	-	-	-	1	-	-	-	-	-
		CO4	1	2		-	1	-	-	-	-	-	-	-

Subject Code	**Course Title**	L	T	P	C	QP
BBTPC7110	Bioreactor Design and Analysis Lab	**0**	**0**	**2**	**1**	

Course Educational Objective

In this laboratory, students will have the opportunity to study about parts, operation and standardization of bioreactor

Study about the effect of various parameters on the growth of microorganisms in controlled bioreactor conditions.

Course outcomes: At the end of the course, the student will be able to:

CO1	The student will study about the various parts and operation of bioreactor.
CO2	Effect of physical parameters on the growth of microorganisms.
CO3	The student will determine the oxygen transfer rate in bioreactor by folowing various methods.
CO4	The undergraduate will learn working of various bioreactors used in industries.

LIST OF EXPERIMENT

1. Bioreactor operation – Demonstration
2. Batch, fed batch and continuous cultures a) Estimation of Monod parameters b) Pure and mixed cultures.
3. Temperature effect on growth-estimation of energy of activation and Arrhenius constant for micro-organisms.
4. Determination of Oxygen transfer rate
   K_La determination by sulphite oxidation method
   K_La determination by dynamic gassing method
   K_La determination by power correlation analysis
5. Packed bed bioreactor: study of process parameters
6. Fluidised bed reactor: study of process parameters
7. Screening of process variables single dimensional search, Blackett Burman design, design expert etc.
8. Study of rheology of fermentation broth and power determination.
9. Bioprocess control using software
10. Production of secondary metabolites by feed batch culture.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	1												
CO2	3	1	2												
CO3	1	2	3												
CO4	2	1	3												
Avg.															

EIGHTH SEMESTER									
Sl. No.	**Course Category**	**Course Code**	**Course Title**	**Hours per week**			**Credits**	**ISA**	**ESA**
				L	**T**	**P**			
			THEORY						
1	PE	BBTPE8011	IPR, Bioethics and Bio safety	3	0	0	3	50	100
		BBTPE8012	Bioprocess Optimization						
		BBTPE8013	Biofuel and Energy Technology						
2	PE	BBTPE8021	Structural Biology	3	0	0	3	50	100
		BBTPE8022	Protein Engineering						
		BBTPE8023	Biosensor and Diagnostics						
3	OE	BCHOE8033	Treatment of Industrial Effluent	3	0	0	3	50	100
		BEIOE8032	Industrial Instrumentation						
		BMEOE8032	Quality Control and Reliability						
		BCHOE8031	Integrated Solid Waste Management						
			PRACTICAL/ SESSIONAL						
4	PC	BBTPC8150	Major Project/ Industrial Project /Startup Training cum Project	0	0	12	6	300	-
5	PC	BBTPC8180	Seminar and Technical Writing	0	0	4	2	100	-
6	PC	BBTPC8190	Comprehensive Viva-Voce	0	0	4	2	100	-
		TOTAL:		**9**	**0**	**20**	**19**	**650**	**300**

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8011	**IPR, Bioethics and Bio safety**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To provide the knowledge on importance on IPR in Biotechnology.

CEO2:To introduce biosafety regulations and its application in biotechnology

Course outcomes: At the end of the course, the student will be able to

CO1	Student will understand the basics of intellectual property rights and its importance
CO2	Students will obtain knowledge in patent requirements; patent writing and patenting procedure.
CO3	Students will understand the professional responsibilities for biosafety, biosafety levels, international agreements and protocols for Biosafety.
CO4	Students will understand the social and ethical issues related to plant, animal and modern biotechnology.

UNIT:1 (12 Hours)

Concept of property, rights, duties and their correlation; Intellectual property rights and its types- Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of new GMOs; Process patent vs product patent; International framework for the protection of IP; IP as a factor in R&D; IPs of relevance to Biotechnology and few Case Studies; Introduction to History of GATT, WTO, WIPO and TRIPS.

UNIT:2 (14 Hours)

Basic requirement of a patentable invention- novelty, inventive step, Prior art and Stae of art; Patent databases; Searching International Databases; Analysis and report formation; Indian Patent Act 1970 and Recent Amendments; Filing of a patent application; Precautions before patenting-disclosure/non-disclosure; WIPO Treaties; Budapest Treaty; PCT and Implications; Role of a Country Patent Office; Procedure for filing a patent, International patenting-requirement, Patent infringement- meaning, scope, litigation, remedies; Case studies and examples-Rice, Neem etc.

UNIT:3 (12 Hours)

Introduction to Biosafety regulations; Primary Containment for Biohazards and Biosafety Levels; Biosafety Levels of Specific Microorganisms; Recommended Biosafety Levels for Infectious Agents and Infected Animals; Biosafety guidelines - Government of India. Definition of GMOs & LMOs; Roles of Institutional Biosafety Committee, RCGM, GEAC etc. for GMO applications in food and agriculture; Environmental release of GMOs.

UNIT:4 (10 Hours)

Overview of National Regulations and relevant International Agreements including Cartagena Protocol. Concept of Bioethics, Public concerns on Human genome research and

transgenics- Genetic testing and screening, Ethics in clinical trials and GCP, ELSI & Human genome projects; Ethics in human cloning-a case study.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Stanley SA, Bioethics, Wisdom educational services 2. Sateesh MK, Bioethics and Biosafety, IK International Pvt. Ltd.

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	2	1	2	-	-	-	-		-	-			
CO2	1	2	2	3	-	-	-	-	-	-	-	-			
CO3	-	1	2	1	2	-	-	-	-	-	-	-			
CO4	-	-	2	2	-	-	-	3	-	-	-	2			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8012	**Bioprocess optimization**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1: To introduce the basic knowledge of biochemical process and its application

CEO2: To understand the solving of material balances problems involving chemical reactions

Course outcomes: At the end of the course, the student will be able to

CO1	familiar with different types of biochemical process variables and their measurements
CO2	know about biochemical kinetic models
CO3	know about the calculation of bioprocess optimization
CO4	have an idea about different types biopharmaceutical production process

UNIT:1 (10 Hours)

Biochemical process variables and their measurements; Control principles and their application in bioreactors; Theory of electrode processes and their applications; Measurement and control of pH, temperature, dissolved oxygen, aeration and agitation, redox potential, foam, etc.; On-line analysis of process parameters; Use of computer in control and optimization of microbiological processes.

UNIT:2 (10 Hours)

Types of kinetic model; Data smoothing and analysis; Mathematical representation of bioprocess; Parameter estimation; Numerical integration techniques; Parameter sensitivity analysis; Statistical validity; Discrimination between two models; Physiological state markers and its use in the formulation of a structured model; Dynamic simulation of batch, fed-batch steady and transient culture metabolism; Numerical optimization of bioprocess using mathematical models.

UNIT:3 (15 Hours)

Calculations of Bioprocess Optimization: Units and dimensions, mole concept, the chemical equations and stoichiometry, limiting and excess reactant, conversion and yield. Mass and energy balances in bioprocesses, flow sheet and process calculations, metabolic stoichiometry of growth and product formation, Ideal gas law calculations, real gas relationships, vapor pressure and liquids, saturation, partial saturation and humidity. Microbial Stoichiometry

UNIT:4 (10 Hours)

Supervision of bio pharmaceutical production process: Supervise bio pharmaceutical production activities: Biopharmaceutical production schedule and guidelines to production operators to handle production activities, Directions for junior biologists production operators -proper ingredients.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books

1.Optimization and Applicability of Bioprocesses : Purohit, H.J., Kalia, V.C., Vaidya, A.N., Khardenavis, A.A. (Eds.)

2. Fundamentals of Modern Bioprocessing: Sarfaraz K. Niazi, Justin L. Brown

Ref. Books
1.Bioprocess Engineering Principles by Pauline M Doren
2. Bioprocess Engineering: Basic Concepts by Michael L Shuler and F. Kargi

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	1	2	-	-	-	-	-	-	-	-			
CO2	2	-	1	1	-	-	-	-	-	-	-	-			
CO3	2	-	-	2	-	-	2	1	-	-	-	-			
CO4	1	-	2	2	-	-	1	-	-	-	-	1			
Avg.	2.4	2.4													

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8013	**Biofuel and Energy Technology**	**3**	**0**	**0**	**3**	

Pre -Requisite:

Course Educational Objective

CEO1: To gain the knowledge about natural energy resources

CEO2:Build models that simulate sustainable and renewable green energy technology systems

Course outcomes: At the end of the course, the student will be able to

CO1	To gain the knowledge about natural energy resources
CO2	Build models that simulate sustainable and renewable green energy technology systems
CO3	Understand the history, global, environmental and economical impacts of green energy technology
CO4	To acquire the technical knowledge of biofuel production and its applications

UNIT:1 (10 Hours)

Energy: Introduction; Resources: Renewable and non-renewable resources (Water, Minerals, and Energy; Use and over exploitation; Classification and Sources of Energy ; Problems relating demand and supply of various energy sources; Coal, Petroleum etc.

UNIT:2 (12 Hours)

Biomass and Energy Crops: wood (Lignocellulose)–Degradation by microorganisms andpathway studies. Sugar and Starch crops-Degradation by microorganisms and pathway studies. Oil seeds crops-Degradation by microorganisms and pathway studies. Hydrocarbon producing crops-Degradation by microorganisms and pathway studies.

UNIT:3 (13 Hours)

Biofuels: First Generation Biofuels: Bioethanol ,–Production meachnisms by microbes,Second Generation Biofuels:Methane and Hydrogen–Production mechanismsby microbes, Factors affecting Biogas yields. Third Generation Biofuels: Biobutanol. Biodeselfromalgae. Definition, advantages of biodiesel, properties of biodiesel, Transesterification, biodiesel from microalgae, algae cultivation, types of photobioreactor, Indian perspective of biofuels.

UNIT:4 (10 Hours)

From Microbes to Megawatts–Microbial Fuel Cells-Types of Biological fuelcells–Working Principle-Applications of Biological Fuel cells. Biofilm-Theory and applications. Biosensor-Theory and Applications. Environmental Nanobiotechnology, design of bioreactor

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Samir K. Khanal, “Anaerobic Biotechnology for Bioenergy Production:

Principles and Applications", Wiley-Blackwell Publishing, 2008
2.David M. Mousdale, "Biofuels: Biotechnology, Chemistry, and Sustainable Development "CRC Press, 2008.
3. Gupta, Vijai Kumar; Tuohy, Maria G. (Eds.), "Biofuel Technologies Recent Developments", Springer, 2013

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	2	1	-	-	1	-	-	-		-	-			
CO2	-	2	3	2	2	-	-	-	-	-	-	-			
CO3	2	-	-	2	2	1	-	-	-	-	-	-			
CO4	-	-	2	1	1	2	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8021	**Protein Engineering**	**3**	**0**	**0**	**3**	A

Course Educational Objective

CEO1:To provide importance and application of protein engineering.

CEO2: To have an idea about industrial important enzymes.

Course outcomes: At the end of the course, the student will be able to

CO1	Gain the knowledge about different forces acting on protein structure interactions and proeinenginnering applications.
CO2	Know thermodynamic and chemical principle of proteins
CO3	Have the knowledge in the features, design principles and approaches of protein engineering with stabilization.
CO4	Be understand the biophysical techniques used in protein characterization.

UNIT:1 **(12 Hours)**

Overview of protein structure and its hierarchical architecture; Protein engineering – definition,applications; Forces stabilizing proteins – Van der waals, electrostatic, hydrogen bonding andweakly polar interactions, hydrophobic effects. Structural features of protein, Ramachandranmap, Protein-protein, Protein-DNA, protein-ligand interactions. Protein structure-functionrelationship.

UNIT:2 **(10 Hours)**

Stability of Protein Structure: Laws of thermodynamics, heat, energy and work, chemical equilibrium flexibility, reversible folding and unfolding, pH titration, chemical denaturation, thermal denaturation, solvent perturbation and chemical modification.

UNIT:3 **(11 Hours)**

Features or characteristics of proteins that can be engineered- affinity and specificity; Experimental methods of protein engineering: Rational designing, Directed evolution like site directed mutagenesis, Module shuffling, Guided protein recombination, etc.; Computational Approaches to protein engineering. Mechanism of stabilization of proteins from psychrophilesand thermophiles vis-à-vis those from mesophiles; Protein and enzyme engineering case studies For its stability, specifity and affinity- Protease, Lipase and Lysozyme. Role of solvent.

UNIT:4 **(10 Hours)**
Characterization of proteins: NMR spectroscopy, crystallography, spectroscopic (UV-Vis, CD, IR,Florescence), calorimetric methods, Viscometry, Molecular sieve chromatography, Electrophoresis, EPR in protein structure and function analysis with example.
Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS
Text Books 1. Edited by T E Creighton, Protein function. A practical approach, 2nd Edition, Oxforduniversity press. 2. Cleland and Craik, Protein Engineering, Principles and Practice, Vol 7, Springer Netherlands. 3. Mueller and Arndt., Protein engineering protocols, 1st Edition, Humana Press. 4. L. Alberghina, Protein Engineering for industrial biotechnology, Harwood Academic Publisher

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	1	-	2	1	2	-	-	-	-		-	-			
CO2	2	1	2	2	-	-	-	-	-	-	-	-			
CO3	-	2	1	3	2	-	-	-	-	-	-	-			
CO4	-	-	2	1	3	-	-	-	-	-	-	1			
Avg.															

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8022	**Structural Biology**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1: Evaluate appropriate physical scale (length, force, time, energy, etc.) that is applicable Inliving systems.

CEO2: To study the bimolecular assemblies and its confirmations

Course outcomes: At the end of the course, the student will be able to

CO1	Student can evaluate the appropriate physical scale (length, force, time, energy, etc.) that is applicable in living systems.
CO2	The undergraduate will study the bimolecular assemblies and its confirmations
CO3	Student will know the biophysical techniques used in structural and functional analysis
CO4	Student will get the knowledge of experimental physical techniques and their mechanisms in biological systems.

UNIT:1 (10 Hours)

Life and its physical basis, length force and time scales in living systems, chemicalbonding and stability of molecules, forces and energies at nanometer scale: Intermolecular interactions,electrostatic screening, chemical composition ofliving systems

UNIT:2 (10 Hours)

Macromolecules and supramolcular assemblies: types of macromolecules and biological systems, molecular assemblies, membrane, ribosome, extracellular matrix, Chromatin. Chromosomal analysis.

UNIT:3 (12 Hours)

Macromolecular structural determination: Physical technique in proteins, nucleic acids and polysaccharides structure analysis- UV, IR, Fluorescence spectrophotmetry, NMR,ESR, Raman Spectroscopy and their application in Biomedical field. Structure determination by Crystallography and X-Ray Diffraction.

UNIT:4 (10 Hours)

Physical Techniques: Diffusion, Sedimentation, Osmosis, Viscosity, theirdefinition, factors Influencing them and their application in biology.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1 Crothers and Eisenberg: Physical chemistry application to life sciences ,

Benjamin Cummings, USA.

2.Biophysical techniques by Upadhyay and Upadhyay

3 The Cell by Cooper

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	-	1	1	-	-	-	-		-	-			
CO2	-	1	2	2	1	-	-	-	-	-	-	-			
CO3	2	2	1	-	3	-	-	-	-	-	-	-			
CO4	1	1	-	2	-	-	-	-	-	-	-	1			
Avg.	2.4	2.4													

Title of the subject						
Subject Code		L	T	P	C	QP
BBTPE8023	**Biosensor and Diagnostics**	**3**	**0**	**0**	**3**	A

Pre -Requisite:

Course Educational Objective

CEO1: To Provide knowledge about different biosensors and their principles

CEO2: To utilize the bioreactor to produce different products

knowledge about different biosensors and their principles

CO1	Student will gain the knowledge about different biosensors and their principles
CO2	Student will know the construction and mechanism of biosensor with their components
CO3	Student will get the relationship of biosensors with biological systems
CO4	Students will know the application of biosensor for different diagnosis process

UNIT:1 (15 Hours)

Introduction to biosensors- principles and applications; Components of Biosensor- Biological, Biochemical, Electrochemical, Electronic; Immobilization as key to biosensor construction, Bioaffinity principle and biosensor.

UNIT:2 (15 Hours)

Biosensor diversification, Principle, construction and applications of Redox mediated (Amperometric& Potentiometric) biosensor, Field Effect transitor systems (FETs) based biosensor, Thermistor based biosensor, Piezoelectric biosensors, Conductimetric biosensor, Calorimetric biosensor &Optoelectric biosensors; Whole cell biosensor, Immunosensors & In-vivo Biosensors.

UNIT:3 (6 Hours)

Variations on the biological /biochemical component, Bioaffinity principles, whole cell biosensors

UNIT:4 (9 Hours)

Applications of Biosensors: Clinical Chemistry & diagnostics, Medicine and health care, Veterinary, Agriculture and food production, Food preservation & contamination, Environment and pollution monitoring.

Teaching Methods: Chalk& Board/ PPT/Video Lectures/Lecture by Industry Expert/MOOCS

Text Books 1Turner APF et al., Biosensors fundamentals & Applications, Oxford University Press.

2 Blum LJ &Coulet PR, Biosensor Principles & Applications, , Marcel & Decker

3 Ramsay G, Commercial Biosensor, John Willey & Son

4 Walker JM &Rapley R, Molecular Biology and Biotechnology, Panima publishers

CO-PO & PSO Mapping

COs	PROGRAMME OUTCOMES												PSOs		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	2	-	1	2	1	-	-	-	-		-	-			
CO2	-	2	2	-	2	1	-	-	-	-	-	-			
CO3	-	2	2	1	3	-	-	-	-	-	-	-			
CO4	-	-	-	2	2	1	-	-	-	-	-	1			
Avg.															

CO-PO MAPPING MATRIX

TREATMENT OF INDUSTRIAL EFFULUENT	VIII	CO1	-	-	2	-	-	2	1	-	-	-	-	-
		CO2	-	-	1	-	-	3	2	-	-	-	-	-
		CO3	-	-	1	-	-	2	2	-	-	-	-	-
		CO4	-	-	1	-	-	1	1	-	-	-	-	-

Subject code	Title of the subject	L	T	P	C	QP
BCHOE8032	**INTEGRATED SOLID WASTE MANAGEMENT**	3	0	0	3	

Course Educational Objective

CEO1: To Understand the solid, hazardous waste and their treatment and disposal methods and Learn pollution control aspects for selected process industries

CEO2: To study various processing methods of polymers and elastomers.

CEO3: To study various properties and application of polymers.

Pre-Requisites (If any)-Chemical Process Technology, Fuel Technology

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Explain about the different types of solid waste.
CO2	Understand the various collection and disposal method.
CO3	Apply the knowledge to utilize solid waste in different way.
CO4	Develop new method for degradation process of solid waste

Unit:1 **10hrs**

Solid waste Management: Sources, Composition and Properties of Municipal Solid Waste, Engineering principles; Generation, Onsite handling, storage and processing including segregation; Collection, Recycling, Transfer and transport,Wasteprocessing, Recovery of resources.

Unit:2 **10hrs**

Waste processing technologies, Biological, chemical and thermal technologies – Composting, Anaerobic digestion, Incineration and pyrolysis,Disposal of solid waste including sanitary landfill, planning, siting, design, closure and post-closure monitoring

Unit:3 **10hrs**

Regional/Integrated solid waste management related issues. Principles of E-waste Management. Biomedical waste: Regulatory framework, categorization; generation, collection, transport, treatment and disposal.

Unit:4 **10hrs**

Hazardous Waste Fundamentals, Definition, Classification, Generation, Regulatory process, Current Management Practices, Treatment and Disposal Methods, Physicochemical processes, Biological processes, Stabilization and solidification; Thermal methods; Land disposal, Remediation of Contaminated Sites.

Teaching Mentod (s):Chalk& Board/PPT/Video Lectures
Text Books 1: Peavy H. S., Rowe D. R. and Tchobanoglous G., Environmental Engineering, McGraw-Hill International Edition. 2:3. LaGrega, M.D., Buckingham P.L., and EvansJ.C., Hazardous Waste Management, McGraw-Hill International Editions, 1994
Ref. Books 1:Martin E.J. and Johnson J.H., Hazardous Waste Management Engineering, van NostrandReinhold,1987. 2: Wentz C.A., Hazardous Waste Management, 2nd Edition, McGraw Hill, 1995

CO-PO MAPPING MATRIX

INTEGRATED SOLID WASTE MANAGEMENT	VIII	CO1	-	-	2	-	-	2	1	-	-	-	-	-
		CO2	-	-	1	-	-	2	3	-	-	-	-	-
		CO3	-	-	2	-	-	2	1	-	-	-	-	-
		CO4	-	-	1	-	-	1	1	-	-	-	-	-

Subject code	Title of the subject	L	T	P	C	QP
BSHOE8033	**TREATMENT OF INDUSTRIAL EFFULUENT**	3	0	0	3	

Course Educational Objective

CEO1: Emphasize on this course is on the fundamentals of pollution control aspects and characterization of effluent streams.

CEO2: Know the primary, secondary and advanced wastewater treatment process.

CEO3: Learn about different air pollutants sampling and analysis methods and air pollution control equipments.

Pre-Requisites (If any)-Chemistry, Chemical process Technology

Course Outcome: Upon successful completion of this course, students should be able to:

CO1	Explain about the various disposal and biological treatment process.
CO2	Describe various air and water treatment methods.
CO3	Apply the knowledge in developing new digester for treatment process.
CO4	Make use of various chemical and biological processes for effluent treatment.

Unit:1

10hrs General Characteristics of Industrial effluents, effects on Environment –ISI tolerance limits for discharging industrial effluents into surface water, into public sewers and on to land for Irrigation.

Unit:2

10hrs Hazardous Waste Fundamentals, Definition, Classification, Generation, Regulatory process, Current Management Practices, Treatment and Disposal Methods, Physicochemical processes, Biological processes.

Unit:3

10hrs Necessity of treatment –Segregation – Process changes – Salvaging –By Product Recovery –Ion Exchange, Electro dialysis, Solvent Extraction,Floatation – Removal of Nitrogen and Phosphorus – Boiler water treatment methods and cooling water treatment methods.

Unit:4 **10hrs** Sources, characteristics and treatment of Sugar, Dairy, Distilleries,treatment of power plants, oil refineries,cement and steel.,Paper and pulp, tanneries, textiles, fertilizers and pharmaceuticals
Teaching Mentod (s):Chalk& Board/PPT/Video Lectures
Text Books 1:Rao, M.N. & Dutta, A.K. "Waste Water Treatment", 3rd Edition, IBH Publishers, 1982 2. Metcalf and Eddy. "Waste water Engineering – Collection, Treatment, Disposal and Reuse", Mc Graw Hill Pub. Co., 1995.
Ref. Books 1:Numersorn. N.L., "Liquid Waste from industry – theories, Practice and Treatment". 2: Bhide, A.D. &Sunderesan, B.B. "Solid Waste Management", INSDOC, NEERI, Nagpur 1994