



**RAMAIAH**  
Institute of Technology

# **CURRICULUM**

**Outcome Based Education**  
**(Academic Year 2022 – 2023)**

**DEPARTMENT OF BIOTECHNOLOGY**

**III & IV SEMESTER B.E.**

**RAMAIAH INSTITUTE OF TECHNOLOGY**  
(Autonomous Institute, Affiliated to VTU)  
Bangalore – 560054.

## About the Institute

Dr. M. S. Ramaiah a philanthropist, founded ‘Gokula Education Foundation’ in 1962 with the objective of serving society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with ‘A+’ grade by NAAC in March 2021 for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute is also been conferred autonomous status for Ph.D program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 65% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **M S Ramaiah Institute of Technology has obtained “Scimago Institutions Rankings” All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company “Ramaiah Evolute” have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. **As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, M S Ramaiah Institute of Technology has achieved 67<sup>th</sup> rank among 1249 top Engineering Institutions & 17<sup>th</sup> Rank for School of Architecture in India for the year 2022 and is 1<sup>st</sup> amongst the Engineering Colleges affiliated to VTU, Karnataka.**

## About the Department

The Department of Biotechnology established in 2002 offers a four year B.E. Biotechnology Program with an intake of 60 students and a two-year M.Tech. Biotechnology Program with an intake of 18 students. The UG and PG curriculum emphasizes on biology-engineering interface bringing together engineering principles and life sciences to impart knowledge in core areas of Biotechnology. Both UG and PG Programs are accredited by the National Board of Accreditation (NBA). The Department is a recognized Research Centre by VTU, Belgaum, offering M.Sc (Engg.) by research and PhD programs. The Department also offers a Post Graduate Diploma in Biopharmaceutical Technology under the Biotechnology Skill Enhancement Programme (BiSEP), supported by the Department of IT & BT, Government of Karnataka.

The Department has 15 faculty members, of them 14 are Ph.D. holders. The faculty members have competence in core areas of Biotechnology viz. Food and Agricultural Biotechnology; Health and Medical Biotechnology; Environmental Biotechnology and Bioprocess Engineering. The faculty members have expertise in diverse disciplines of Biotechnology with focused research funded by national/state funding agencies (DST, AICTE, KBITS, VGST, VTU, RGUHS etc.). The average number of publications of the department in SCI and SCOPUS-indexed journals is 30/per year. The Department has collaborations with some of the leading biotech industries like Biocon, Hindustan Unilever Limited (HUL), Bristol Myers Squibb India Ltd, Novozymes South Asia Pvt Ltd, Merck Life Sciences, Himalaya Drug Company, etc.

The Department has well-equipped academic laboratories and state-of-the-art research laboratories. High-quality research-based in-house projects guided by the faculty have attracted state funding, resulting in publications in high-impact journals, and won Best project awards at the state level. Students carry out their internships at various premier institutes in India and abroad. Several students receive the prestigious Indian Science Academies Fellowship (INSA) and Jawaharlal Nehru Centre for Advanced Scientific Research (JNC SAR) Summer research fellowship. Every year, a sizeable number of graduate students pursue their higher education at various premier Institutes in India and abroad after qualifying for the GATE, GRE & TOEFL exams. The Department has established student clubs and professional student chapters to provide a collaborative learning platform for the students. Students at the Department of Biotechnology not only excel in academics but also have received awards and recognitions in various extra-curricular activities.

## **VISION OF THE INSTITUTE**

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs.

## **MISSION OF THE INSTITUTE**

**RIT shall meet the global socio-economic needs through**

- Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization.
- Establishing research clusters in emerging areas in collaboration with globally reputed organizations.
- Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs.

## **QUALITY POLICY**

We at Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stakeholders concerned

### **VISION OF THE DEPARTMENT**

To be a leading Biotechnology Engineering department that imparts quality technical education with strong research component, to develop solutions in the field of food, health and environment.

### **MISSION OF THE DEPARTMENT**

To provide quality technical education in a conducive learning environment to produce professionals, researchers with a zeal for lifelong learning and a commitment to society.

## **Programme Educational Objectives (PEOs) of the program**

**PEO 1:** To impart strong foundation in mathematics, basic and engineering sciences contributing to Biotechnology.

**PEO 2:** To produce graduates who can pursue higher education and research in biotechnology and allied fields.

**PEO 3:** To produce graduates with an ability to design, develop and implement research projects and apply to solve problems related to areas of biotechnology.

**PEO 4:** To provide opportunities to students to work in multidisciplinary teams with professional ethics, good communication, leadership skills and commitment to society.

## **Programme Outcomes (PO): As per NBA guidelines**

### **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.

### **Program Specific Outcomes (PSO)**

1. To have thorough grounding in Mathematics, Chemistry and Biology.
2. To be proficient in the principles and practices of advanced biological sciences.
3. To apply engineering principles to biological systems to solve Biotechnology problems.

**SEMESTER WISE CREDIT BREAKDOWN**  
**BATCH: 2021-2025**

<b>Semester</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>Total</b>
Humanities & Social Sciences (HSMC)	2		1	1	6				10
Ability Enhancement Courses (AEC) +UHV	1	1	1	1			2		6
Basic Sciences/ Lab (BSC)	8	8	3	3					22
Engineering Sciences/ Lab (ESC)	9	11							20
Professional Courses Core (Hard core, soft core, Lab) (PCC)			15	15	9	8	7		54
Professional Courses - Electives (PEC)					3	6	3		12
Other Electives (IOE)					3	3	3		9
Project Work (PW)						3		14	17
Internship/other activities (INT/TS)			2		2		5	1	10
<b>Total semester load</b>	<b>20</b>	<b>20</b>	<b>22</b>	<b>20</b>	<b>23</b>	<b>20</b>	<b>20</b>	<b>15</b>	<b>160</b>



## SCHEME OF TEACHING

### III Semester

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	BT31	Integral Transforms, Numerical Techniques and Biomodelling	Mathematics	BSC	2	1	0	3	4
2	BT32	Cell Biology and Genetics	BT	IPCC	2	0	1	3	4
3	BT33	Bioprocess Principles and Calculations	BT	PCC	2	1	0	3	3
4	BT34	Biochemistry	BT	PCC	3	0	0	3	3
5	BT35	Microbiology	BT	PCC	3	0	0	3	3
6	BTL36	Biochemistry Lab	BT	PCC	0	0	1	1	2
7	BTL37	Microbiology Lab	BT	PCC	0	0	1	1	2
8	UHV38	Universal Human Values	BT	UHV	2	0	0	2	2
9	HS392	Constitution of India & Professional Ethics	Humanities	HSMC	1	0	0	1	1
10	AEC310	Ability Enhancement Course-III	Humanities	AEC	1	0	0	1	1
<b>Total</b>								<b>21</b>	<b>25</b>
11	PE83	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters. Qualifying is mandatory for the award of the degree.				
	YO83	Yoga							
	NS83	NSS							
12	AM31	Additional Mathematics - I *	Mathematics	NCMC	0	0	0	0	3

<p><b>NOTE: Branches: CSE, AI &amp; ML, AI &amp; DS, CSE(CS), CSE (AI &amp; ML), ISE, ECE: Kannada (Kali / Manasu) in III Semester Constitution of India &amp; Professional Ethics in IV Sem</b></p> <p><b>Branches: EEE, MLE, ETE, EIE, ME, CV, IEM, CH, BT: Constitution of India &amp; Professional Ethics in III Semester Kannada (Kali / Manasu) in IV Semester</b></p>
<p><b>Nomenclature: BSC:</b> Basic Science Course, <b>IPCC:</b> Integrated Professional Core Course, <b>PCC:</b> Professional Core Course, <b>HSMC:</b> Humanity and Social Science &amp; Management Courses, <b>AEC</b>–Ability Enhancement Courses, <b>UHV:</b> Universal Human Value Course, <b>NCMC:</b> Non-credit Mandatory Course</p>
<p><b>L –Lecture, T – Tutorial, P- Practical/ Drawing</b></p>

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

**HS39/ HS49 Kannada Manasu** is for students who speak, read and write Kannada and  
**HS39/ HS49 Kannada Kali** is for non-Kannada speaking, reading, and writing students.

**The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):**

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for VIII semesters and shall attend the course from the III semesters and upto end of VIII semesters to complete all the formalities of the course and appear for the SEE. Marks scored in SEE shall be included in the VIII semester grade card.
2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
3. SEE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field in the ratio of 50:50. Maximum CIE marks are 50. SEE should be awarded by the course teacher every semester (III to VIII) for 50 marks and marks scored by the student are scaled down to 50 in the VIII semester.
4. The students who take a course on Physical Education and Yoga, he/she has to take up the semester end practical examination prescribed for 100 marks. The students who opt for NSS course have to submit report and attend viva-voce examination. The marks of the report shall be 50 marks and for the presentation/viva-voce 50 marks. SEE scale down to 50 marks.
5. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured 'F' grade.

**\* Lateral Entry Students:**

**The Non-Credit Mandatory Course, Additional Mathematics I** is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured 'F' grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. In case student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

**Inter/Intra Institutional Internship:** All the students admitted under lateral entry category shall have to undergo a mandatory summer Internship-I of 03 weeks during the intervening vacation of III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during IV semester and the prescribed credit shall be included in IV semester after students clearing this head. The internship shall be considered as a head of passing and shall be considered for vertical progression and for the award of degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

**Lateral Entry Students:**

**AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

## IV Semester

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	BT41	Biostatistics and Design of Experiments	Mathematics	BSC	2	1	0	3	4
2	BT42	Biochemical Thermodynamics and Heat Transfer	BT	IPCC	2	0	1	3	4
3	BT43	Fundamentals of Biochemical Engineering	BT	PCC	2	1	0	3	3
4	BT44	Molecular Biology and Genetic Engineering	BT	PCC	3	0	0	3	3
5	BT45	Structural Biology & Analytical Techniques	BT	PCC	2	1	0	3	3
6	BTL46	Biochemical Engineering Lab	BT	PCC	0	0	1	1	2
7	BTL47	Molecular Biology and Genetic Engineering Lab	BT	PCC	0	0	1	1	2
8	BTL48	Bioanalytical Technique Lab	BT	PCC	0	0	1	1	2
9	HS491	Kannada (Kali / Manasu)	Humanities	HSMC	1	0	0	1	1
10	BTAEC410	Scientific Writing and Communication	BT	AEC	1	0	0	1	1
11	INT411	Inter/ Intra Institutional Internship	BT	INT	0	0	2	2	-
<b>Total</b>								<b>22</b>	<b>25</b>
12	AM41	Additional Mathematics II *	Mathematics	NCMC	0	0	0	0	-

**BSC:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT:** Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC:** Ability Enhancement Courses, **NCMC:** Non-credit Mandatory Course; **L:** Lecture, **T:** Tutorial, **P:** Practical/ Drawing

**NOTE: Branches: CSE, AI & ML, AI & DS, CSE(CS), CSE (AI & ML), ISE, ECE: Kannada (Kali / Manasu) in III Semester  
Constitution of India & Professional Ethics in IV Sem**

**Branches: EEE, MLE, ETE, EIE, ME, CV, IEM, CH, BT: Constitution of India & Professional Ethics in III Semester  
Kannada (Kali / Manasu) in IV Semester**

**Nomenclature: BSC:** Basic Science Course, **IPCC:** Integrated Professional Core Course, **PCC:** Professional Core Course, **INT** –Internship, **HSMC:** Humanity and Social Science & Management Courses, **AEC**–Ability Enhancement Courses, **NMC:** Non-credit Mandatory Course

**L –Lecture, T – Tutorial, P- Practical/ Drawing**

**Integrated Professional Core Course (IPCC):** Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 03 and its Teaching–Learning hours (L : T : P) can be considered as (2 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

**HS39/ HS49 Kannada Manasu** is for students who speak, read and write Kannada and **HS39/ HS49 Kannada Kali** is for non-Kannada speaking, reading, and writing students.

**Innovation/ Societal/ Entrepreneurship based Internship:** At the End of fourth Semester four - weeks summer internship shall be carried out at industry, State and Central Govt./NGO/MSME, Innovation centre’s or incubation centres. The internship can be Rural Internship. All the students shall have to undergo mandatory internship of 04 weeks during the intervening period of IV & V semesters. A Viva-Voce examination (CIE) shall be conducted during V semester and the prescribed credit shall be included in VI semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements. The in-charge faculty has to monitor the student’s internship progress and interact to guide them for the successful completion of the internship.

Innovation/ Societal/ Entrepreneurship based Internship shall have only CIE no SEE component.

**\* Lateral Entry Students:**

**The Non-Credit Mandatory Course, Additional Mathematics II** is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfil the requirements during subsequent semester/s to appear for CIE. In case student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

**AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):**

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. In case student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

# **III Semester**

<b>INTEGRAL TRANSFORMS, NUMERICAL TECHNIQUES AND BIOMODELING</b>	
<b>Course Code:</b> BT31	<b>Credits:</b> 2:1:0
<b>Pre – requisites:</b> Calculus	<b>Contact Hours:</b> 28L+14T
<b>Course Coordinator:</b> Dr. S.H.C.V. Subba Bhatta & Dr. A Sreevallabha Reddy	

### Unit I

**Laplace Transforms:** Definition, transforms of elementary functions, properties of Laplace transforms, existence conditions, transform of derivatives, integrals, multiplication by  $t^n$ , division by  $t$ , evaluation of integrals by Laplace transforms. Transform of Periodic function

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/119640/593>

### Unit II

**Application of Laplace Transforms:** Unit–step function, Unit–impulse function. Inverse transforms, Convolution Theorem, Solution of linear differential equations and Simultaneous linear differential equations using Laplace transforms. Engineering applications

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/119640/593>

### Unit III

**Finite Differences and Interpolation:** Forward and backward differences, Interpolation, Newton Gregory forward and backward interpolation formulae, Lagrange’s interpolation formula, Newton’s divided difference interpolation formula (no proof).

**Numerical Differentiation and Numerical Integration:** Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cote’s quadrature formula, Trapezoidal Rule, Simpson’s  $(1/3)^{rd}$  rule, Simpson’s  $(3/8)^{th}$  rule

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/106/111106101/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>



## Unit IV

**Finite Element Method:** Introduction, element shapes, nodes and coordinate systems, Shape functions, assembling stiffness equations- Galerkin's method, Discretization of a structure, Applications to solve ordinary differential equations.

**Fourier Transforms:** Infinite Fourier transform and properties, Fourier sine and cosine transforms.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: [https://www.youtube.com/channel/UC\\_6qLqJhuIloQJOZv5qoSBA](https://www.youtube.com/channel/UC_6qLqJhuIloQJOZv5qoSBA)  
<https://nptel.ac.in/courses/111/105/111105134/>
- Impartus recording: <https://a.impartus.com/ilc/#!/course/132243/636>

## Unit V

**Models of flows:** Introduction to fluid dynamics, continuity equation for two and three dimensions in different coordinate systems, Navier-Stokes equations in different coordinate systems, Hagen-Poiseuille flow, special characteristics of blood flows, fluid flow in circular tubes, Stenosis and different types of stenosis, blood flow through artery with mild stenosis

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Impartus recording: <https://a.impartus.com/ilc/#!/course/132243/636>

### Text Books:

1. Erwin Kreyszig –Advanced Engineering Mathematics – Wiley publication – 10<sup>th</sup> edition-2015.
2. J.N. Kapur – Mathematical Models in Biology and Medicine – East-West Press Private Ltd., New Delhi – 2010.
3. S.S. Bhavikatti – Finite Element Analysis – New Age International Publishers – 2015.

### Reference Books:

1. Glyn James – Advanced Modern Engineering Mathematics – Pearson Education – 4<sup>th</sup> edition – 2010.
2. B. S. Grewal –Higher Engineering Mathematics – Khanna Publishers – 44<sup>th</sup> edition – 2017.
3. S.S. Sastry – Introductory Methods of Numerical Analysis – Prentice Hall of India – 5<sup>th</sup> edition – 2012.

### Course Outcomes (COs):

At the end of the course the student will be able to

1. Determine Laplace transform of standard functions. (PO-1, PO-2 & PSO-1)
2. Solve initial and boundary value problems using Laplace transforms (PO-1, PO-2 & PSO-1)
3. Find functional values, derivatives, areas and volumes numerically from a given data. (PO-1, PO-2 & PSO-1)
4. Solve ordinary differential equations using finite element method and evaluate Fourier transforms of given functions. (PO-1, PO-2 & PSO-1)
5. Discuss models of Bio-fluid flows. (PO-1, PO-2 & PSO-1, PSO-3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50</b>		
<b>Assessment Tool</b>	<b>Marks</b>	<b>Course outcomes addressed</b>
Internal test – I	30	CO1, CO2, CO3
Internal test – II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
<b>Other components</b>		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>		
Course end examination (Answer any one question from each unit – Internal choice)	100	CO1, CO2, CO3, CO4, CO5

# CELL BIOLOGY AND GENETICS

<b>Course Code:</b> BT32	<b>Credits:</b> 2:0:1
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 28L+14L
<b>Course Coordinator:</b> Dr. Prabha M & Dr. Y S Ravikumar	

## Unit I

### Cell Structure & Function

Introduction and Scope of Cell Biology; Evolution of prokaryotic & eukaryotic cells and structure; Structural organization and functions of cell organelles: Nucleus, Mitochondria, Chloroplast, Endoplasmic reticulum, Golgi bodies, Ribosomes, Lysosomes, Peroxisomes, Vacuoles.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for cellular organelles and cytoskeleton  
<https://nptel.ac.in/courses/102106025>  
<https://nptel.ac.in/courses/102103012>

## Unit II

### Protein Trafficking

Cytoskeleton – Structure and Function, Eukaryotic & Prokaryotic, Cell-Cell junctions. Transport of molecules between the nucleus and the cytosol, transport of proteins into mitochondria, protein transport to endoplasmic reticulum.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for cell cycle and signalling  
<https://nptel.ac.in/courses/102106025>  
<https://nptel.ac.in/courses/102103012>

## Unit III

### Cell Cycle & Cell Signalling

Cell cycle; Regulation and check points, Mitosis, and Meiosis. Introduction to cell signaling- para, endo and autocrine; Hormones, different Receptors: cell surface, ion channel linked; neurotransmitter, G protein linked; beta adrenergic receptor, cAMP and enzyme linked; Ras-DAG, calmodulin.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for cell cycle and signaling  
<https://nptel.ac.in/courses/102106025>  
<https://nptel.ac.in/courses/102103012>.

## Unit IV

### Fundamentals of genetics

Introduction & scope of Genetics; Chromosomes, Genomes, DNA, Gene structure and gene interaction, Mendel's principles. Incomplete dominance, Co-dominance, Multiple alleles– blood grouping. Linkage and mapping.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for chromosome organization: <https://nptel.ac.in/courses/102104052>

## Unit V

### Mutation and population genetics

Mutation, Types, Gene Mutation, and Chromosome mutations, Mutagens and mutagenesis. Population genetics: Basic concepts, Hardy–Weinberg principle. Dynamics of evolution, Human population genetics. Epigenetics, pedigree analysis chromosome structure.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for mutation and DNA repair: <https://nptel.ac.in/courses/102104052>

### List of Experiments

1. Study of cell structures (prokaryotic and eukaryotic)
2. Study of Mitotic stages.
3. Study of Meiotic stages in *Allium cepa*
4. Bacterial conjugation
5. Total Protein Extraction
6. Isolation and Quantification of chlorophyll
7. Genomic DNA isolation
8. Qualitative and Quantitative analysis of Bacterial genomic DNA
9. Problems related to genetic engineering
10. Study on Probabilities in genetics and Punnett square problems
11. Study of *Drosophila melanogaster* mutants
12. Maintenance/special chromosome of *Drosophila melanogaster*
13. Human Karyotype analysis
14. Pedigree analysis of Humans

### Text book:

1. Bruce Alberts - Molecular Biology of the Cell, Garland science, 5th edition, 2007.
2. Pierce BA. Genetics A Conceptual Approach W. H. Freeman and Company, 4th edition 2012.

### References book:

1. Verma P.S. and Agarwal VK - Cell Biology, Genetics, Molecular Biology, Evolution and Ecology S. Chand & company Ltd.2005.
2. Hardin J - Becker's World of the Cell. Pearson Benjamin Cummings, 8th edition, 2012.
3. Cell Biology and Genetics: A text Book for Undergraduate Students PB. Gupta P K Gupta P K (Author), Rastogi Publications 2016.

### Web links and Video Lectures (e-Resources):

1. <http://mbvi-au.vlabs.ac.in>
2. <http://cbii-au.vlabs.ac.in>

### Course Outcomes (COs):

On completion of this course student will able:

1. To compare the evolution of prokaryotic and eukaryotic cells and describes the structure and function of various cellular organelles, cell junctions and cytoskeleton. (PO-1 PSO-1)
2. To account for the organization of cytoskeleton, cell junction and molecular mechanisms of Protein trafficking, (PO-1 PSO-1)
3. To describe the mechanism of cell cycle and cell division and exemplify how extracellular signals can be transmitted into the cell interior. (PO-1 and PO-4, PSO-1)
4. To account for basic concepts of hereditary, variation and describe mechanism of Genetic Recombination in prokaryotic and eukaryotic organisms. (PO-1, PO-2, PO-4, PSO-1, PSO-2).
5. To classify and recognize mutation, the causes and its types and analyse the mechanism of cancer and epigenetics. (PO-1, PO2, PO4, PSO-1, PSO3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1, and CO2
Internal Test-II	30	CO3, CO4 and CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
Assignment	10	CO1, CO2 and CO3
Genetics Problems	10	CO4 and CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

# BIOPROCESS PRINCIPLES AND CALCULATIONS

<b>Course Code:</b> BT33	<b>Credits:</b> 2:1:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 28L+14T
<b>Course Coordinator:</b> Dr. Chandrababha M N and Dr. Krishna Murthy T P	

## Unit I

### Introduction to Bioprocess Engineering and Engineering Calculations

Biotechnology and bioprocess engineering, differing approaches to research for biologists and engineers, the story of penicillin: how biologists and engineers work together, Regulatory constraints in bioprocesses, steps in bioprocess development. Physical variables, dimensions, and units, measurement conventions, dimensional homogeneity and analysis. Biochemical calculations: molecule and mole, composition of mixtures and solutions (Percentage by weight, mole and volume; Normality, Molarity, Molality; average molecular weight; ppm), pH, pK and Buffer calculations.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#!/course/81451/295>

## Unit II

### Material balance on non-reactive bioprocess

Bioprocess classification, unit operations and unit processes in bioprocess industries, process flow diagram & block diagram. Law of conservation of mass (steady and unsteady state), procedure for material balance calculations, degree of freedom analysis. Material balances in distillation, absorption, extraction, crystallization, psychrometry, drying, mixing, evaporation operations.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#!/course/81451/295>

## Unit III

### Cell growth kinetics and Material balance on reactive bioprocess

Batch growth and specific growth rate, quantifying cell concentration, growth patterns and kinetics in batch culture, kinetic patterns of growth and product formation in batch fermentations. Principles of stoichiometry, definitions of limiting and excess reactants, fractions and percentage conversion, yield and percentage yield, selectivity, yields in cell culture. environmental conditions affecting growth kinetics, effect of substrate concentration and Monod equation, models with growth inhibitors.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#!/course/81451/295>

## Unit IV

### **Stoichiometry of growth and product formation**

Coefficients for ATP consumption and oxygen, stoichiometric calculations, elemental balances, degree of reduction, theoretical predictions of yield coefficients, estimation of elemental cell composition, stoichiometry by oxidation-reduction half-reactions, theoretical oxygen demand, maximum possible yield.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#/course/81451/295>

## Unit V

### **Energy balance and Unsteady State Balances**

Energy Balances: Basic energy concepts, General energy balance equation. Procedures of enthalpy calculation, enthalpy change in nonreactive processes, energy balance calculations without reactions, enthalpy change due to reaction, heat of reaction for processes with biomass production, energy balance equation for cell culture. Material balances involving bypass & recycle. Unsteady-state material and energy balance with and without biochemical reaction.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#/course/81451/295>

### **Textbooks:**

1. Pauline M Doran (2013) Bioprocess Engineering Principles, 2<sup>nd</sup> Edition, Academic Press.
2. Michael L Shuler, FikretKargi (2017) Bioprocess Engineering: Basic Concepts, 3<sup>rd</sup> Edition, Pearson publishers.
3. Felder, Richard M., Ronald W. Rousseau, and Lisa G. Bullard (2014) Elementary principles of chemical processes, 4<sup>th</sup> Edition, John Wiley & Sons.

### **References:**

1. D.M. Himmelblau (2014) Basic Principles and Calculations in Chemical Engineering, 8<sup>th</sup> Edition, Phi Learning Pvt Ltd.
2. Segel IH (2010) Biochemical Calculations 2<sup>nd</sup> Edition, John Wiley & Sons.
3. El-Mansi, E. M. T., Bryce, C. F., Allman, A. R., & Demain, A. L. (2018) Fermentation Microbiology and Biotechnology. 4<sup>th</sup> Edition, CRC press.
4. Narayanan K V, Lakshmikutty B (2016) Stoichiometry and Process Calculations, 2<sup>nd</sup> Edition, PHI India.
5. B. I. Bhatt, Shuchen B. Thakore (2010) Stoichiometry, 5<sup>th</sup> Edition, Tata McGraw-Hill Education.

### Web links and Video Lectures (e-Resources):

1. <https://learncheme.com/quiz-yourself/interactive-self-study-modules/>
2. <https://archive.nptel.ac.in/courses/102/106/102106069/>
3. <https://archive.nptel.ac.in/courses/103/105/103105209/>
4. <https://archive.nptel.ac.in/courses/102/105/102105064/>

### Course Outcomes (COs):

On completion of this course student will able:

1. Conduct unit conversions and basic chemical calculations (PSO-1)
2. Conduct material balances around steady- state multi-unit processes without chemical reactions. (PSO-1,3)
3. Evaluate kinetics of microbial growth and conduct material balances around steady- state processes with biochemical reactions. (PSO-1,3)
4. Predict stoichiometric requirements and conduct elemental balance of biochemical reactions. (PSO-1,3)
5. Conduct energy balances around multi-unit processes with and without biochemical reactions. (PSO-1,3)

### Course Assessment and Evaluation:

Continuous Internal Evaluation: 50 Marks		
Assessment tool	Marks	Course outcomes attained
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
Other Components		
Assignment	10	CO1, CO2, CO3, CO4, CO5
Quiz/Tutorial Test	10	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5



<b>BIOCHEMISTRY</b>	
<b>Course Code:</b> BT34	<b>Credits:</b> 3:0:0
<b>Pre – requisites:</b> Engineering Chemistry	<b>Contact Hours:</b> 42L
<b>Course Coordinator:</b> Dr. P. Dhamodhar & Dr. Ahalya N	

### **Unit I**

#### **Introduction to Biomolecules**

Structure, Properties and Classification of Carbohydrates, Amino acids and Proteins, Purines, pyrimidines, nucleotides, Nucleic Acids- DNA and RNA.

- Pedagogy/Course delivery tools: Chalk and talk and Power point presentation
- Links: <https://a.impartus.com/ilc/#/course/2128875/1174>  
[https://onlinecourses.nptel.ac.in/noc22\\_cy06/preview](https://onlinecourses.nptel.ac.in/noc22_cy06/preview)

### **Unit II**

#### **Introduction to Enzymes**

Introduction to enzymes, Advantages of enzymes vs chemical catalysts, Classification of enzymes, Features of active site, Mechanism of enzyme action, Enzyme specificity. Introduction to coenzymes and co-factors.

- Pedagogy/Course delivery tools: Chalk and talk and Power point presentation
- Links: <https://a.impartus.com/ilc/#/course/59747/295>  
<https://nptel.ac.in/courses/102106087>

### **Unit III**

#### **Carbohydrate Metabolism**

Glycolysis – Aerobic and anaerobic pathway and energetics, TCA cycle and its regulation, Glyoxylate cycle, Pentose Phosphate Pathway. Electron transport chain and oxidative phosphorylation, Gluconeogenesis, Glycogenesis.

- Pedagogy/Course delivery tools: Chalk and talk and Power point presentation
- Links: <https://a.impartus.com/ilc/#/course/2128875/1174>  
<https://nptel.ac.in/courses/102106087>

### **Unit IV**

#### **Lipid Metabolism**

Structure, Properties and Classification of Lipids, Biosynthesis of fatty acids, Fatty acid synthase, Biodegradation of fatty acids-beta oxidation pathway and its energetics. Biosynthesis of cholesterol and phospholipids.

- Pedagogy/Course delivery tools: Chalk and talk and Power point presentation

- Links: <https://a.impartus.com/ilc/#/course/2128875/1174>  
[https://onlinecourses.swayam2.ac.in/cec20\\_bt12/preview](https://onlinecourses.swayam2.ac.in/cec20_bt12/preview)

## Unit V

### Amino Acid & Nucleotide Metabolism

Biosynthesis and degradation of amino acids, deamination, transamination and urea cycle. Biosynthesis and degradation of Purine & pyrimidine nucleotides: De novo pathway, salvage pathway. Regulation of nucleotide metabolism

- Pedagogy/Course delivery tools: Chalk and talk and Power point presentation
- Links: Particle in a box: <https://a.impartus.com/ilc/#/course/2128875/1174>  
[https://onlinecourses.nptel.ac.in/noc22\\_bt22/preview](https://onlinecourses.nptel.ac.in/noc22_bt22/preview)

#### Text Books:

1. David L. Nelson, Michel M. Cox (2008) Lehninger Principles of Biochemistry, 4<sup>th</sup> Edn., Palgrave Macmillan, W H Freeman Publisher, New York, USA
2. Jereny M. Berg, John L. Tymoczko, Lubert Stryer (2006) Biochemistry, 6th Edn. W H Freeman Publisher, New York, USA

#### Reference Books:

1. Donal J. Voet, Judith G. Voet, Charlotte W. Pratt (2005) Fundamentals of Biochemistry, Upgrade Edn. Wiley Publishers, New York, USA
2. Trevor Palmer and Philip Bonner (2008) Enzymes: Biochemistry, Biotechnology and clinical Chemistry. 2nd Edition, East West Press Pvt. Ltd.
3. Robert K Murray, Daryl K Granner, Peter A Mayes (2006) Harper's Illustrated Biochemistry 27th Edn. McGraw Hill Book Company, USA
4. Nicholas C. Price and Lewis Stevens (2006), Fundamentals of Enzymology, 3rd Edition, Oxford University Press.

#### Web links and Video Lectures (e-Resources):

1. <https://a.impartus.com/ilc/#/course/2128875/1174>
2. <https://a.impartus.com/ilc/#/course/59747/295>
3. [https://onlinecourses.nptel.ac.in/noc22\\_bt22/preview](https://onlinecourses.nptel.ac.in/noc22_bt22/preview)
4. [https://onlinecourses.swayam2.ac.in/cec20\\_bt12/preview](https://onlinecourses.swayam2.ac.in/cec20_bt12/preview)
5. <https://nptel.ac.in/courses/102106087>

### Course Outcomes (COs):

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

1. Classify the macromolecules and analyze the structure, functions and their properties. (PO-1; PSO-1)
2. Classify the enzymes, understand their properties and mechanism of action of enzymes. (PO-1; PO-2; PSO-1).
3. Analyze the importance of carbohydrate metabolism in human body. (PO-1, 4; PSO-1)
4. Analyze the importance of Lipid metabolism in human body. (PO-1; PSO-1)
5. Analyze the importance of Amino acid and nucleotide metabolism in human body. (PO-1; PSO-1)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1, CO2, CO3
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
Assignment	10	CO4 & CO5
Quiz	10	CO1, CO2, CO3
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

<b>MICROBIOLOGY</b>	
<b>Course Code:</b> BT35	<b>Credits:</b> 3:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 42L
<b>Course Coordinator:</b> Dr. Ahalya N and Dr. Dhamodhar P	

## Unit I

### Introduction of Microbiology

Scope and History of microbiology (Milestone contributions from scientists); Origin of life-: Archaea, Prokaryotes and Eukaryotes. Microbial Diversity and Taxonomy. Structure, Classification and Reproduction of bacteria, Fungi, Viruses, Protozoa and Algae. General features of Prions, Spirochetes, Actinomycetes, Rickettsiae and Mycoplasma.

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/102105087>  
<https://a.impartus.com/ilc/#/course/81452/295>

## Unit II

### Microscopy

Microscopy: Concepts, Light Microscopy - Bright-Field Microscopy, Dark-Field Microscopy, Phase-Contrast Microscopy, Fluorescence Microscopy, Preparation and Staining of Specimens, Electron Microscopy – Scanning and Transmission Electron Microscopy, Atomic Force Microscopy, Confocal Microscopy,

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/102105087>  
<https://a.impartus.com/ilc/#/course/81452/295>

## Unit III

### Microbial Growth and Metabolism

Growth curve patterns, Physical conditions required for growth, Nutritional requirements, Media preparation, types of media, Maintenance and Preservation of Microorganisms, Microbial Metabolism: Aerobic and anaerobic growth, Metabolic pathways. Primary and secondary metabolites. Characterization: Biochemical tests and 16-s rRNA homology studies. Culture methods - pure culture techniques

- Pedagogy/Course delivery tools: Chalk and Board; and Power point presentations
- Links: <https://nptel.ac.in/courses/102105087>  
<https://a.impartus.com/ilc/#/course/81452/295>

## Unit IV Microbial Control

Control of Microorganisms by physical methods (heat, filtration, radiation), Control by chemical methods (phenol & phenolic compounds, Alcohols, Halogens, Dyes, Detergents, Aldehydes, Heavy metals, etc), Antibiotics and other chemotherapeutic agents.

- Pedagogy/Course delivery tools: Chalk and Board; and Power point presentations
- Links: <https://nptel.ac.in/courses/102105087>  
<https://a.impartus.com/ilc/#!/course/81452/295>

## Unit V Applied Microbiology

**Medical Microbiology:** Bacterial diseases: Typhoid, Cholera, Tuberculosis, Syphilis, Viral diseases: Polio, Hepatitis, AIDS, SARS and H1N1; Protozoan diseases: Malaria; common types of fungal infections

**Soil Microbiology:** Role of microbes and soil fertility. Bio fertilizers: VAM, Rhizobium and Azotobacter. Microbial Insecticides.

**Environmental Microbiology:** Microorganisms in Bioremediation; Hydrocarbon bioremediation and microorganisms in metal removal

- Pedagogy/Course delivery tools: Chalk and Board; and Power point presentations
- Lab component/Practical Topics:
- Links: <https://nptel.ac.in/courses/102105087>  
<https://a.impartus.com/ilc/#!/course/81452/295>

### Text Books:

1. Pelczar MJ Jr, Chan ECS, Kreig NR 2001, Microbiology McGraw Hill Education; 5th edition, India
2. Prescott LM, Harley JP, Klein DA (2012) Microbiology, 8th Edn. McGraw- Hill Publications, USA

### Reference Books:

1. Madigan MT, Bender KS, Buckley DH, Sattley WM, Stahl DA. 2020. Brock Biology of Microorganisms. 16th edition. Pearson, New York, NY.
2. Gerard Tortora , Berdell Funke , Christine Case, 2018 Microbiology: An Introduction, 13<sup>th</sup> Edition, Pearson New York, NY.

### Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/102105087>
2. <https://a.impartus.com/ilc/#/course/81452/295>
3. [www.nos.org/media/documents/dmlt/microbiology](http://www.nos.org/media/documents/dmlt/microbiology)
4. [www.columbia.edu/itc/hs/medical/pathophys/id/2009](http://www.columbia.edu/itc/hs/medical/pathophys/id/2009)

### Course Outcomes (COs):

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

1. Demonstrate the knowledge of different types of microorganisms, their classification, modes of reproduction and significance (PO- 1, PSO-1).
2. Describe the techniques of microscopy and isolate and identify the microorganisms (PO- 1, 2. PSO-1).
3. Discuss the microbial growth and metabolism (PO- 1, PSO-1).
4. Evaluate and apply the various microbial control measures (PO- 1, 2, PSO-1).
5. Analyze the role of microorganisms in the field in the field of environment, food and medicine (PO- 1. PSO-1).

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1 CO2 CO3
Internal Test-II	30	CO3 CO4 CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
<b>Assignment</b>	10	CO1, CO2, CO3
<b>Quiz</b>	10	CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

<b>BIOCHEMISTRY LAB</b>	
<b>Course Code:</b> BTL36	<b>Credits:</b> 0:0:1
<b>Pre – requisites:</b> Biochemistry	<b>Contact Hours:</b> 14P
<b>Course Coordinator:</b> Dr. Samrat K and Dr. P. Dhamodhar	

### **List of Experiments**

1. Preparation of buffers, molar and normal solutions.
2. Qualitative tests for Carbohydrates
3. Qualitative tests for Amino acids and Proteins.
4. Titration of Amino acids- Sorenson’s formal titration.
5. Estimation of glucose by enzymatic (GOD/POD) method.
6. Estimation of inorganic Phosphate by Fiske-Subbarao method.
7. Estimation of Amino acid by Ninhydrin method.
8. Estimation of Protein by Lowry’s method/Biuret method
9. Estimation of Urea by Diacetyl Monoxime method.
10. Spectrophotometric measurement of Proteins.
11. Estimation of phenol by Folin- Ciocalteu method.
12. Determination of Saponification value of Lipids.
13. Determination of Iodine value of Lipid.
14. Determination of total carbohydrate by Anthrone method

Students are required to perform 12 prescribed experiments from the above list of experiments.

### **Reference Books:**

1. Sadasivam S, Manickam A (2018), Biochemical Methods.3<sup>rd</sup> Edition, New Age International Pvt. (L.) Publisher, India.
2. Artinagam, Archana Ayyagari (2008), Lab Manual in Biochemistry, Immunology and Biotechnology, Tata McGraw Hill- Publishing company Ltd., India.

### **Web links and Video Lectures (e-Resources):**

1. <http://biotech01.vlabs.ac.in/List%20of%20experiments.html>
2. <https://vlab.amrita.edu/?sub=3&brch=64>

### Course Outcomes (COs):

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

1. Apply the principles and concepts of biochemistry for preparation of reagents, buffers and solutions to conduct experiments. (PO-1,2,3; PSO-1,2)
2. Design and conduct biochemical experiments like qualitative analysis of carbohydrates, amino acids, proteins and analyse & interpret the data. (PO-1, 2, 3, 4; PSO-1,3)
3. Perform biochemical experiments like estimation of different bio molecules and analyse & interpret the data. (PO-1,2, 3, 4; PSO-1,3)
4. Conduct quantitative determination of lipids, proteins and carbohydrates in biological samples. (PO-1,2,3; PSO-1,3)
5. Develop basic laboratory, research and analytical skills to carryout experiments in biochemistry laboratory. (PO-1,3,4, 10; PSO-1,3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	50	CO1, CO2, CO3, CO4, CO5



<b>MICROBIOLOGY LAB</b>	
<b>Course Code:</b> BTL37	<b>Credits:</b> 0:0:1
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 14P
<b>Course Coordinator:</b> Dr. Ahalya N, Dr. Priyadarshini Dey	

### **List of Experiments**

1. Preparation of media for the cultivation of bacteria and fungi
2. Hanging drop experiment to study motility
3. Micrometry
4. Gram’s staining of bacteria
5. Isolation of fungi and Lactophenol cotton blue mounting of fungi
6. Enumeration of total count of microorganisms using haemocytometer
7. Isolation and enumeration of bacteria from soil by the serial dilution-agar plating method
8. Biochemical identification of microorganisms I- Catalase test, starch hydrolysis test, carbohydrate fermentation
9. Biochemical identification of microorganisms II- IMViC tests
10. Methods of obtaining pure cultures of microorganisms (Streak-plate method, pour-plate method and spread plate technique)
11. Lactic acid fermentation
12. Antibiotic susceptibility testing of a bacterium
13. Most probable number (MPN) analysis (Demo)
14. Growth curve of bacteria (Demo)

*Any 12 experiments must be performed.*

### **Reference Books:**

1. Aneja, K.R. (2018). Laboratory Manual of Microbiology and Biotechnology. 2<sup>nd</sup> Edition, Medtech
2. Harley, J. (2016). Laboratory Exercises in Microbiology. 10<sup>th</sup> Edition, McGraw-Hill

### **Web links and Video Lectures (e-Resources):**

1. <https://www.youtube.com/watch?v=bm99zrq3ijo> (Video on Streak-plate method for isolation of pure culture)
2. <https://www.youtube.com/watch?v=vlnIDGmgQfk> (Video on Gram’s staining of bacteria)

### Course Outcomes (COs):

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

1. Operate equipment used in a microbiology laboratory. (PO-1, 2, 3, 12; PSO-1)
2. Prepare growth media and isolate microorganisms from various sources. (PO-1, 2, 3, 12; PSO1)
3. Perform aseptic transfers of microorganisms. (PO-1, 2, 3, 12; PSO-1)
4. Identify microorganisms using morphological and physiological tests. (PO-1, 2, 3, 12; PSO-1)
5. Carry out antibiotic susceptibility testing of bacteria. (PO-1, 2, 3, 12; PSO-1)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Weekly evaluation of laboratory manuals/ reports after the conduction of every experiment	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	50	CO1, CO2, CO3, CO4, CO5

## UNIVERSAL HUMAN VALUES

<b>Course Code:</b> UHV38	<b>Credits:</b> 2:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 28L
<b>Course Coordinator:</b> Dr. Roshni Ramachandran	

### Course content

#### Unit I

#### Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
  2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
  3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
  4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
  5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
  6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels
- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
  - Lab component / Practical Topics: Survey/polls for self-exploration
  - Links: Holistic Development and Role of Education <https://youtu.be/sGZfTPe-lhQ>

#### Unit II

#### Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient ‘I’ and the material ‘Body’
- Understanding the needs of Self (‘I’) and ‘Body’ - *Sukh* and *Suvidha*
- Understanding the Body as an instrument of ‘I’ (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of ‘I’ and harmony in ‘I’
- Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure *Sanyam* and *Swasthya*

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration

- Links: Harmony in Human Being- Self and Body  
<https://youtu.be/0ERSMkRPQBM>
- Links: Harmony in Human Being- Self <https://youtu.be/83oGJ4oDeIg>
- Links: Harmony between Self and Body Prosperity  
[https://youtu.be/aJ\\_BU2OgpKs](https://youtu.be/aJ_BU2OgpKs)

### Unit III

#### Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
3. Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
4. Understanding the meaning of *Vishwas*; Difference between intention and competence
5. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
6. Understanding the harmony in the society (society being an extension of family):
7. *Samadhan, Samridhi, Abhay, Sah-astitva* as comprehensive Human Goals
8. Visualizing a universal harmonious order in society- Undivided Society (*Akhand Samaj*), Universal Order (*Sarvabhaum Vyawastha* )- from family to world family!

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Family- Trust <https://youtu.be/F2K VW4WNnS8>
- Links: Harmony in family- Respect [https://youtu.be/iLqNR Puv0\\_8](https://youtu.be/iLqNR Puv0_8)
- Links: Harmony in family- Other Feeling Justice <https://youtu.be/TcYJB7reKnM>
- Links: Harmony in the Society <https://youtu.be/BkWgFinrnPw>

### Unit IV

#### Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Harmony in Nature [https://youtu.be/K1Jpd\\_ojydw](https://youtu.be/K1Jpd_ojydw)
- Links: Harmony in Existence [https://youtu.be/mormUeZ\\_RUE](https://youtu.be/mormUeZ_RUE)

## Unit V

### Implications of the above Holistic Understanding of Harmony on Professional Ethics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics:
  - A. Ability to utilize the professional competence for augmenting universal human order
  - B. Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
  - C. Ability to identify and develop appropriate technologies and management patterns for above production systems.
    - Case studies of typical holistic technologies, management models and production systems
    - Strategy for transition from the present state to Universal Human Order:
      - A. At the level of individual: as socially and ecologically responsible engineers, technologists and managers
      - B. At the level of society: as mutually enriching institutions and organizations

### Suggested Learning Resources:

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration

### Text Books:

1. **R.R Gaur, R Sangal, G P Bagaria**, A foundation course in Human Values and professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

### Reference Books:

1. **B L Bajpai**, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.

2. **PL Dhar, RR Gaur**, 1990, *Science and Humanism*, Commonwealth Publishers.
3. **Sussan George**, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. **Ivan Illich**, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. **Donella H. Meadows, Dennis L. Meadows, Jorgen Randers**, William W. Behrens III, 1972, *Limits to Growth*, Club of Rome's Report, Universe Books.
6. **Subhas Palekar**, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. **A Nagraj**, 1998, *Jeevan Vidya ek Parichay*, Divya Path Sansthan, Amarkantak.
8. **E.F. Schumacher**, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. **A.N. Tripathy**, 2003, *Human Values*, New Age International Publishers.

#### **Web links and Video Lectures (e-Resources):**

1. [https://www.youtube.com/channel/UCQxWr5QB\\_eZUnwxSwxXEkQw](https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw)
2. <https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZIGC4>
3. **Course handouts:**  
[https://drive.google.com/drive/folders/1zioX\\_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing](https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing)
4. **Presentation slides:**  
[https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp\\_b1mpS-duNRcwS6YH?usp=sharing](https://drive.google.com/drive/folders/1rMUKh1s0HPRBlpp_b1mpS-duNRcwS6YH?usp=sharing)

#### **Course Outcomes (COs):**

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

1. Apprehend the need of Value Education over Human aspirations (PO-6)
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. (PO-6)
3. Recognize the need of Harmony in the Family and Society for a better World. (PO-6)
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. (PO-6)
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. (PO-6, PO-8)

## Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE)</b>		
<b>Assessment Tool</b>	<b>Marks</b>	<b>Course outcomes addressed</b>
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
<b>Other components</b>		
<ul style="list-style-type: none"><li>• Assignment</li><li>• Quiz</li><li>• Presentation</li><li>• Model / mini project</li><li>• Any other</li></ul>	20 (10 + 10)	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

# CONSTITUTION OF INDIA AND PROFESSIONAL ETHICS

<b>Course Code:</b> HS392	<b>Credits:</b> 1:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 14L
<b>Course Coordinator:</b> Mrs. Kanya Kumari S	

## Course Content

### Unit I

#### Introduction to the Constitution of India

Meaning and Significances of the Constitution, making of the Indian Constitution and its salient features, Preamble of the Constitution, Fundamental Rights and relevant cases.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### Unit II

#### Relevance of Directive Principles of State Policy -part-IV

Fundamental Duties & their significance. Special constitutional provisions for the betterment of Women, children and backward classes in India.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### Unit III

#### Union executive and State executive

President of India, Vice President, Prime Minister & Council of Ministers. The Union Legislature, Compositions & the functions of Parliament and the Supreme court of India -composition & Jurisdictions

State executive-Governor, Chief Minister& council of Ministers, State legislature-composition & functions of legislative assembly& legislative council and State Judiciary.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### Unit IV

#### Local self-Governments, Emergency provisions, Electoral process & Major Constitutional Amendments

Local Self Governments- Panchayath Raj system, Emergency provisions, election commission of India & Electoral process, Amendment procedure and Major Constitutional amendments.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation



## Unit V

### Human Rights and Professional Ethics

Human Rights - meaning and significances of Human Rights. Universal Declaration of Human Rights (UDHR) protection of Human Rights in Indian Context. Scope and Aim of Ethics. Responsibility of Engineers, impediment to Responsibility.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

#### Text Books:

1. A Primer on Constitution of India & Professional ethics, VTU Publication-2007.

#### Reference Books:

1. Durga Das Basu,- ' Introduction to Constitution of India' - 19<sup>th</sup> /20<sup>th</sup> edition 2001
2. M.V.Pylee.- ' An Introduction to Constitution of India, 4<sup>th</sup> edition, 2008
3. Dr. K. R. Phaneesh,- 'Constitution of India & Professional ethics' –Sudha publication, Tenth revised edition 2018.

#### Course outcomes (COs):

At the end of the course students will be able to

1. Identify the fundamental principles of Indian constitution. (PO-12)
2. Examine various provisions of the Directive principles of state policies and fundamental duties. (PO-6, PO-12)
3. Understand the powers & functions of executive, Legislature and judicial system at the center and state level. (PO-6, PO-12)
4. Identify the role of government. (PO-12)
5. Understand about basic Human rights in India (PO-6, PO-8, PO-12)

#### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcome attained</b>
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
<b>Other components</b>		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
<b>Semester end examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

### ABILITY ENHANCEMENT COURSE - III

<b>Course Code:</b> AEC310	<b>Credits:</b> 1:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 14L
<b>Course Coordinator:</b> Dr. Rama Shivakiran Reddy	

Ability Enhancement Courses (AEC) are the generic skill courses which are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behaviour, human rights and the law.

Every student shall register for AEC course under the supervision of his/her proctor. For III, IV & V semester, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.

## PHYSICAL EDUCATION

<b>Course Code:</b> PE83	<b>Credits:</b> NCMC
<b>Pre – requisites:</b> Nil	
<b>Course Coordinator:</b> Dr. Kiran Kumar H K	

### Course Learning Objectives:

1. To introduce students to the importance of physical fitness for success in any career.
2. To instill in them concepts of team spirit and team building
3. To develop positive thinking, goal setting and decision-making abilities under duress.
4. To harness values and skills like leadership, communication and sacrifice.
5. To inculcate in students, the ability to handle success and failures with equanimity.

**Selection Process:** A Student shall select any one of the following Sports based on his/her interest and the facility available. The details of **Sports Facilities available (both indoor and outdoor) at institute campus** are as below:

Outdoor Games		Indoor Games		Athletics	
Games	No. of Students	Games	No. of Students	Events	No. of Students
Volleyball	12 x 4 = 48	Badminton	30	Sprint - 100mt, 200mt, 400mt	60
Basketball	12 x 4 = 48	Table Tennis	30	Middle distance running – 800mt, 1,500mt	
Kabaddi	12 x 4 = 48	Chess	30	Long distance running – 5,000mt, 10,000mt	
Kho Kho	12 x 4 = 48	Weight Training [Gym]	35	Jumping Events – Long Jump Triple Jump High Jump	30
Throw ball	12 x 4 = 48			Throwing Events Shot Put Discuss Javelin	30
Football	16 x 4 = 64	<b>Note: Students should bring their own sports attires</b>			
Hockey	16 x 4 = 64				
Cricket	16 x 4 = 64				

**Contact Sessions:** A student shall abide by the following during the sessions scheduled in the semester.

### **Session 1**

Fundamentals of Physical Education, value addition to personality through fitness education, discipline and team building activities, Orientation towards particular sports and skill training

### **Session 2**

Formation of teams based on student's orientation and preference. Team practice and skill enhancement.

### **Session 3**

Conduction of matches in all sporting events registered by Students. Evaluation of each student shall be based on their performance either in team or individual. The student representing the Institute at University/State/National/International Level will be awarded additional marks during evaluation.

### **Course Outcomes (COs):**

1. Develop interest and skill in playing particular sports.
2. Understand the process of organizing sporting events.
3. Appreciate the role of fitness for a better lifestyle.
4. Derive lessons from sports activities for effective planning and discipline in Life.
5. Analyze situations and optimize end results.

### **Course Assessment & Evaluation:**

1. A committee consisting of Sports Director and Coaches of respective Sports will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation process will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8<sup>th</sup> Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE.

<b>YOGA</b>	
<b>Course Code:</b> YO83	<b>Credits:</b> NCMC
<b>Pre – requisites:</b> Nil	
<b>Course Coordinator:</b> Dr. Hari Chandra B P & Dr. Parimala P	

### **Course Learning Objectives:**

1. To introduce to the students, the fundamental theoretical aspects of yoga.
2. To inculcate in students a habit of practicing yoga.
3. To be able to demonstrate basic yoga asanas.
4. To be able to practice fundamental breathing practices and mudras.
5. To understand the relevance of yoga and research in modern times.

### **Course Content**

**Introduction:** Definition of yoga, benefits, astangas of yoga, Relevance of yoga and yoga-research in modern times.

**Asanas:** Kriyathmakachalanas, Suryanamaskar, Superbrain yoga, Vrikshasana, Trikonasana, Veerabhadrasana, Paschimotasana, Purvothanasana, Bharadwajasana, Amruthasana, Parivruttha Trikonasana, Parsvakonasana, Ustrasana, Padmasana, Jaaanushirshasana, Navasana, Ardachakrasana, Ardhakatichakrasana, Jataraparivarthananasana, Sethubandasana, Sarvangasana, Mathyasana, Dhanurasana, Shirshasana.

**Pranayamas:** Anuloma-Viloma, Suryanuloma, Chandranuloma, Brahmari, Suryanbedhana, Chandrabedhana, Sheetali, Seethkari, Sadantha, bastrika.

**Mudras:** Chinmudra-Jnanamudra, Praana mudra, panchaprana mudras, panchabhoota mudras, Pruthvi mudra, Shoonya mudra, Surya mudra, Jalodharanashaka mudra, Kundalini mudra, shoonyaavaayu mudra, shakti mudra, sandhi mudra, vajra mudra and garuda mudra.

### **Course Outcomes (CO's):**

At the end of the course, a student will

1. Understand the fundamental and theoretical aspects of yoga.
2. Develop a habit of practicing yoga.
3. Demonstrate basic yoga asanas.
4. Demonstrate fundamental breathing practices.
5. Understand the relevance of yoga and its research in modern times.

### **Reference books:**

1. Light on yoga, B K S Iyengar, Publisher -Thorsons, UK, 2006

2. Light on pranayama, B K S Iyengar, Publisher - Element; First Edition
3. The Essential Yoga Mudras for Healing, Dr. Aasoori K. Rangaraja Iyengar, Saranga Publishing; First Edition 2021

### **Pedagogy:**

Chalk and talk, demonstration, videos, ppt.

### **Contact Sessions:**

There would be one introduction class, and five contact classes in each semester.

The candidates shall practice yoga on a daily basis, or in the worst case on alternate days at their place of residence and maintain a short diary in the format provided by yoga teacher. The same shall be brought to the classes.

### **Online reference sources:**

- Yoga for beginners part 1: <https://www.youtube.com/watch?v=VwPeThpwfWI>
- Yoga for beginners part 2: [https://www.youtube.com/watch?v=s\\_pnJTcOp8A](https://www.youtube.com/watch?v=s_pnJTcOp8A)
- Suryanamaskar: <https://www.youtube.com/watch?v=nUdlucNd6go&t=133s>
- Yoga for anxiety and stress: [https://www.youtube.com/watch?v=hJbRpHZr\\_d0](https://www.youtube.com/watch?v=hJbRpHZr_d0)
- Common yoga protocol: [https://www.youtube.com/watch?v=Av5ib\\_XRKT4](https://www.youtube.com/watch?v=Av5ib_XRKT4)
- Relevance of yoga in modern times:  
[www.youtube.com/watch?v=HUzBCts7BT0](http://www.youtube.com/watch?v=HUzBCts7BT0)

### **Course Assessment & Evaluation:**

1. A committee consisting of Yoga Instructors will be formed to observe and evaluate the students for CIE in each semester.
2. Students shall follow the schedules, rules, and regulations as prescribed by the Committee.
3. Students shall mandatorily have 85% attendance to be eligible for evaluation.
4. All the Sessions and evaluation processes will be common for all semesters of the academic year.
5. The final result will be reflected on the grade card of 8<sup>th</sup> Semester.
6. The final marks shall be calculated after scaling down CIE to 50 marks & combining it with 50 marks for SEE.

### **Scheme of SEE**

Practical Demonstration	30 marks
Write-up	10 marks
Viva	10 marks
<b>Total</b>	<b>50 marks</b>

## NATIONAL SERVICE SCHEME

<b>Course Code:</b> NS83	<b>Credits:</b> NCMC
<b>Pre – requisites:</b> Nil	
<b>Course Coordinator:</b> Dr. Puttabore Gowda & Dr. Siddaraju C	

### Course Learning Objectives:

1. To introduce students to the importance of national service
2. To harness values and skills like leadership, teamwork and sacrifice.
3. To serve society through educational services and health
4. To work towards rural and local development through technological services
5. To inculcate in students, the ability to handle socially relevant projects.

### Students shall involve in activities related to national and regional technical and non-technical services, as listed below.

- Serving society by bringing awareness on education and cleanliness.
- Blood donation camps
- Developing technologies for rural masses.
- Conduction and participation in camps for a social cause.
- Educating towards health and well-being of individuals/society.
- Cultural and educational programs for society.
- Contributing towards the improvement of civil services and bringing certain shortcomings to the notice of higher authorities for suitable remedial actions.
- Contribution towards traffic management and other public services.
- Clean up and development of water sources around public places.
- Services during a disaster or other needy situations.
- Camps for the rejuvenation of lakes and water bodies.
- Serving nature and agriculture.
- Awareness programs on health and food adulteration.
- Presenting papers/talks in various fora on the above topics.
- Developing technologies for rural masses beyond academic requirements.
- Plantation programs.
- Conducting programs for self-sustainability, and human and national development.
- Contribution towards orphans and challenged individuals through well-recognized organizations.
- Carrying out designated activities in villages.

- Development and implementation of strategies for solid waste, E-waste etc.
- Education towards pollution control and traffic management.
- Production of documentaries and short films/videos for motivating people on any of the above causes.

### **Course Outcomes (COs):**

At the end of the course, a student will be able to

1. Understand the importance of national service.
2. Gain skills like leadership and teamwork.
3. Volunteer towards educational services and health.
4. Contribute to rural and local development through technical services.
5. Comprehend socially relevant projects

### **Contact Sessions:**

The students shall attend the review and contact sessions as scheduled by the course coordinator.

### **Course Assessment & Evaluation:**

1. The candidates shall maintain a record of activities in a Diary, and get them endorsed during the contact sessions at least 3 times in a semester.
2. A detailed project report should be submitted during the last fortnight of the semester
3. Evaluation will be done during each semester based on the nature of the contribution.
4. The final marks shall be calculated after scaling down CIE to 50 marks & combining with 50 marks for SEE



## ADDITIONAL MATHEMATICS – I

<b>Course Code:</b> AM31	<b>Credits:</b> 0:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 42L
<b>Course Coordinator:</b> Dr. Shashi Prabha Gogate S	

### Course Content

#### Unit I

**Differential Calculus:** Successive differentiation, nth derivatives of some standard functions, Leibnitz theorem, Polar curves. Angle between the radius vector and the tangent, angle between curves, length of the perpendicular from pole to the tangent, pedal equations. Taylor’s and Maclaurin’s expansions.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>  
<https://nptel.ac.in/courses/111/104/111104144/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

#### Unit II

**Integral Calculus:** Introduction, Reduction formula, Reduction formula for  $\int \sin^n x \, dx$ ,  $\int \cos^n x \, dx$  and  $\int \sin^n x \cos^m x \, dx$ . Evaluation of double and triple integrals.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- <https://a.impartus.com/ilc/#/course/107625/1030>

#### Unit III

**Vector Algebra:** Scalar and vectors. Vector addition and subtraction. Multiplication of vectors (Dot and Cross products). Scalar and vector triple product-simple problems. Vector functions of a single variable. Derivative of a vector function, geometrical interpretation. Velocity and acceleration.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105134>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

#### Unit IV

**Vector Differentiation:** Scalar and vector fields, gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field,

irrotational vector. Laplace's operator. Vector identities connected with gradient, divergence and curl.

- Pedagogy/Course delivery tools: Chalk and Talk
- Links: <https://nptel.ac.in/courses/111/105/111105134>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

### Unit V

**First Order Differential Equations:** Solution of first order and first degree differential equations, variable separable methods, homogeneous equations, linear and Bernoulli's equations, exact differential equations.

- Pedagogy/Course delivery tools: Chalk and talk, Power Point Presentation
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/59742/295>

### Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10<sup>th</sup> Edition, 2015.

### Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998.
2. **B. V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

### Course Outcomes (COs):

At the end of the course the student will be able to

1. Solve problems related to nth derivative to some standard functions, polar curves and power series expansions.
2. Apply the concept of reduction formula to determine the length, area, volume of revolution of an arc of the curve.
3. Solve the problems related to velocity and acceleration.
4. Apply vector differentiation to identify solenoidal and irrotational vectors.
5. Apply the concept of various methods to solve first order first degree differential equations.

# **IV Semester**

## BIOSTATISTICS AND DESIGN OF EXPERIMENTS

<b>Course Code:</b> BT41	<b>Credits:</b> 2:1:0
<b>Pre – requisites:</b> Calculus & Probability	<b>Contact Hours:</b> 28L+14T
<b>Course Coordinator:</b> Dr. S.H.C.V. Subba Bhatta & Dr. A Sreevallabha Reddy	

### Unit I

**Statistics:** Curve fitting by the method of least squares, Fitting linear, quadratic and geometric curves. Correlation and Regression, multiple regression.

**Random Variables and Discrete Probability Distributions:** Random variables, Binomial distribution, Poisson distribution, Geometric distribution.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105035/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>

### Unit II

**Continuous Probability Distributions:** Exponential distribution, Uniform distribution, Normal distribution

**Joint Probability Distributions:** Joint and Marginal Probability Distributions of Discrete and Continuous Random Variables, Covariance and Correlation of Discrete and Continuous Random Variables.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105035/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>

### Unit III

**Stochastic Process:** Classification, Unique fixed probability vector, Regular stochastic matrix, Transition probability matrix, Markov chain.

**Genetic application of probability:** Genetic Applications of Probability, Hardy - Weinberg law, multiple alleles and application to blood groups

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>

### Unit IV

**Sampling and Statistical Inference:** Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level

of significance, One tailed and two tailed tests, Z-test: for single mean, for single proportion, for difference between means, Student's  $t$  –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit, for independence of attributes.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://nptel.ac.in/courses/111/107/111107119/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96151/1112>

### Unit V

**ANOVA and DOE:** Introduction to DOE, Fisher's principles, Analysis of variance (One way and Two-way classifications): Case studies of statistical designs of biological experiments (RCBD and RBD), Latin Squares, Single and double – blind experiments, Limitations of experiments, Optimization models in Biology and Medicine – Medical diagnosis problem, Hospital diet problem

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://www.youtube.com/watch?v=-rQjyUQcFo0>  
<https://www.youtube.com/watch?v=OXIpBKpOHxk>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96151/1112>

### Text Books:

1. Marcello Pagano and Kimberlee Gauvreau – Principles of Biostatistics – Thompson Learning – 2nd edition – 2007.
2. B. S. Grewal –Higher Engineering Mathematics – Khanna Publishers – 44<sup>th</sup> edition – 2017.
3. J. N. Kapur – Mathematical Models in Biology and Medicine- East-West Press Private Ltd. –New Delhi – 2010.

### Reference Books:

1. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 9<sup>th</sup> edition – 2012.
2. Warren J. Ewens, Gregory R. Grant – Statistical Methods in Bioinformatics: An Introduction – Springer Publications – 2<sup>nd</sup> edition – 2006.
3. Wayne W. Daniel – Biostatistics: A Foundation for Analysis in the Health sciences – John Wiley & Sons – 10<sup>th</sup> edition – 2014.

### Course Outcomes (COs):

At the end of the course the student will be able to

1. Fit a least squares curve to a given data, analyze the given discrete random data and its probability distribution. (PO – 1, 2 & PSO – 1, 3)
2. Find parameters of continuous probability distributions and calculate the marginal and conditional distributions of bivariate random variables. (PO-1, 2 & PSO – 1, 3)
3. Apply the concept of Markov Chain in the prediction of future events and the probable characteristics possessed by the off springs of the  $n^{\text{th}}$  generation. (PO – 1, 2 & PSO – 1, 3)
4. Choose an appropriate test of significance and make inference about the population from a sample. (PO – 1, 2 & PSO – 1, 3)
5. Use one way and two-way ANOVA to compare sample means. (PO – 1, 2 & PSO-1, 3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50</b>		
<b>Assessment Tool</b>	<b>Marks</b>	<b>Course outcomes addressed</b>
Internal test – I	30	CO1, CO2, CO3
Internal test – II	30	CO3, CO4, CO5
Average of the two internal tests will be taken for 30 marks.		
<b>Other components</b>		
Quiz	10	CO1, CO2, CO3
Assignment	10	CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>		
Course end examination (Answer any one question from each unit – Internal choice)	100	CO1, CO2, CO3, CO4, CO5

# BIOCHEMICAL THERMODYNAMICS AND HEAT TRANSFER

<b>Course Code:</b> BT42	<b>Credits:</b> 2:1:0
<b>Pre – requisites:</b> Bioprocess Principles and Calculations	<b>Contact Hours:</b> 28L+14P
<b>Course Coordinator:</b> Dr. Chandrababha M N & Dr. T P Krishna Murthy	

## Unit I

**Laws of Thermodynamics:** Introduction to thermodynamic systems and properties; reversible and irreversible processes; steady and equilibrium state; phase rule. First Law of Thermodynamics: General statement, concept of enthalpy; first law for cyclic process, non-flow process and flow process. Second law of thermodynamics: General statement, concept of entropy, the Carnot principle, calculation of entropy changes, Clausius inequality, entropy and irreversibility, third law of thermodynamics.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#/course/305470/1112>

## Unit II

**P-V-T behaviour:** P-V-T behaviour of pure fluids, equations of state and ideal gas law, processes involving ideal gas law: constant volume, constant pressure, constant temperature, adiabatic and polytropic processes. Equations of real gases, principles of corresponding states, compressibility charts.

**Thermodynamic Properties of Pure Fluids and solutions:** Thermodynamic energy properties: work function & Gibbs free energy, Clapeyron equation, Concept of Fugacity and activity.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#/course/305470/1112>

## Unit III

**Phase and Chemical Equilibria:** Criteria of phase Equilibria, Partial molar properties, Chemical potential, Gibbs-Duhem equation & its applications, Consistency test for VLE data, Criteria of biochemical reaction equilibrium, equilibrium constant and standard free energy change, effect of temperature on equilibrium constant, factors affecting equilibrium conversion.

**Biochemical Energetics:** Concept of pH and ionization of biochemicals, Ligand binding to substrate, Membrane transport (Gibbs Donnan equation), Energy coupling reactions (ATP and NADH), Energetics of metabolic pathways (Glucose metabolism, Photosynthesis).

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#/course/305470/1112>

## Unit IV

**Introduction to Heat Transfer:** Modes of heat transfer; Conduction – steady state heat conduction through unilayer and multilayer plane wall sphere, cylinder; Insulation – types, critical radius, Optimum thickness of insulation. Forced and Natural convection; Significance of Dimensionless numbers (Nu, Gr, Pr, Re, Pe numbers only); Heat transfer without phase change, heat transfer in laminar and turbulent flow inside closed conducts, concepts of film heat transfer coefficients.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#!/course/96152/452>

## Unit V

**Heat Transfer Equipment:** Equations and numerical problem for calculations of film heat transfer coefficients, Heat transfer with phase change - Condensation – film wise and drop wise; Boiling – types of boiling. Co current and counter current flow. Individual and overall Heat transfer coefficients, LMTD, Elementary design of double pipe heat exchanger and shell and tube heat exchanger.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links: <https://a.impartus.com/ilc/#!/course/96152/452>

## List of Experiments

1. Introduction to features and commands of software (Microsoft excel<sup>®</sup>/MATLAB<sup>®</sup>)
2. Solving Equations of States (EOS)
3. Fugacity estimation through numerical integration
4. Computation of bubble point and dew point
5. Consistency test for VLE data
6. Solving energetics & fluxes of metabolic Pathways
7. Simulation of for protein-ligand binding kinetics
8. Estimation of rate of heat transfer and overall heat transfer coefficient
9. Computation of fouling and pipe wall resistance
10. Calculation of heat transfer area
11. Design calculation for Shell and Tube Heat exchanger (STHE)
12. Design Calculations for double pipe heat exchanger (STHE)
13. Heat transfer calculations in Sterilization systems
14. Heat transfer calculations in bioreactors



### **Textbooks:**

1. Narayanan KV (2013) A Textbook of Chemical Engineering Thermodynamics, 2nd Edition, Prentice Hall Publication, India.
2. Ann Marie Flynn, Toshihiro Akashige, Louis Theodore (2019) Kern's Process Heat Transfer, 2<sup>nd</sup> Edition John Wiley & Sons, Inc.
3. David Nicholls L (2013) Bioenergetics, 4<sup>th</sup> Edition Academic Press, New York.

### **References:**

1. J. M. Smith, H. C. Van Ness, M. M. Abbott, M. T. Swihart, B. I. Bhatt (2018) Introduction to Chemical Engineering Thermodynamics, 8<sup>th</sup> Edition, McGraw Hill Publications, USA.
2. Stanley I. Sandler (2017) Chemical, Biochemical, and Engineering Thermodynamics, 5<sup>th</sup> Edition, John Wiley & Sons, USA.
3. Pauline M Doran (2013) Bioprocess Engineering Principles, 2<sup>nd</sup> Edition, Academic Press.
4. R. P. Chhabra V. Shankar (2018) Coulson and Richardson's Chemical Engineering Volume 1B: Heat and Mass Transfer: Fundamentals and Applications, 7<sup>th</sup> Edition, Butterworth-Heinemann.
5. David L. Nelson; Michael M. Cox (2021) Lehninger Principles of Biochemistry, 8<sup>th</sup> Edition, W. H. Freeman and Company

### **Web links and Video Lectures (e-Resources):**

1. <https://archive.nptel.ac.in/courses/102/106/102106082/>
2. <https://archive.nptel.ac.in/courses/102/106/102106026/>

### **Course Outcomes (COs):**

On completion of this course student will able to:

1. Explain the fundamental concepts of the laws of thermodynamics and apply the laws of thermodynamics to solve engineering problems. (PSO-1)
2. To evaluate thermodynamic properties of pure substances and to use various PVT equations-of-state and heat capacities to estimate the thermodynamic properties of pure fluids as well as fluid mixtures. (PSO-1)
3. Predict equilibrium compositions of mixtures under phase, predict feasibility and equilibrium constant of chemical reactions and explain the energetics of metabolic pathways. (PSO-1,3)
4. Apply the basic laws of heat transfer to analyze problems involving steady state heat conduction and convection. (PSO-1)
5. Estimate heat transfer coefficients and analyze the performance of various types of heat exchangers (PSO-1,3)

**Course Assessment and Evaluation:**

<b>Continuous Internal Evaluation: 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
Assignment	10	CO1, CO2, CO3, CO4, CO5
Quiz/Tutorial Test	10	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

# FUNDAMENTALS OF BIOCHEMICAL ENGINEERING

<b>Course Code:</b> BT43	<b>Credits:</b> 2:1:0
<b>Prerequisites:</b> Engineering Mathematics and Bioprocess Principles and Calculations	<b>Contact Hours:</b> 28L+14T
<b>Course Coordinator:</b> Dr. Samrat K and Mr. Gokulakrishnan M	

## Unit I

**Introduction to Fluid Flow:** Dimensional homogeneity, Dimensional analysis - Rayleigh method, Buckingham's pi theorem, Dimensionless numbers, Types of fluids – Newtonian and Non-Newtonian, laminar and Turbulent; Reynolds number; Rheological behavior of fluids, Fluid statics and its applications, Basic equations of fluid flow - Continuity equation and Bernoulli equation, Conceptual numerical.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://a.impartus.com/ilc/#/course/590891/1030>

## Unit II

**Flow of Incompressible Fluids:** Flow through circular and non-circular conduits - Hagen Poiseuille equation, Flow past immersed bodies – Kozney-Carmen equation, Burke Plummer equation, Conceptual numericals.

**Flow Measurements:** Flow measurements – Orifice meter, Venturimeter, Pumps - Centrifugal & Reciprocating pumps, Pipes, fittings and valves.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation
- Links: <https://a.impartus.com/ilc/#/course/590891/1030>

## Unit III

**Fluid flow and its applications:** Theory of mixing, role of mixing in bioprocess, Flow patterns in agitated tanks, mechanism of mixing, Power requirements for mixing, mixing equipments, Types of drag and Drag coefficient, Terminal settling velocity (settling regimes for spherical particles), Batch sedimentation theory (Kynch), Conceptual numericals.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://a.impartus.com/ilc/#/course/590891/1030>

## Unit IV

**Basics of mass transfer:** Diffusion, Role of Diffusion in Bioprocessing, Measurement of diffusivity, Liquid-Liquid, Gas-Liquid, and Liquid-Solid Mass transfer, Individual

and Overall Mass Transfer Coefficients, oxygen transfer in fermentation process, Drying: Drying rate, drying curve and drying equipments, Conceptual numericals.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://a.impartus.com/ilc/#/course/96152/452>

### Unit V

**Mass Transfer and its applications:** Distillation – methods of distillation, fractionation of binary mixtures -McCabe Thiele method, Azeotropic distillation, design equations and equipments for extraction, absorption, adsorption and evaporation, Conceptual numericals.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: <https://a.impartus.com/ilc/#/course/96152/452>

### Text Books:

1. McCabe W.L., Smith J.C. and Harriott P (2017) Unit operations in Chemical Engineering, 7<sup>th</sup> Edn., McGraw-Hill Publications, USA.
2. Treybal R.E. (2017) Mass Transfer Operations, 3<sup>rd</sup> Edition, McGraw-Hill Publications, USA.
3. Flynn A.M., Akashige T. and Theodore L (2019) Kern's Process heat transfer, 2<sup>nd</sup> Edn., Wiley publisher, USA

### Reference Books:

1. Pauline Doran (2012) Bioprocess Engineering Principles, 2<sup>nd</sup> Edition, Academic Press, USA.
2. Foust A.S., Wenzel L.A., Clump C.W., Maus L., and Anderson L.B. (2008) Principles of Unit Operations, 3<sup>rd</sup> Edn, John Wiley & Sons, USA.
3. R. P. Chhabra V. Shankar (2018) Coulson and Richardson's Chemical Engineering Volume 1B: Heat and Mass Transfer: Fundamentals and Applications, 7<sup>th</sup> Edition, Butterworth-Heinemann.

### Web links and Video Lectures (e-Resources):

1. <https://nptel.ac.in/courses/103106158>
2. <https://nptel.ac.in/courses/103104044>
3. <https://nptel.ac.in/courses/103103034>
4. <https://nptel.ac.in/courses/103104046>

### Course Outcomes (COs):

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

1. Predict the dimensional analysis and solution for fluid flow problems. (PO-1,2, 4; PSO-1)
2. Estimate the pressure drop and flow rate of fluids and design the pumps for transportation of fluids. (PO-1, 2, 3; PSO-3)
3. Analyse the forces involved in flow through solids and its operations (PO-2, 3; PSO-3)
4. Predict mass transfer rates and coefficients in bioprocess systems (PO-2, 3, 4; PSO-3)
5. Analyse the design parameters of various mass transfer operations (PO-2, 3, 4; PSO-3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1, CO2
Internal Test-II	30	CO3, CO4, CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
<b>Assignment</b>	10	CO1, CO2, CO3, CO4, CO5
<b>Numerical test/ Quiz</b>	10	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

# MOLECULAR BIOLOGY AND GENETIC ENGINEERING

<b>Course Code:</b> BT44	<b>Credits:</b> 3:0:0
<b>Pre – requisites:</b> Cell Biology and Genetics, Biochemistry, Microbiology	<b>Contact Hours:</b> 42L
<b>Course Coordinator:</b> Dr. Ravikumar Y. S. and Dr. Abhijith S. R.	

## Unit I Replication

Scope of molecular biology. Genomes- genetic material, gene structure and functions.: replication models, Replication in prokaryotes: DNA polymerases, replication Initiation, elongation, termination. Replication in Eukaryotes: ARS, DNA polymerases and their composition, replication initiation, Replication of telomeric DNA, Fidelity of replication. DNA Repair mechanisms: Direct reversal, Mismatch and excision repair, Chromosome repair.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for Mechanism of replication: <https://nptel.ac.in/courses/102108086>

## Unit II Transcription

Prokaryotic transcription: promotor, RNA polymerase, Initiation, elongation, termination. Eukaryotic transcription: types of RNA polymerases and promoters. General transcription factors, Initiation, elongation, termination, tRNAs: structural features, Prokaryotic and eukaryotic mRNAs, structural feature. **RNA Processing:** capping, polyadenylation. RNA editing, splicing: exons & introns, spliceosomes, Alternative splicing, trans splicing,

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for Mechanism of transcription: <https://nptel.ac.in/courses/102108086>

## Unit III Translation, regulation of gene expression

Mechanism of prokaryotic and eukaryotic translation: initiation, elongation and termination. Genetic code, Protein folding: molecular chaperon, Post translational modification:

Regulation of prokaryotic genes expression: Operons and their types, Regulation of lac and tryptophan operon. role of sigma factors in regulation of gene expression. Regulation of eukaryotic gene expression: Levels of gene regulation, DNA binding proteins. Chromatin remodeling. Histone modification. RNA mediated gene-expression regulation.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for Mechanism of gene expression regulation:  
<https://nptel.ac.in/courses/102108086>

## **Unit IV**

### **Introduction to recombinant technology**

Scope and applications of genetic engineering. Extraction and purification of DNA. Enzymes in Genetic Engineering– restriction endonucleases, polymerases, ligases, Modifying enzymes, phosphatases, Polynucleotide Kinase and kinases, RNase, DNase, linkers and adaptors. Vectors in recombinant DNA technology –Bacterial plasmids, cosmids, viruses and artificial chromosomes.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for DNA isolation and enzymes of rDNA technology:  
<https://nptel.ac.in/courses/102103074>
- <https://nptel.ac.in/courses/102103013>

## **Unit V**

### **Cloning strategies**

Construction of genomic DNA library: Generation of DNA fragmentation, Joining of DNA fragments, Delivery/Introduction of recombinant molecules into the selected host cells: Physical, Chemical and Biological methods. Screening of recombinants. Insertional inactivation, Blue-white screening, replica platin, Blotting techniques, DNA Sequencing and finger printing. Construction of cDNA library: cDNA Synthesis-mRNA enrichment, Reverse transcription, PCR, Joining of DNA fragments, Delivery and Screening.

- Pedagogy/Course delivery tools: Chalk and Talk, Power Point Presentation
- Links for cDNA and Genomic DNA library construction and screening:  
<https://nptel.ac.in/courses/102103074>  
<https://nptel.ac.in/courses/102103013>

### **Textbooks:**

1. Watson JD. - Molecular Biology of the Gene, Pearson Education, 2014.
2. Robert F. Weaver - Molecular Biology Edition, McGraw-Hill, 3<sup>rd</sup> 2003.
3. Brown T.A - Gene cloning and DNA analysis: an introduction, Wiley Blackwell 6th ed. 2010.

### **Reference book**

1. Maniatis T, Fritsch E.F. & Sambrook J. - Molecular Cloning: A Laboratory Manual. CSHL, 3<sup>rd</sup> edition, 2002.

2. Old W. & Primrose; Principles of Gene Manipulation. S.B. University Press, 6<sup>th</sup> edition, 2001.
3. Lewin B - Genes IX, Jones and Bartlett Publishers, 9<sup>th</sup> edition 2007.

### Course Outcomes (COs):

On completion of this course student will able to:

1. To acquire knowledge of DNA replication and differentiate various steps and mechanism involved in DNA replication and repair. (PO-1 and PO-4. PSO- 1 and PSO-2)
2. To compare and analyze mechanism of prokaryotic and eukaryotic transcription and RNA processing. (PO-1 PSO- 1 and PSO-2)
3. To describe mechanism of translation and various levels of gene expression regulation and compare the mechanism involved in regulation prokaryotic and eukaryotic gene expression. (PO 1 and PO-4 PSO- 1 and PSO-2)
4. To apply the properties of various enzymes and vectors in gene and genome manipulation. (PO- 1, PO-3, PO-4 PO- 5 PSO-1 and PSO-2)
5. Able to apply different techniques to construct and screen genomic and cDNA library. (PO- 3, PO-4 and PO-5 PSO-2 and PSO-3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1, and CO 2
Internal Test-II	30	CO 3, CO 4 and CO 5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
Quiz	10	CO 1, CO 2 and CO 3
Assignment	10	CO 4 and CO 5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5



# STRUCTURAL BIOLOGY & ANALYTICAL TECHNIQUES

<b>Course Code:</b> BT45	<b>Credits:</b> 2:1:0
<b>Pre – requisites:</b> Engineering Chemistry and Biochemistry	<b>Contact Hours:</b> 28L+14T
<b>Course Coordinator:</b> Dr. Ahalya N and Dr. Dhamodhar P	

## Unit I

### Structural Characteristics of Proteins

Introduction to primary structure of proteins, torsional/dihedral angles, properties of peptide bond. Secondary structures: helix, beta sheet, turns and loops. Ramachandran steric contour diagram. Tertiary, Quaternary structures of proteins-example of haemoglobin. Forces that stabilize protein structures. Protein folding- Levinthal's paradox, Anfinsen experiment, thermodynamic aspects of protein folding, molecular chaperons in protein folding.

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/104102009>  
<https://nptel.ac.in/courses/102107086>

## Unit II

### Structure of Nucleic acids and Biomembranes

Nucleic acid structures, geometries, glycosidic bond, phosphodiester linkage. stabilizing ordered forms of DNA (A, B and Z), base pairing types, base stacking, tertiary structure of DNA and preferred torsion angles. Ribose puckering and structure of tRNA. Structure & conformational properties of cell membranes. Membrane proteins conformational variations during ion transport. Structure and function of ATPase

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/104102009>  
<https://nptel.ac.in/courses/102107086>

## Unit III

### Spectroscopic Techniques

UV, visible, IR spectrophotometry theory and instrumentation, Spectrofluorimetry: Principles & Applications. NMR Spectroscopy: Principles, Instrumentation, Applications; Mass Spectrometry: Principles, Instrumentation, and applications. Photobleaching, Fluorescence Resonance Energy Transfer (FRET), Applications of

FRET. Polarized light, Linear & Circular Dichroism (CD), Applications of CD. X-ray diffraction method (XRD)

- Pedagogy/Course delivery tools: Chalk and Board and Power point presentations
- Links: <https://nptel.ac.in/courses/104102009>  
<https://a.impartus.com/ilc/#/course/169530/1112>

## Unit IV

### Purification of Biomolecules- Centrifugation and Chromatography

**Centrifugation:** Principles of centrifugation, different types of centrifuges and rotors, preparative, differential and density gradient centrifugation, analytical ultra-centrifugation, determination of molecular weights and other applications, subcellular fractionation

**Chromatography:** Modes of chromatography; Thin Layer Chromatography, Molecular Exclusion chromatography, Ion Exchange and Affinity chromatography, Gas liquid chromatography; High Pressure Liquid Chromatography (HPLC): Principles, Instrumentation, Application

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/102103044>  
<https://a.impartus.com/ilc/#/course/169530/1112>

## Unit V

### Electrophoresis

General principles, Support media, Electrophoresis of proteins – SDS PAGE, Native PAGE, Gradient gel electrophoresis, 2D gel electrophoresis, Isoelectric focusing, Electrophoresis of Nucleic acids- Agarose Gel Electrophoresis.

- Pedagogy/Course delivery tools: Chalk and Board; Video Based (Animation) and Power point presentations
- Links: <https://nptel.ac.in/courses/102103044>  
<https://a.impartus.com/ilc/#/course/169530/1112>

### Text Books:

1. Van Holde, Curtis Johnson, Shing Ho (2006), Principles of Physical Biochemistry, 2<sup>nd</sup> Edition, Pearson Prentice Hall.
2. Nelson DL and Cox MM (2013) Leninger Principles of Biochemistry, 6<sup>th</sup> edition, W.H. Freeman.
3. Keith Wilson, John Walker (2010) Principles and Techniques of Biochemistry and Molecular Biology, Cambridge University Press, USA

## Reference Books:

1. Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath (2009) Biophysical Chemistry, Himalaya Publishing House, India
2. Narayanan P (2000), Essentials of Biophysics, New Age International Publishers.
3. Bengt Nölting (2006) Methods in Modern Biophysics. 2nd edn., Springer Berlin Heidelberg New York

## Web links and Video Lectures (e-Resources):

- <https://a.impartus.com/ilc/#/course/169530/1112>
- <https://nptel.ac.in/courses/104102009>
- <https://nptel.ac.in/courses/102103044>
- <https://nptel.ac.in/courses/102107086>

## Course Outcomes (COs):

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

1. Correlate the relationship between primary structure and higher order structures of proteins.
2. Analyze the nucleic acid and biomembrane structures.
3. Compare the working principle of various biophysical/spectroscopic techniques and apply them to characterize macromolecules.
4. Separate and purify biological samples using chromatographic and centrifugation techniques.
5. Describe the techniques of electrophoresis.

## Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Internal Test-I	30	CO1 CO2, C03
Internal Test-II	30	CO3 CO4 CO5
Average of the two internal tests shall be taken for 30 marks.		
<b>Other Components</b>		
<b>Assignment</b>	10	CO1CO2 CO3
<b>Quiz</b>	10	CO4, CO5
<b>Semester End Examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

## BIOCHEMICAL ENGINEERING LAB

<b>Course Code:</b> BTL46	<b>Credits:</b> 0:0:1
<b>Pre – requisites:</b> Bioprocess Principles and Calculations	<b>Contact Hours:</b> 14P
<b>Course Coordinator:</b> Dr. Samrat K and Mr. Gokulakrishnan M	

### List of Experiments

1. Friction in circular pipes/ non-circular pipes/ helical or spiral Coils
2. Flow rate measurement using orifice meter and Venturi meter
3. Determination of minimum thickener area using batch sedimentation tests
4. Separation of biomass from fermentation broth using leaf filter/ plate and frame filtration/ Rotary vacuum filtration.
5. Rheological properties and mixing characteristics of fermentation broth
6. Solid liquid extraction of phytochemicals from medicinal plants
7. Liquid-liquid extraction biomolecules from bioprocess fluids
8. Simple or packed bed distillation of ethanol from fermentation broth
9. Steam/ hydro-distillation of essential oils from plant source
10. Adsorption of biomolecules/pollutants onto activated carbon
11. Diffusion of organic vapors in air/ diffusion of oxygen in the water
12. Determination of heat transfer coefficient in vertical/horizontal shell and tube heat exchanger (Condenser)
13. Determination of heat transfer coefficient in double pipe heat exchanger
14. Determination of critical radius of insulation

Students are required to perform 12 prescribed experiments from the above list of experiments.

### Reference Books:

1. McCabe W.L., Smith J.C. and Harriott P(2017) Unit operations in Chemical Engineering, 7<sup>th</sup> Edn., McGraw-Hill Publications, USA.
2. Treybal R.E. (2017) Mass Transfer Operations, 3rd Edition, McGraw-Hill Publications, USA.
3. Pauline Doran (2012) Bioprocess Engineering Principles, 2nd Edition, Academic Press, USA.

### Web links and Video Lectures (e-Resources):

1. <http://uorepc-nitk.vlabs.ac.in/List%20of%20experiments.html>
2. <http://vmt-iitg.vlabs.ac.in/>
3. <http://ceitb.vlabs.ac.in/List%20of%20experiments.html?domain=Chemical%20Engineering>

### Course Outcomes (COs):

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

1. Estimate the pressure drop, friction factor and flow rate through circular conduits (PO-1, 2; PSO-1).
2. Analyze the mixing characteristics and predict the thickener area (PO-1, 2, 4; PSO-3).
3. Conduct experiments on enrichment and purification operations to enhance the product output and analyze & interpret the data (PO-2, 3, 5; PSO3).
4. Determine the mass transfer coefficient of mass transfer operations and the efficiency (PO-2, 3, 4; PSO-3).
5. Predict the individual and overall heat transfer coefficients of condenser and heat exchangers (PO-2, 3, 4; PSO-3).

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	50	CO1, CO2, CO3, CO4, CO5

## MOLECULAR BIOLOGY & GENETIC ENGINEERING LAB

<b>Course Code:</b> BTL47	<b>Credits:</b> 0:0:1
<b>Pre – requisites:</b> Cell Biology and Genetics Lab	<b>Contact Hours:</b> 14P
<b>Course Coordinator:</b> Dr. Bindu S and Dr. Bhavya S G	

### List of Experiments

1. Isolation of plasmid DNA from *E. coli*
2. DNA ligation
3. Restriction mapping (Single/Double digestion) - pattern analysis
4. Amplification of specific DNA fragment by Polymerase Chain Reaction (PCR)
5. Agarose gel electrophoresis of DNA
6. DNA Fingerprinting by RAPD/RFLP technique
7. Isolation and estimation of total RNA- Spectrophotometry
8. Preparation of cDNA
9. Amplification of cDNA using Reverse Transcription Polymerase Chain Reaction (RT-PCR)
10. Multiplex Polymerase Chain Reaction
11. Preparation of Competent Cells of *E. coli* By Calcium Chloride Method
12. Transformation of *E. coli* cells By Heat shock Method and Blue White Screening
13. Southern Blotting
14. Amplification and quantification of DNA using qPCR

### Reference Books:

1. T. A. Brown, (2020) Gene Cloning and DNA analysis: An introduction. 8<sup>th</sup> edition, Wiley publishers. UK
2. Sandy B. Primrose & Richard Twyman, (2016) Principles of Gene Manipulation and Genomics, 8<sup>th</sup> edition, Wiley-Blackwell Publishers.
3. Michael R. Green and Joseph Sambrook (2012) Molecular cloning: a laboratory manual. 4<sup>th</sup> edition Volumes I -III. Cold Spring Harbor Laboratory Press, New York, USA.
4. Jordanka Zlatanova, Kensal van Holde, (2015) Molecular Biology, 1<sup>st</sup> edition, Taylor & Francis group, New York.

### Web links and Video Lectures (e-Resources):

1. <https://vlab.amrita.edu/?sub=3&brch=186&sim=319&cnt=1>
2. <https://www.khanacademy.org/science/biology/biotech-dna-technology>

### Course Outcomes (COs):

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

1. Choose appropriate method to isolate & quantify DNA. (PO-1, 4; PSO-1)
2. Amplify DNA/gene(s) using PCR & RT-PCR. (PO-1, 2, 4; PSO-2)
3. Compare, analyse and interpret the agarose gel electrophoresis results (PO-3, 4; PSO-2)
4. Perform gene transformation using the appropriate method. (PO-3, 4, 5; PSO-3)
5. Identify the transformed cells by appropriate screening technique (PO- 4, 5; PSO-3)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Weekly evaluation of laboratory manuals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	50	CO1, CO2, CO3, CO4, CO5

## BIOANALYTICAL TECHNIQUES LAB

<b>Course Code:</b> BTL48	<b>Credits:</b> 0:0:1
<b>Pre – requisites:</b> Engineering Chemistry Laboratory	<b>Contact Hours:</b> 14P
<b>Course Coordinator:</b> Dr. Divyashri G & Dr. Ahalya N	

### List of Experiments

1. Preparation of solutions/reagents and calibration of equipment
2. Spectrophotometric analysis of biomolecules (Proteins/Enzymes/Polyphenols)
3. Determination of Na, Ca, K in a given water sample using Flame Photometry
4. Fluoride estimation by Ion-selective electrode
5. Determination of iso-electric point (PI) of amino acids by Capillary Isoelectric Focusing
6. Fractionation of crude biomolecules (polyphenols) from plant materials
7. HPLC analysis of amino acids/polyphenols/drugs
8. Density gradient centrifugation of plant materials
9. Estimation of polyphenols using a microplate reader
10. Culture staining technique and analysis in a fluorescent microscope
11. Qualitative analysis of bioactive compounds in a given sample using Thin Layer Chromatography
12. Ion Exchange/gel permeation chromatography for separation of plant materials
13. Analysis of functional groups in a biopolymer using FT-IR technique (Demo)
14. Dissolution testing using Tablet Dissolution Apparatus (Demo)

*Any 12 experiments must be performed.*

### Reference Books:

1. Wilson, K., Hofmann, A., Walker, J. M., & Clokie, S. (Eds.). (2018). Wilson and Walker's principles and techniques of biochemistry and molecular biology. Cambridge University Press.
2. Jayaram, J. (2005). Laboratory manual in Biochemistry. New age international (P) ltd, 24, 75-78.
3. Boyer, R. (2000). Modern experimental biochemistry. Pearson Education India.
4. Skoog, D. A., West, D. M., Holler, F. J., & Crouch, S. R. (2013). Fundamentals of analytical chemistry. Cengage learning.
5. Olivieri, A. C., Escandar, G. M., Goicoechea, H. C., & de la Peña, A. M. (2015). Fundamentals and analytical applications of multiway calibration. Elsevier.



- Pearson, D. (1981). General methods in chemical analysis of foods pp: 11. Edinburgh/London/New York: Churchill Livingstone.

### Web links and Video Lectures (e-Resources):

- <https://www.youtube.com/watch?v=9jpp4U5j0cA> (NPTEL Video lecture on UV VIS Spectroscopy)
- <https://www.youtube.com/watch?v=kAiNq2HtBg8> (NPTEL Video lecture on HPLC)
- <https://www.youtube.com/watch?v=4j5cMHVPStc> (NPTEL Video lecture on FT-IR)
- <https://www.youtube.com/watch?v=XfPrkIL6ZDQ> (Video lecture on capillary electrophoresis)
- <https://www.youtube.com/watch?v=Z5aCuGxUPpI> (NPTEL Video lecture on XRD)

### Course Outcomes (COs):

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

- Compare the working principles of different bioanalytical techniques and apply them to quantify biomolecules. (PO1, PO2, PO4, PSO1, PSO2)
- Compare, analyze and interpret basic and advanced laboratory equipment used in the field of bioanalytical technology. (PO1, PO2, PO4, PSO1, PSO2)
- Quantify concentration of compounds using appropriate bioanalytical technique (PO1, PO2, PO4, PSO1, PSO2)
- Develop methods for isolation, separation, identification, and quantification of biomolecules (PO1-2, PO4, PSO1)
- Interpret of HPLC, FT-IR and XRD results (PO1, PO2, PO4, PSO1, PSO2)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 Marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcomes attained</b>
Weekly evaluation of laboratory manuals/ reports after the conduction of every experiment.	30	CO1, CO2, CO3, CO4, CO5
Practical test	20	CO1, CO2, CO3, CO4, CO5
<b>Semester End Examination (SEE)</b>	50	CO1, CO2, CO3, CO4, CO5

## KANNADA KALI

**Course Code:** HS491K

**Credits:** 1:0:0

**Pre – requisites:** Nil

**Contact Hours:** 14L

**Course Coordinator:** Mrs. KanyaKumari S

### Unit I

#### (Parichaya) - Introduction

Kannada Bhashe - About Kannada Language, Eight Kannada Authors – JnanpiTh Awardies

Introduction to Kannada Language, Karnataka State and Literature.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### Unit II

#### naamapadagaLu – Sarva namapadagaLu – (Nouns -Pronouns) and it's usage in Kannada

Kannada namavisheshanagaLu - (Adjectives-Interrogatives)

kriyapadagaLu, kriya visheshaNagaLu- (verb-adverb)

Sambhashaneyalli Prashnarthaka padagalu –vaakyagaLu mattu kriyapadagaLu-visheshaNagaLu (Kannada- Interrogative words & Sentences and verb-adverb in Conversation)

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### Unit III

#### Samanya Sambhashaneyalli Kannadada Padagalu mattu Vaakyagalu

(Kannada Words and Sentences in General Conversation with activities)

sambhashaNe: (Conversation with Friends- Teachers, between Friends)

(Conversation in Shop, Hostel, Market, Bus and Train)

Shabdakosha: Vocabulary – chaTuvaTike: Exercises

Vicharaneya / Bedikeya vakyagalu(Enquiry /Request sentences in Conversation)

Sambhashane Conversation with House Owner and Room mate

Shabdakosha – Vocabulary - Exercises to test their knowledge of understanding the Language.

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

## Unit IV

### **Kannada padagaLu (eakavachana,bahuvachanagaLu,virudda padagaLu dina nityadalli baLasuva padagaLu mattu sankya vyavaste**

Sambhashaneyalli Eakavachana mattu Bhahuvachana- (Singular and Plural nouns)

Conversation- Sambhashaneyalli Linga rupagaLu- Genders in Conversation

Viruddha padagalalu /Virodathaka padagalalu (Antonyms) Asamanjasa Uchcharane (Inappropriate Pronunciation)

Sankhya Vyavasthe(Numbers system) -Samaya /Kalakke Sambhandhisida padhagalalu (Words Relating to time) – Dikkugalige sambhadhisida padhagalalu (Words Relating to Directions)

Aaharakke sambandhisida padagaLu(Names connected with food)

Manavana shareerada bhagalalu / Angagalalu (Parts of the Human body) Manava Sambhandhada da padhagalalu (Terms Relating to Human Relationship)

Manavana Bhavanegalige sambandhisida Padagalalu (Words Relating to Human's feelings and Emotions)

Vaasada staLakke sambhandhisidanthaha padhagalalu (Words Relating to place of leaving)

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

## Unit V

### **Kannada akshara maale (Kannada alphabets and their practices with pronunciations)**

swara aksharagaLu –vyanjanaksharagaLu- gunitaksharagaLu, tantragnana mattu AaDalita padagaLu-Technical and administrative worlds in Kannada

- Pedagogy/Course delivery tools: Chalk and Talk, power point presentation

### **Text Book:**

1. Dr. L. Thimmesha, Prof. Keshava muurthy, 'BaLake kannada' prasarangaa, VTU,2020.

### **Reference Book:**

1. Smt. KanyaKumari.S – 'Kannada Kali' Kinnari publications' First edition, Bengaluru,2022
2. Lingadevaru Halemane – 'Kannada Kali', Prasaranga kannada University Hampi, 6<sup>rd</sup> Edition. 2019

### Course outcomes (COs):

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

1. Develop vocabulary (PO-10)
2. Identify the basic Kannada language skill (PO-10)
3. Develop listening & speaking skill in Kannada language. (PO-6, PO-12)
4. Enrich language skill. (PO-12)
5. Apply Kannada language skill for various purpose (PO-12)

### Course Assessment and Evaluation:

<b>Continuous Internal Evaluation (CIE): 50 marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcome attained</b>
Internal test-1	30	CO1, CO2, CO3
Internal test-II	30	CO4, CO5
Average of the Two Internal Test Two will be Taken for 30 Marks		
<b>Other components</b>		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
<b>Semester end examination (SEE)</b>	100	CO1, CO2, CO3, CO4, CO5

<b>ಕನ್ನಡ ಮನಸು</b>	
<b>Course Code:</b> HS491M	<b>Credits:</b> 1:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 14L
<b>Program:</b> B.E(Common to all the Branches)	<b>Semester:</b> IV
<b>Course Coordinator:</b> Mrs. KanyaKumari.S	

### **ಘಟಕ – 1 (Unit I)**

#### **ಲೇಖನಗಳು (Articles)– ಕಾವ್ಯಭಾಗ (poetry)**

ಕನ್ನಡ ಭಾಷೆ ನಾಡು - ನುಡಿ

ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ

ಆಡಳಿತ ಭಾಷೆಯಾಗಿ ಕನ್ನಡ

ವಚನಗಳು-ಅಕ್ಕಮಹಾದೇವಿ-ಬಸವಣ್ಣ-ಅಲ್ಲಮಪ್ರಭು

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

### **ಘಟಕ – 2 (Unit II)**

#### **ಕೀರ್ತನೆ ಮತ್ತು ತತ್ವ ಪದಗಳು**

ಪುರಂದರ ದಾಸರು ಮತ್ತು ಕನಕದಾಸರ ಪದಗಳು

ಶಿಶುನಾಳ ಶರೀಫರು ಮಹಾಂತ ಶಿವಯೋಗಿಗಳ ಪದಗಳು

ಜನಪದ ಗೀತೆ

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

### **ಘಟಕ – 3 (Unit III)**

#### **ಆಧುನಿಕ ಕಾವ್ಯಗಳು**

ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ

ಕುರುಡು ಕಾಂಚಾಣ

ಚೋಮನ ಮಕ್ಕಳ ಹಾಡು

Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

### **ಘಟಕ –4 (Unit IV)**

#### **ತಾಂತ್ರಿಕ ಧುರೀಣರು( ವ್ಯಕ್ತಿ ಪರಿಚಯ) ಕಥೆ-ಪ್ರವಾಸ ಕಥನ**

ಡಾ.ಸರ್.ಎಂ.ವಿಶ್ವೇಶ್ವರಯ್ಯ- ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ - ಎ,ಎನ್.ಮೂರ್ತಿರಾಯರು

ಯುಗಾದಿ -ವಸುಧೇಂದ್ರ

ಮೆಗಾನ್ ಎಂಬ ಗಿರಿಜನ ಪರ್ವತ -ಹಿ.ಚಿ.ಬೋರಲಿಂಗಯ್ಯ

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

### ಘಟಕ- ೫ (Unit V)

ಕರಕುಶಲ ಕಲೆಗಳು –ತಾಂತ್ರಿಕ ವಿಜ್ಞಾನ (technical science)

ಕರಕುಶಲ ಕಲೆಗಳು –ಮತ್ತು ಪರಂಪರೆ ವಿಜ್ಞಾನ- ಕರಿಗೌಡ ಬೇಚನ ಹಳ್ಳಿ  
ಕಂಫ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿ ತಂತ್ರಜ್ಞಾನ-

ಕ'ಮತ್ತು ಬ ಬರಹ ತಂತ್ರಾಂಶಗಳು ಮತ್ತು .ಕಂಫ್ಯೂಟರ್ ಮುಖಾಂತರ ಕನ್ನಡ ಟೈಪಿಂಗ್  
ತಾಂತ್ರಿಕ ಪದಕೋಶ' ತಾಂತ್ರಿಕ ಹಾಗೂ ಪಾರಿಭಾಷಿಕ ಕನ್ನಡ ಪದಗಳು

- Pedagogy/Course delivery tools: Ch Chalk and Talk, power point presentation

### ಪಠ್ಯ ಪುಸ್ತಕ (text book):

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ'

ಸಂಪಾದಕರು : ಡಾ.ಹಿ,ಚಿ, ಬೋರಲಿಂಗಯ್ಯ -ವಿಶ್ರಾಂತ ಕುಲಪತಿಗಳು, ಕನ್ನಡ  
ವಿಶ್ವವಿದ್ಯಾಲಯ ,ಹಂಪಿ,ಪ್ರಸಾರಂಗ ವಿಶ್ವೇಶ್ವರಯ್ಯತಾಂತ್ರಿಕ ವಿಶ್ವವಿದ್ಯಾಲಯ,ಬೆಳಗಾವಿ,ಪ್ರಥಮ  
ಮುದ್ರಣ-2020

### ಪೂರಕ ಪಠ್ಯ (reference book)

ಕನ್ನಡ ಮನಸು, ಪ್ರಸಾರಂಗ - ಕನ್ನಡ ವಿಶ್ವವಿದ್ಯಾಲಯ-ಹಂಪಿ, ಆರನೇಮುದ್ರಣ 2016

### ಕನ್ನಡ ಕಲಿಕೆಯ ಉದ್ದೇಶಗಳು:

- ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡದ ಜೊತೆಗೆ ಕ್ರಿಯಾತ್ಮಕ ಸಾಹಿತ್ಯ ಮತ್ತು ಸಂಸ್ಕೃತಿ ಮತ್ತು ನಾಡು-ನುಡಿಯ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು (PO-6)
- ಕನ್ನಡ ಭಾಷೆಯ ವ್ಯಾಕರಣ, ಭಾಷಾರಚನೆ ಯ ನಿಯಮಗಳನ್ನು ಪರಿಚಯಿಸುವುದು(PO-10)
- ಕನ್ನಡ ಭಾಷಾಬರಹದಲ್ಲಿ ಕಂಡು ಬರುವ ದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ(PO10)
- ಸಾಮಾನ್ಯ ಅರ್ಜಿಗಳು, ಸರ್ಕಾರಿ ಹಾಗೂ ಸರ್ಕಾರಿ ಪತ್ರವ್ಯವಹಾರದ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು(PO-12)
- ಭಾಷಾಂತರ ಮತ್ತು ಪ್ರಬಂಧ ರಚನೆ ಬಗ್ಗೆ ಅರಿವು ಮೂಡಿಸುವುದು ಕನ್ನಡ ಭಾಷಾಭ್ಯಾಸ, ಸಾಮಾನ್ಯ ಕನ್ನಡ ಹಾಗೂ ಆಡಳಿತ ಕನ್ನಡದ ಪದಗಳ ಪರಿಚಯ ಮಾಡಿಕೊಡುವುದು. (PO-12)

**Course Assessment and Evaluation:**

<b>Continuous Internal Evaluation (CIE): 50 marks</b>		
<b>Assessment tool</b>	<b>Marks</b>	<b>Course outcome attained</b>
Internal test-I	30	CO1, CO2, CO3
Internal test-II	30	CO4, CO5
Average of the Two Internal Test Two will be Taken for 30 Marks		
<b>Other components</b>		
Assignment	10	CO1, CO2
quiz	10	CO3, CO4, CO5
Semester end examination (SEE)	100	CO1, CO2, CO3, CO4, CO5

## ABILITY ENHANCEMENT COURSE - IV

<b>Course Code:</b> AEC410	<b>Credits:</b> 1:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 14L
<b>Course Coordinator:</b> Dr. Rama Shivakiran Reddy	

Ability Enhancement Courses (AEC) are the generic skill courses that are basic and needed by all to pursue any career. These courses are designed to help students enhance their skills in communication, language, and personality development. They also promote a deeper understanding of subjects like social sciences and ethics, culture and human behavior, human rights, and the law.

Every student shall register for the AEC course under the supervision of his/her proctor. For III, IV & V semesters, the student shall select the Ability Enhancement Course online such that the selected course does not overlap with any professional core/ elective course offered by the parent department of the student. After selection, the registration of the course has to be done by the student at his/her parent department.



## ADDITIONAL MATHEMATICS - II

<b>Course Code:</b> AM41	<b>Credits:</b> 0:0:0
<b>Pre – requisites:</b> Nil	<b>Contact Hours:</b> 42
<b>Course Coordinator:</b> Dr. Veena B N	

### Unit I

**Differential Calculus- I:** Partial differentiation, Euler’s theorem, total differential coefficient, differentiation of composite and implicit functions.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software’s to demonstrate methods and solve problems on interpolation
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>

### Unit II

**Differential Calculus- II:** Jacobian and Properties. Taylor’s theorem for function of two variables, maxima and minima for functions of two variables.

- Pedagogy/Course delivery tools: Chalk and talk
- Online tools: Use of open source software’s to demonstrate methods and solve problems on numerical differentiation and integration.
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/107625/1030>  
<https://a.impartus.com/ilc/#/course/59742/295>

### Unit III

**Vector Integration:** Line integrals, surface integrals and volume integrals. Green’s theorem, Stokes’ and Gauss divergence theorem (without proof) and problems, orthogonal curvilinear coordinates.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105134/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/619570/1030>

### Unit IV

**Higher Order Differential Equations:** Higher order linear differential equations, method of variation of parameters, Cauchy’s and Legendre’s homogeneous differential equations.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/105/111105121/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/96127/452>  
<https://a.impartus.com/ilc/#/course/59742/295>

### Unit V

**Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability- illustrative examples. Bayes theorem – examples.

- Pedagogy/Course delivery tools: Chalk and talk
- Links: <https://nptel.ac.in/courses/111/107/111107119/>  
<https://nptel.ac.in/courses/111/107/111107119/>
- Impartus recording: <https://a.impartus.com/ilc/#/course/283623/703>

#### Text Books:

1. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44<sup>th</sup> edition, 2017.
2. **Erwin Kreyszig** – Advanced Engineering Mathematics – Wiley Publication, 10<sup>th</sup> Edition, 2015.

#### Reference Books:

1. **H. K. Dass** – Higher Engineering Mathematics – S Chand Publications, 1998
2. **B. V. Ramana** – Engineering Mathematics – Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008.

#### Course Outcomes (COs):

At the end of the course, the student will be able to

1. To carry out the differentiation of function of several variables.
2. Solve the problems related to Jacobians, the extreme values of a function, and the Taylors series.
3. Exhibit the interdependence of line, surface, and volume integrals using integral theorems.
4. Find the solution of second and higher-order ODEs with constant and variable coefficients.
5. Solve the problems on conditional probability and Baye’s theorem.