s

SAHRDAYA AUTONOMOUS
COLLEGE OF ENGINEERING & TECHNOLOGY
A CENTRE OF EXCELLENCE IN SCIENCE & TECHNOLOGY | MANAGED BY IRINJALAKUDA DIOCESAN EDUCATION TRUST
Approved by AICTE & Affiliated to APJ Abdul Kalam Technological University | Accredited by:
Estd.2002

B. Tech

Curriculum (2024) Semester I to VIII

Biotechnology

Branch Code: BT

(SHR/AC/Auto/Acad. Council/B.Tech/2/Curri. /BT)

Recommended by BoS on 30/08/2024

Approved by Academic Council on 31/08/2024

Preface to the Curriculum

The B.Tech Biotechnology (BT) curriculum is meticulously drafted to cultivate industry-ready professionals endowed with creativity and innovative thinking. This comprehensive curriculum includes induction programs, core and elective courses, practical courses, projects, internships, skill enhancement courses, and extracurricular activities. Designed to total 170 credits, the curriculum ensures a holistic education that prepares students for the dynamic field of Biotechnology. Below is a detailed overview of the curriculum's salient features:

1. **Project-Based Learning Courses:** From the first semester to the fifth semester, one course integrated with Project-Based Learning **(PBL)** empowers students with creativity, engaging them in meaningful projects to learn, explore, and investigate. PBL promotes teamwork and collaboration, essential skills for any professional, by having students work together in teams,each contributing unique skills and perspectives to achieve a common goal.
2. **Skill Enhancement Courses**: These courses are designed to provide students with industry- relevant certifications from reputed organizations, enhancing their employability by certifying their skill sets. They are integral to the academic curriculum and offered from Semester 1 to Semester 5, each carrying one credit.
3. **Foreign Language Courses**: To prepare students for global careers, the curriculum includes options to learn foreign languages, promoting cross-cultural communication skills and international collaboration. These courses are available in the seventh semester.
4. **Program Electives and Micro Specializations**: Students can pursue micro-specializations by completing thematic courses, which allow them to gain in-depth knowledge in specific sub-areasof their discipline. Starting in the fourth semester, this provides an opportunity for focused learning and expertise in emerging fields in alignment with program elective courses.
5. **Industry Elective Courses**: Offered jointly with industry partners, these courses ensure relevance and practical applicability. The academic department and industry partners develop and assess them collaboratively, without end-semester examinations, providing continuous andpractical learning experiences.
6. **Startups and Entrepreneurial Skills**: The curriculum encourages students to pursue startups, offering options to engage in product-based or service-based startups during their seventh and eighth semesters. This fosters innovation, creativity, and entrepreneurial skills, preparing students for the dynamic business environment.
7. **Courses Embedded with Practical**: The curriculum includes theory courses embedded with practical and projects, ensuring students apply theoretical knowledge to real-world problems. This hands-on approach enhances learning outcomes and practical skills.
8. **Internships**: The program includes mandatory internships, allowing students to

gain industry exposure and practical experience. Students can undertake at least four to six months of internship in a recognized industry, research organization, or prestigious institution relevant to their field. This bridges the gap between academic learning and industry requirements, enhancing employability.

9. **Community Work, Social Responsibility, and Universal Human Value Courses**: The curriculum integrates opportunities for community work and socially relevant projects promoting civic responsibility and leadership skills. Universal Human Value courses also aim to cultivate a holistic understanding of life, enhancing physical and mental well-being and social and life skills. These courses address various dimensions of life, including individual, family, society, and the environment, promoting a healthy and harmonious lifestyle.
10. **Activity Points**: In addition to academic credits, students must earn activity points through participation in extracurricular activities such as sports, cultural events, community service, and entrepreneurship. This holistic approach ensures the development of leadership, teamwork, and communication skills, preparing students for global challenges.
11. **MOOC Courses:** Students selected for internships can fulfil their credit requirements in the seventh and eighth semesters through MOOC courses, providing flexibility and additional learning opportunities.
12. **Higher Credit Elective:** These courses carry more than the standard credit weight of elective courses. They allow students pursuing honors to reduce the number of required courses by earning additional credits through higher-credit electives. Additional credits earned from highercredit electives can be credited towards the total credit requirement of the honors program, witha maximum of 12 additional credits being applied towards the honors credit requirement.

This curriculum is designed to blend theoretical knowledge with practical experience, foster interdisciplinary learning, and enhance employability through hands-on projects and internships, preparing students for successful careers in Biotechnology.

General Course Structure

1. Credit and Courses:

Credits are a unit of measurement for coursework based on the number of hours of instruction requiredper week. One hour of classroom lecture (L), 60 minutes long per week and carried out during all weeksof the semester, is considered one instructional unit or one credit. The same goes for a tutorial (T) or aproject (R) that is 60 minutes long per week and carried out during all weeks of the semester. In addition, a minimum of 120 minutes per week of laboratory session, practical or fieldwork, training (P) or a combination of these, carried out during all weeks of the semester, is also considered one Instructional Unit or one Credit.

Classification	Credit assigned
1 Hour Lecture [L] per week	1 Credit
1 Hour Tutorial [T] per week	1 Credit
1 Hour Project [R] per week	1 Credit
1-2 Hours Practical [P] per week	1 Credit
3-4 Hours Practical [P] per week	2 Credit

- *For internship/Start-Up/Main project/Mini project, the credit weightage for equivalent hours is 50% of that for lectures/tutorials*

2. Course Category and Credits

The B.Tech Program curriculum has 168 academic credits and 2 additional pass/fail credits that can be gained through 100 activity points. The program is expected to accommodate courses from other disciplines so that students have multi-disciplinary exposure. Additionally, the program should providesufficient opportunities for students to enhance their communication, soft, managerial, and technical skills. Depending on the program, the courses should fall under the engineering, basic science, humanities science, and management categories. The structure of the UG program should essentially have the following categories of courses with the breakup of credits as given:

Sl. No	Category	Code	Credits
1	Humanities and Social Sciences including Management Courses	HMC	9
2	Basic Science Courses	BSC	20
3	Engineering Science Courses	ESC	26
4	Programme (Professional) Core Courses	PCC	52
5	Programme (Professional) Core Courses-Project Based Learning	PBL	16
6	Program Elective Courses	PEC	18
7	Open Elective Courses/Industry Linked Elective	OEC/ILE	9
8	Project Work and Seminar	PS	12
9	UHV and Community Work	PW	1
10	Skill Enhancement Courses	SEC	5
11	Mandatory Student Activities.	MSA	2
	Total Mandatory Credits	**170**	

A 10% to 15 % deviation in credits is permitted under each discipline. While developing the curriculum,the department offering the program should ensure that the students attain the above distribution upon completing their program. Either Minor or Honours can be opted from the optional specialization.

The courses are organized into 1/2/3/4 credit courses based on the content delivery mechanism and desired depth. The delivery methods include Theory-only, Theory with

tutorial, Theory with practice, Theory with project, etc. The L-T-P-R-C for each course indicates the number of credits delivered as Lecture (L), Tutorial (T), Practical (P), Project (R) and the total instructional delivery indicated as Credits (C).

$$C = L + T + [P/2] + R$$

Apart from lectures, tutorials, practical/practice and project hours, the curriculum offers Self-learning hours (S) that indicate the number of hours students are expected to spend for activities that should be completed outside the class defined by the faculty handling courses. The activities aim to support learning and should be initiated by the students themselves without guidance or direction from tutors. For each course, the self-learning hour per week is calculated as:

$$S = (L*1+P*1+[R/2])$$

Categories of courses included in the curriculum and their L-T-P-R-C components are given in the table below:

Sl. No.	Lecture- Tutorial- Practical- Project [L-T-P-R]	Credit [C]	Description
1.	1-0-2-0	2	Theory course without End Semester Examination [ESE]
2.	1-0-0-0	1	
3.	2-0-2-1	4	Theory course embedded with practical and project
4.	3-1-0-0	4	Theory course embedded with tutorial
5.	3-0-0-0	3	Theory course
6.	2-0-0-0	2	
7.	3-0-2-0	4	Theory course embedded with practical
8.	3-0-0-1	4	Theory course embedded with project
9.	0-0-2-0	1	Practical course without ESE
10.	0-0-3-0	2	Practical course
11.	0-0-0-3	2	Mini Project
12.	0-0-3-0	2	Seminar
13.	0-0-0-8	4	Major Project/Internship/Start-Up
14.	0-0-0-0	1	MOOC Course
Mandatory Courses			
15.	0-0-2-0	1	Skill Enhancement Courses
Minor/ Honors Course			
16.	4-0-0-0	4	Theory course
17.	0-0-0-4	4	Project only course

3. Course Code

Every course of B. Tech. The program shall take a code from the table given below.

Course category	Description
PCC	Program (Professional) Core Courses

PBL	Project Based Learning
CLT	Combined Lab Theory
PEC	Professional Elective Course
OEC	Open Elective Course
BSC	Basic Science Course
ESC	Engineering Science Course
HMC	Humanities, Social Sciences and Management course
MOOC	MOOC Course
IEL	Industry Elective Course
PW	Socially Relevant course
PS	Project Work and Seminar
SEC	Skill Enhancement Courses
HR	Honours
MR	Minor

Structure of Course Code: Each course will be identified by a unique Course Code consisting of eight alphanumeric characters, formatted as **24XXYABC**. The code can be interpreted as follows: "24" represents the regulation year, "XX" is the course category code, "Y" indicates the course delivery mode, "A" is the semester number (ranging from 1 to 8, with 0 indicating the course is offered in both odd and even semesters), "B" denotes the version of the course under each category, and "C" signifies the course sequence number.

For example, 24CET303 is a theory course offered by the civil engineering department in the third semester of the 2024 scheme.
24BML408 - laboratory course offered by the biomedical engineering department in the fourth semester of the 2024 scheme
The detailed expansion of the abbreviation of the course code structure is listed in the table below:

XX	**Y**	**A**	**B**	**C**
Course category	Course delivery mode	Semester No	Version of the course	Serial No: of course
BM-Biomedical Engineering BT-Biotechnology CE – Civil Engineering CS-Computer Science Engineering EC-Electronics and Communication Engineering EE-Electrical and	T-Theory L-Laboratory R-Theory Embedded with Project K-Certification Course E-Elective Course G-Minor H-Honour	0 1 2 3	1 2 3 etc.	1 2 3 4

Electronics Engineering MA-Mathematics CY – Chemistry PH-Physics ES-Engineering Science course HU-Humanities and Management Courses SE-Skill Enhancement Courses PW-Social Science and Community work	M-MOOC O-Open Elective I-Industry Elective S-Seminar P-Project N-Internship U-Start Up C – Theory Embedded with practical	etc.		5 6 etc .

4. Allotted and Cumulative Credits

The allotted and cumulative credits are given in the table below:

Semester	Allotted Credits	Cumulative Credits
First	21	-
Second	22	43
Third	26	69
Fourth	24	93
Fifth	24	117
Sixth	23	140
Seventh	17	157
Eighth	11	168

FIRST SEMESTER (July-December)												
10 Days Compulsory Induction Program												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24MAT121	BSC	Linear Algebra, Differential Equations & Laplace Transform	3	0	0	0	40	60	3	3
2	B	24CYC132	BSC-CLT	Chemistry for Bioengineering	3	0	2	0	50	50	4	5
3	C	24EST103	ESC	Basic Concepts of Biotechnology and Biochemical Engineering	3	0	0	0	40	60	3	3
4	D	24EST144	ESC	Foundations of Electrical & Electronics Engineering	4	0	0	0	40	60	4	4
5	F	24ESR105	ESC-PBL	Algorithmic Thinking with Python	2	0	2	1	50	50	4	5
6	L	24ESL106	ESC	Fundamentals in Biotechnology Lab	0	0	2	0	50	---	1	2
7	I*	24HUT007	HMC	Communicative English	0	0	2	0	100	—-	1	2
8	J*	24SEK10N	SEC	Skill Enhancement Course 1							1	
Total											**21**	**24**

SECOND SEMESTER(January-June)												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24MAT221	BSC	Infinite series, Multiple Integrals and Vector Calculus	3	0	0	0	40	60	3	3
2	B	24PHC232	BSC-CLT	Engineering Physics	3	0	2	0	50	50	4	5
3	C	24EST003	ESC	Engineering Graphics	3	0	0	0	40	60	3	3
4	D	24ESC204	ESC-CLT	Programming in C	3	0	2	0	50	50	4	5
5	E	24BTR205	PCC-PBL	Bioprocess Calculations	2	1	0	1	50	50	4	4
6	I*	24HUT006	HMC	Professional Ethics and Sustainable Development	1	0	2	0	100	---	2	3
7	L	24ESL007	ESC	Computer Aided Drawing (CAD) & Manufacturing Workshop	0	0	2	0	50	---	1	2
8	J*	24SEK10N	SEC	Skill Enhancement Course 2							1	
Total											**22**	**25**

No Grade Points will be awarded for the MOOC, I and J slot courses.
***The self-learning (S) hours for each course is calculated based on the formulae,* S= (L*1+P*1+[R/2])**

THIRD SEMESTER (July-December)												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24MAT321	BSC	Complex Analysis & Partial Differential Equations	3	0	0	0	40	60	3	3
2	B	24BTT302	PCC	Biochemistry	3	1	0	0	40	60	4	4
3	C	24BTT303	PCC	Microbiology	3	1	0	0	40	60	4	4
4	D	24BTR304	PCC-PBL	Industrial Bioprocess Technology	3	0	0	1	50	50	4	4
5	G	24HUT005	HMC	Engineering Economics	2	0	0	0	50	50	2	2
6	F	24EST306	ESC	Introduction to Artificial Intelligence and Data Science	3	1	0		40	60	4	4
7	L	24BTL307	PCL	Biochemistry Lab	0	0	3	0	50	50	2	3
8	Q	24BTL308	PCL	Microbiology Lab	0	0	3	0	50	50	2	3
9	J*	24SEK10N	SEC	Skill Enhancement Course 3							1	
10	R/M	24BTG3XX	VAC	Remedial/ Minor							4*	4*
Total											**26/ 30***	**27/ 31***

FOURTH SEMESTER (January-June)												
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24MAT421	BSC	Probability Distributions, Numerical Methods & Transforms	3	0	0	0	40	60	3	3
2	B	24BTT402	PCC	Cell Biology and Genetics	3	1	0	0	40	60	4	4
3	C	24BTT403	PCC	Fluid Flow and Particle Technology	3	1	0	0	40	60	4	4
4	D	24BTR404	PCC-PBL	Biological Reaction Engineering	2	1	0	1	50	50	4	4
5	E	24BTE41N	PEC	PE-1	3	0	0	0	40	60	3	3
6	L	24BTL406	PCL	Instrumental Methods of Analysis Lab	0	0	3	0	50	50	2	3
7	Q	24BTL407	PCL	Fluid Flow and Particle Technology Lab	0	0	3	0	50	50	2	3
8	I*	24PWT208	PW	UHV II: Life Skills and Community work	1	0	0	0	100	---	1	1
9	J*	24SEK10N	SEC	Skill Enhancement Course 4							1	
10	R/M/H	24BTG4XX/ 24BTH4XX	VAC	Remedial/Minor/Honours							4*	4*
Total											**24/ 28***	**25/ 29***

PROGRAM ELECTIVE I: 24BTE41N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
E	24BTE 411	Enzyme Engineering And Technology	3-0-0-0	3	3
	24BTE412	Food Safety And Quality Management	3-0-0-0		3
	24BTE 413	Bioenergy And Biofuels	3-0-0-0		3
	24BTE414	Biochemical Thermodynamics	3-0-0-0		3
	24BTE415	Biophysics	3-0-0-0		3
	24BTE416#	Analytical Techniques In Biotechnology	3-0-3-0	6	5

 # Higher credit elective

FIFTH SEMESTER (July-December)													
Sl. No:	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24BTT501	PCC	Molecular Biology	3	1	0	0	40	60	4	4
2	B	24BTT502	PCC	Bioprocess Engineering	3	0	0	0	40	60	3	3
3	C	24BTT503	PCC	Heat and Mass Transfer Operations	3	1	0	0	40	60	4	4
4	D	24BTR504	PCC-PBL	Downstream Processing	3	0	0	1	50	50	4	4
5	E	24BTT52N	PEC	PE-2	3	0	0	0	40	60	3	3
6	I*	24HUM506	HMC	Constitution Of India (MOOC)	-	-	-	-	-	-	1	-
7	L	24BTL507	PCL	Molecular Biology Lab	0	0	3	0	50	50	2	3
8	Q	24BTL508	PCL	Heat and Mass Transfer Lab	0	0	3	0	50	50	2	3
9	J*	24SEK10N	SEC	Skill Enhancement Course 5							1	
10	R/M/H	24BTG5XX/ 24BTH5XX	VAC	Remedial/Minor/ Honours							4*	4*
Total											**24/ 28***	**24/ 28***
S_5/S_6		Industrial Visit (Maximum 12 Days are permitted, Not Exceedingly more than 6 Working Days) /Industrial Training										

PROGRAM ELECTIVE 2: 24BTE52N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
C	24BTE 521	Food Process Technology	3-0-0-0	3	3
	24BTE 522	Bioprocess - Ethics and safety	3-0-0-0		3
	24BTE 523	Cell Signaling	3-0-0-0		3
	24BTE524	Animal and Plant Cell Technology	3-0-0-0		3
	24BTE 525	Biological Waste Treatment	3-0-0-0		3
	24BTE 526#	Cancer Biology and Therapeutics	3-0-0-2	6	5

 # Higher credit elective

SIXTH SEMESTER (January-June)												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24BTT601	PCC	Genetic Engineering	3	0	0	0	40	60	3	3
2	B	24BTT602	PCC	Bioprocess Plant Design and Safety	3	1	0	0	40	60	4	4
3	C	24BTT63N	PEC	PE-3	3	0	0	0	40	60	3	3
4	D	24BTC604	PCC-CLT	Bioinformatics	3	0	2	0	50	50	4	5
5	F	24EST605	ESC	Design Thinking and Product Development	2	0	0	0	40	60	2	2
6	O	24XXO61N/ 24XXI61N	OE/ ILE	OE/ILE-1	3	0	0	0	40	60	3	3
7	L	24BTL607	PCL	Bioprocess Engineering Lab	0	0	3	0	50	50	2	3
8	P	24BTP608	PS	Mini Project	0	0	3	0	100	---	2	3
10	R/M/ H	24BTG6XX/ 24BTH6XX	VAC	Remedial/Minor/ Honours	3	1	0	0			4*	4*
Total											**23/ 27***	**26/ 30***
S5/S6		Industrial Visit (Maximum 12 Days are permitted, Not Exceedingly more than 6 Working Days) /Industrial Training										

Note: Open Electives are such courses which other departments will offer.

PROGRAM ELECTIVE 3: 24BTE63N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
A	24BTE631	Immunology and Immunotechnology	3-0-0-0	3	3
	24BTE632	Environmental Microbiology	3-0-0-0		3
	24BTE633	Clinical Research and Drug Design	3-0-0-0		3
	24BTE634	Process Dynamics and Control	3-0-0-0		3
	24BTE635	Biopharmaceutical Technology	3-0-0-0		3
	24BTE636#	Bioreactor Control and Instrumentation	3-0-3-0	6	5

 # Higher credit elective

OPEN ELECTIVE 1: 24BTO61N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
O	24BTO611	Fundamentals of Food Processing	3-0-0-0	3	3
	24BTO612	Regulatory affairs in Biotechnology Industry	3-0-0-0		3
	24BTO613	Process Design for Pollution Control	3-0-0-0		3
	24BTO614	Energy Engineering and Management	3-0-0-0		3

	24BTO615	Industrial Automation Technology	3-0-0-0		3
	24BTO616	Toxic and Hazardous Waste Management	3-0-0-0		3

SEVENTH SEMESTER (July-December)												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs./ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24BTE74N/ 24BTM74N	PEC	PE-4 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	40	60	3	3
2	B	24BTE75N/ 24BTM75N	PEC	PE-5 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	40	60	3	3
3	O	24XXO72N/ 24XXI72N/ 24XXM72N	OE/ ILE	OE/ILE-2 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	40	60	3	3
4	I	24HUT704 / 24HUM70N	HMC	Elective (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	2	0	0	0	50	50	2	2
5	S	24BTS705	PS	Seminar	0	0	3	0	50	--	2	3
6	P	24BTP706/ 24BTN706/ 24BTU706	PS	Option 1: Major Project Option 2: Internship (4-6 Months) Option 3: Start Up	0	0	0	8	100	0	4	8
	R/M/ H	24BTG7XX/ 24BTH7XX	VAC	Remedial/Minor/Honours							4*	4*
Total											**17/ 21***	**22/ 26***

**The students can take the internship option either in 7th or in 8th semester.*

** Option 1: Work on a Project in the institute/department under the mentorship of faculty members.Option 2: Full semester Internship in Industry/organization (**7th or 8th semester**)*

*Option 3: End semester start-up is service based in 7th or 8th semester; full year start-up is product based **(7th or 8th semester)***

PROGRAM ELECTIVE 4: 24BTE74N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
B	24BTE741	Waste Water Management	3-0-0-0	3	3
	24BTE 742	Proteomics and Protein Engineering	3-0-0-0		3
	24BTE743	Nano biotechnology	3-0-0-0		3
	24BTE744	Drug Delivery Principles and Applications	3-0-0-0		3
	24BTE 745	Plant Cell Bioprocessing	3-0-0-0		3
	24BTE 746#	Biomaterials and Tissue Engineering	3-0-0-3	6	5

PROGRAM ELECTIVE 5: 24BTE75N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
A	24BTE751	Developmental Biology	3-0-0-0	3	3
	24BTE752	Molecular Diagnostics	3-0-0-0		3
	24BTE753	Environmental Biotechnology	3-0-0-0		3
	24BTE754	Bioprocess Quality Control	3-0-0-0		3
	24BTE755	Next Generation Sequencing Technologies: Data analysis and applications	3-0-0-0		3
	24BTE756#	Modelling and Simulation of Bioprocess	3-0-0- 3	6	5

 # Higher credit elective

OPEN ELECTIVE 2: 24BTO72N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
O	24BTO721	Microbial Fuel Cell Technology	3-0-0-0	3	3
	24BTO722	Bioprocess Safety Engineering	3-0-0-0		3
	24BTO723	Industrial Instrumentation	3-0-0-0		3
	24BTO724	Advanced Wastewater treatment	3-0-0-0		3
	24BTO725	Sustainable Energy Processes	3-0-0-0		3
	24BTO726	Air pollution Control	3-0-0-0		3

HMC Elective: 24HUT704/ 24HUM70N

Slot	Course Code	Courses
I*	24HUT704	Project Management: Planning, Execution, Evaluation and Control
	24HUM701	Proficiency course in French (B1 level) (MOOC)
	24HUM702	Proficiency Course in German (B1 Level) (MOOC)
	24HUM703	Proficiency Course in Spanish (B1 Level) (MOOC)
	24HUM704	Introduction to Japanese Language and Culture (N5 level) (MOOC)

EIGHT SEMESTER (January-June)												
Sl. No	**Slot**	**Course Code**	**Course Type**	**Course Title (Course Name)**	**Credit Structure**				**Total Marks**		**Credits**	**Hrs/ Week**
					L	**T**	**P**	**R**	**CIA**	**ESE**		
1	A	24BTE86N/ 24BTM86N	PEC	PE-6 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	40	60	3	3
2	O	24BTO82N/ 24BTI82N/ 24BTN82N	OE/ ILE	OE/ILE-3 (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	3	0	0	0	40	60	3	3
3	I*	24HUT803/ 24HUM803	HMC	Organizational Behavior and Business Communication (Internship Students: Self Study/MOOC Approved by the University/Online Classes)	2	0	0	0	50	50	1	2
4	P	24BTP806/ 24BTN806/ 24BTJ806/ 24BTU806	PS	Option 1: Major Project Option 2: Internship (4-6 Months) Option 3: Major Project Phase-II (For the students who have not opted for internship in S7/S8) Option 4: Start Up	0	0	0	8	100	0	4	8
	H	24BTH8XX	VAC	Project: Honours							4*	4*
Total											**11/ 15***	**16/ 20***

** Option 2: Full semester Internship in Industry/organization (**7th or 8th semester**)*

PROGRAM ELECTIVE 6: 24BTE86N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
B	24BTE861	Biostatistics and Design of Experiments	3-0-0-0	3	3
	24BTE862	Computational Biology	3-0-0-0		3
	24BTE 863	Marine Biotechnology	3-0-0-0		3
	24BTE 864	Environmental Engineering	3-0-0-0		3
	24BTE 865	Synthetic Biology	3-0-0-0		3
	24BTE866#	Preclinical Drug Discovery and Development	3-0-0-3	6	5

 # Higher credit elective

OPEN ELECTIVE 3: 24BT083N

Slot	Course Code	Courses	L-T-P-R	Hours	Credit
O	24BTO831	Environmental Management Systems	3-0-0-0	3	3
	24BTO832	Waste to Energy Technology	3-0-0-0		3
	24BTO833	Nanomaterials and Nanotechnology	3-0-0-0		3
	24BTO834	Food Product design and development	3-0-0-0		3
	24BTO835	Entrepreneurship development inBiotechnology	3-0-0-0		3
	24BTO836	Computational drug discovery	3-0-0-0		3

Micro Specialization Group ID	Specialization	Course Code	Course Name
G-I	Environmental Technology	24BTE413	Bioenergy And Biofuels
		24BTE525	Biological waste treatment
		24BTE633	Environmental Microbiology
		24BTE753	Environmental Biotechnology

Micro Specialization Group ID	Specialization	Course Code	Course Name
G-II	Industrial Biotechnology	24BTE411	Enzyme Engineering and Technology
		24BTE521	Food Process Technology
		24BTE636	Biopharmaceutical Technology
		24BTE743	Nanobiotechnology

Micro Specialization Group ID	Specialization	Course Code	Course Name
G-III	Bioprocess Technology	24BTE414	Biochemical Thermodynamics
		24BTE522	Bioprocess –Ethics and Safety
		24BTE637	Bioreactor Control and Instrumentation
		24BTE754	Bioprocess Quality Control

HMC Courses				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S1**	24HUT007	Communicative English	1
2	**S2**	24HUT006	Engineering Ethics and Sustainable Development	2
3	**S3**	24HUT005	Engineering Economics	2
4	**S5**	24HUM506	Constitution of India (MOOC)	1
5	**S7**	24HUT704/ 24HUM70N	Elective (Project Management/Foreign Languages)	2
6	**S8**	24HUT803/ 24HUM803	Organizational Behavior and Business Communication	1
Total Credits				**9**

BSC Courses				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S1**	24MAT121	Linear Algebra, Differential Equations & Laplace Transform	3
2		24CYC132	Chemistry for Bioengineering	4
3	**S2**	24MAT221	Infinite series, Multiple Integrals and Vector Calculus	3
4		24PHC232	Engineering Physics	4
5	**S3**	24MAT321	Complex Analysis & Partial Differential Equations	3
6	**S4**	24MAT421	Probability Distributions, Numerical Methods & Transforms	3
Total Credits				**20**

ESC Courses				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S1**	24EST103	Basic Concepts of Biotechnology and Biochemical Engineering	3
2		24EST144	Foundations of Electrical & Electronics Engineering	4
3		24ESR105	Algorithmic Thinking with Python-PBL-1	4
4		24ESL106	Fundamentals in Biotechnology Lab	1
5	**S2**	24EST003	Engineering Graphics	3
6		24EST204	Programming in C	4
7		24ESL007	Computer Aided Drawing (CAD) & Manufacturing Workshop	1
8	**S3**	24EST306	Introduction to Artificial Intelligence and Data Science	4
9	**S6**	24EST605	Design Thinking and Product Development	2
Total Credits				**26**

Programme Core Courses (PCC)				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S3**	24BTT302	Biochemistry	4
2		24BTT303	Microbiology	4
3		24BTL307	Biochemistry Lab	2
4		24BTL308	Microbiology Lab	2
5	**S4**	24BTT402	Cell Biology and Genetics	4
6		24BTT403	Fluid Flow and Particle Technology	4
7		24BTL407	Instrumental Methods of Analysis	2
8		24BTL408	Fluid Flow and Particle Technology Lab	2
9	**S5**	24BTT501	Molecular Biology	4
10		24BTT502	Bioprocess Engineering	3
11		24BTT503	Heat and Mass Transfer Operations	4
12		24BTL507	Molecular Biology Lab	2
13		24BTL508	Heat and Mass Transfer Lab	2
14	**S6**	24BTT601	Genetic Engineering	3
15		24BTT602	Bioprocess Plant Design and Safety	4
16		24BTL607	Bioprocess Engineering Lab	2
17		24BTC604	Bioinformatics	4
Total Credits (Theory -11, Lab-6)				**52**

Programme Elective Courses (PEC)				
Sl. No	**Semester**	**Course Code**	**Course Type**	**Credits**
1	**S4**	24BTE41N	PE-1	3
2	**S5**	24BTE52N	PE-2	3
3	**S6**	24BTE63N	PE-3	3
4	**S7**	24BTE74N	PE-4	3
5	**S7**	24BTE75N	PE-5	3
6	**S8**	24BTE86N	PE-6	3
Total Credits				**18**

Programme Core-Project Based Learning (PBL)				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S2**	24BTR205	Bioprocess Calculations	4
2	**S3**	24BTR304	Industrial Bioprocess Technology	4
3	**S4**	24BTR404	Biological Reaction Engineering	4
4	**S5**	24BTR504	Downstream Processing	4

Total Credits	16

Open Elective Courses/Industry Elective (OE/IEL)				
Sl. No	**Semester**	**Course Code**	**Course Type**	**Credits**
1	S6	24BTO61N	OE/ILE-1	3
2	S7	24BTO72N	OE/ILE-2	3
3	S8	24BT083N	OE/ILE-3	3
Total Credits				**9**

Project/Seminar				
Sl. No	**Semester**	**Course Code**	**Course Type**	**Credits**
1	**S6**	24BTP608	Mini project	2
2	**S7**	24BTS705	Seminar	2
3		24BTP706/ 24BTN706/ 24BTU706	Project/Internship/Startup	4
4	**S8**	24BTP806/ 24BTN806/ 24BTJ806/ 24BTU806	Project/Internship/Startup	4
Total Credits				**12**

UHV and Community Work				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	S4	24PWT206	UHV II, Life skills & Community work	1
Total Credits				**1**

Skill Enhancement Course				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**S1-S5**	24SEK10N	Skill Enhancement Course	5
Total Credits				**5**

Mandatory Student Activities				
Sl. No	**Semester**	**Course Code**	**Course Area**	**Credits**
1	**-**	-	Mandatory Student Activities	2
Total Credits				**2**

Total Credits	170

RULES FOR ASSIGNING ACTIVITY POINTS

Apart from technical knowledge and skills, students should have excellent soft skills, leadership qualities and team spirit to be successful as professionals. They should have entrepreneurial capabilities and societal commitment. Student activity points to be earned, covering extracurricular and co-curricular activities, have been specified to nurture these qualities. All students must earn at least 100 activity points from various activity segments listed to qualify for the B.Tech degree. Two creditsare given for this on a pass/ fail basis, mandatory for getting the B.Tech Degree. As no grade forthese two credits is given, they are not included in the CGPA calculation. For lateral entry students joining from the third semester, the activity point requirement is 75 Points earned by the student, whichwill be indicated in the consolidated academic statement. In the case of NSS and NCC, points can be entered after completing a two-year Programme. All documental proof for awarding the activity pointsshould be obtained, and the points will be consolidated. The rules for assigning activity points are given in the following sections. The following table lists the main activity segments and the maximum points associated with each segment.

Activity Points				
Sl. No.	**Group**	**Courses**	**Credits**	**Minimum Credit Requirements**
1	I	NSS, NCC, NSO (National Sports Organization)	1 (50 Points)	2 Credits (One credit from each Group)
2		Arts/Sports/Games		
3		Union/Club Activities		
4	II	English Proficiency Certification (TOFEL, IELTS, BEC etc.)	1 (50 Points)	
5		Aptitude Proficiency Certification (GRE, CAT, GMAT etc.)/Valid Gate Score		
6		Short Term Internship, Clinical Exposure/Training (Minimum 2 weeks), Conferences/Paper Presentation/ Workshop Activities/ Professional Body Activities/ MOOC Courses/ Entrepreneurship and Innovation		

- ***75% per group for B. Tech Lateral Entry Students***
- ***To obtain the 2 Activity Credits required in the curriculum, students must acquire at least100 activity points.***

The following table lists the activities under each of these segments, the expected level of achievement, activity points, the evidence needed to assign the points, and the minimum duration required for certain activities. Additional activities under these segments can be considered after approval from the Academic Council.

Group	Activity Head	Sl. No	Activity	Achievement Levels and Assigned Activity Points					** Approval Document	Max. Points	Min. duration of activity
			*Level	I	II	III	IV	V			
GROUP I	National Initiatives Participation	1.	NCC	-	-	-	-	-	a/b	50	2 Year
		2.	NSS	-	-	-	-	-	a/b	50	2 Year
		For a C certificate / outstanding performance supported by certification, additional marks up to 20 can be provided, subject to a maximum limit of 80 points. Best NSS Volunteer Awardee (University level) / Participation in National Integration Camp/ Pre-Republic Day Parade Camp (South India), supported by certification, additional marks up to 10 can be provided, subject to a maximum limit of 70 points. For the best NSS Volunteer Awardee (State / National level), Participation in Republic Day Parade Camp or International Youth Exchange Programme supported by certification, additional marks up to 20 can be provided, subject to a maximum limit of 80 points.									
	Sports & Games Participation	3.	Sports	5	10	20	30	50	a	50	1 Year
		4.	Games	5	10	20	30	50	a	50	1 Year
			First Prize	8	8	8	15	15	Additional points can be provided for winning. The maximum limit for activity points is 60. However, the maximum point limit is enhanced to 80 for Level IV and V winning.		
			Second Prize	5	5	5	12	12			
			Third Prize	3	3	3	9	9			
	Cultural Events	5.	Music	5	10	20	30	50	a	50	1 Year
		6.	Performing arts	5	10	20	30	50	a	50	1 Year
		7.	Literary arts	5	10	20	30	50	a	50	1 Year
			First Prize	8	8	8	15	15	Additional points can be provided for winning. The maximum limit for activity points is 60. But for Level IV and V winning, the maximum point limit is enhanced to 80.		
			Second Prize	5	5	5	12	12			
			Third Prize	3	3	3	9	9			
	Union/Club Activities			**Coordinator**		**Sub/joint-coordinator**		**Volunteer**			
		8.	Elected student representatives	25 (Chairman)		20 (Secretary)		10 (Members)	d	50	1 Year
		9.	Hobby Clubs	10		5		3	d	30	1 Year

		10.	Placement Activities	10		5	3	d	30	1 Year
		11.	Student Professional Societies (IEEE, IET, ASME, SAE, NASA etc.)	10		5	3	d	30	1 Year
		12.	Department Associations	10		5	3	d	30	1 Year
		13.	Festival & Technical Events (College approved)	10		5	3	d	30	1 Year
GROUP II	**Professional Self Initiatives**		**Activity**	**Achievement Levels and Assigned Activity Points**						
			***Level**	**I**	**II**	**III**	**IV**	**V**		
		14.	Tech Fest, Tech Quiz	10	20	30	40	50	a	40
		15.	MOOC with final assessment certificate (Other than specified in the curriculum)	30					a	40
		16.	Competitions conducted by Professional Societies - (IEEE, IEI, IET, ASME, SAE, NASA etc.)	5	10	15	20	30	a	30
		17.	Hackathon	5	10	15	20	30	a	30
			Additional 10 points for Winners of Smart India Hackathon (SIH)/ India Innovation Challenge Design Contest (IICDC)							
		18.	Attending Full time Conference/ Seminars / Exhibitions/ Workshop/ STTP conducted at IITs /NITs	10					a	20
		18a	Attending Full time Conference/ Seminars / Exhibitions/ Workshop/ STTP conducted at KTU or its affiliated institutes	4					a	8
		19.	Paper presentation/	15					a	30

			publication at IITs/NITs				
			Additional 10 points for certificate of recognition.				
		19. a	Paper presentation/ publication at KTU or its affiliated institutes	6	a	12	
			Additional 2 points for a certificate of recognition.				
		20.	Poster Presentation at IITs /NITs	8	a	15	
			Additional 10 points for certificate of recognition.				
		20.a	Poster Presentation at KTU or its affiliated institutes	3	a	5	
			Additional 2 points for a certificate of recognition.				
		21.	Industrial Training/ Internship (at least for 2 weeks)	15	a/b	15	
		22.	Industrial/ Exhibition visits	3	a/b/ d	8	
		23.	Foreign Language Skills (TOEFL/ IELTS/ BEC exams, etc.)	40	a	40	
		24.	Aptitude Proficiency Certification (GRE, CAT, GMAT, etc)/Valid Gate Score	40	a	40	
		25.	Skilling Certificates (if not considered as part of the curriculum)	25	a	25	
	Entrepreneurship and Innovation	26.	Start-up Company Registered Legally (if not considered as part of the curriculum)	50	d	50	
		27.	Patent-Filed	25	d	25	
		28.	Patent - Published	30	d	50	
		29.	Patent- Granted (if Grace marks are not awarded)	40	d	50	
		30.	Patent- Licensed	70	d	70	

		31.	Prototype developed and tested	50	d	50	
		32.	Awards for Products developed	50	d	50	
		33.	Innovative technologies developed and used by industries/users	50	d	50	
		34.	Got venture capital funding for innovative ideas/products.	70	d	70	
		35.	Startup Employment (Offering jobs to two persons not less than Rs. 15000/- per month)	70	d	70	
		36.	Societal innovations	40	d	40	

*Level I College Events
*Level II Zonal Events
*Level III State/ University Events
*Level IV National Events
*Level V International Events
**Approval Documents: (a) Certificate (b) Letter from Authorities (c) Appreciation recognition letter (d) Documentary evidence (e) Legal Proof (f) Others (specify)