VINAYAKA MISSION'S RESEARCH FOUNDATION
(Deemed to be University under section 3 of the UGC Act 1956)

Faculty of Engineering and Technology

REGULATIONS 2021

DEPARTMENT OF BIOTECHNOLOGY

Programme:

M.Tech. BIOTECHNOLOGY

REGULAR (2 Years)

CHOICE BASED CREDIT SYSTEM (CBCS)

CURRICULUM AND SYLLABUS

(Semester I to IV)

PROGRAMME OUTCOMES

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of problems in the area of Biotechnology.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex biotechnology- oriented problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex bio-based 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
PO4	**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. .
PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations in the area of biotechnology.
PO6	**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 practice.
PO7	**Environment and sustainability**: Understand the impact of the professional biotechnological solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the technology practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the technology audience 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.
PO11	**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.
PO12	**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.

PROGRAMME SPECIFIC OUTCOMES (PSO)

Upon successful completion of the course the students are expected:

PSO1	To endow with methods and tools for producing industrially important metabolites and products for sociologically useful and commercially viable for the long term.
PSO2	To develop expertise towards the effects on human health and the environment, offering expert mitigation strategies that are appropriate, and putting biotechnological tools to use.
PSO3	To assess the human health and environmental issues and provide relevant professional mitigation measures and implementation of biotechnological tools.
PSO4	To perform as a multidisciplinary team, comprehend professional obligations and ethics, and be prepared to confront societal challenges.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

PEO1	To inculcate the graduates to have strong foundation in Scientific fundamentals required to solve biopharmaceutical related problems
PEO2	To educate students with excellent scientific and industrial knowledge which will enable them to know, examine, design and create novel solutions and products for the health related ailments
PEO3	To inculcate students in professional ethics, scientific communication skills, teamwork skills, multidisciplinary approach, and an ability to address health related problems to broader social context.
PEO4	To develop skills in emerging areas of pharmaceutical technology and to encourage the students for interdisciplinary projects

Mapping of PEOs with POs for M. Tech. – Biotechnology (FT) Programme

PEO\PO	1	2	3	4	5	6	7	8	9	10	11	12
1	S	M	M	M	S	S	S	L	M	M	S	M
2	S	M	S	S	S	S	S	S	M	M	S	S
3	M	M	M	S	M	M	L	S	M	S	S	M
4	M	S	S	M	M	M	L	M	S	L	M	L

S- Strong Correlation, M – Medium Correlation, L – Low Correlation

VINAYAKA MISSIONS RESEARCH FOUNDATIONS
FACULTY OF ENGINEERING AND TECHNOLOGY

Credit Structure for Post Graduate Engineering Program (M.E / M.Tech –Regular-FT) -2021

S.No	Category of courses (credits)	Type of courses	Suggested break up of credits
1.	**A. Foundation courses (5)**	Mathematics/Applied Mathematics	3
		Research Methodology and IPR	2
2.	**B. Program core courses (32)**	Core courses	32
3.	**C. Elective courses (18)**	Program electives	15
		Open electives (Courses on emerging areas.)	3
4.	**D. Employability Enhancement Courses and courses for presentation of Technical skills related to the specialization (20)**	Project work phase I	6
		Project work phase II	12
		Technical Seminar*	1*
		Research Presentation Skills*	1*
		Internship*	1*
5.	**E. Mandatory Courses/Audit courses**	**Any two courses on:** 1. English for Research Paper Writing 2. Disaster Mitigation and Management 3. Value Education 4. Constitution of India 5. Pedagogy Studies 6. Personality Development Through Life Enlighten Skills	**Zero credit**
Total credits to be earned for the award of M.E /M.Tech degree			**75**

Note*: In category D, out of 20 credits minimum Two credits should be earned among anyof the following courses – Technical seminar*, Research Presentation Skills*, Internship*

CURRICULUM

M.TECH.BIOTECHNOLOGY

SEMESTER I TO IV

A. FOUNDATION COURSES - CREDITS (5)									
S. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1		APPLIED MATHEMATICS FOR BIOENGINEERING	MATH	FC-BS	3	0	0	3	NIL
2		RESEARCH METHODOLOGY AND IPR	BTE	FC-HS	2	0	0	2	NIL

B. PROGRAM CORE COURSES									
CORE COURSES CREDITS (32)									
SL. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1		ADVANCED BIOCHEMISTRY	BTE	CC	3	0	0	3	NIL
2		MICROBIAL TECHNOLOGY	BTE	CC	3	0	0	3	NIL
3		PRINCIPLES OF CHEMICAL ENGINEERING	BTE	CC	4	0	0	4	NIL
4		GENETIC ENGINEERING	BTE	CC	3	0	0	3	NIL
5		IMMUNO TECHNOLOGY	BTE	CC	3	0	0	3	NIL
6		STEM CELL BIOLOGY	BTE	CC	3	0	0	3	NIL
7		ADVANCED BIOPROCESS ENGINEERING	BTE	CC	3	0	0	3	NIL
8		PROTEIN ENGINEERING	BTE	CC	3	0	0	3	NIL
9		PLANT AND ANIMAL DISEASE AND THEIR CONTROL	BTE	CC	3	0	0	3	NIL
10		CANCER BIOLOGY	BTE	CC	3	0	0	3	NIL
11		GOOD MANUFACTURING AND LABORATORY PRACTICE	BTE	CC	3	0	0	3	NIL
12		BIOFUEL TECHNOLOGY	BTE	CC	3	0	0	3	NIL
13		FOOD AND NUTRITION	BTE	CC	3	0	0	3	NIL

		TECHNOLOGY							
14		ADVANCED BIOCHEMISTRY LAB	BTE	CC	0	0	4	2	NIL
15		MICROBIOLOGY LAB	BTE	CC	0	0	4	2	NIL
16		GENETIC ENGINEERING LAB	BTE	CC	0	0	4	2	NIL
17		IMMUNO TECHNOLOGY LAB	BTE	CC	0	0	4	2	NIL
18		ADVANCED BIOPROCESS LAB	BTE	CC	0	0	4	2	NIL

PROGRAM ELECTIVES -CREDITS (15)

S. NO	CODE	COURSE	OFFERING DEPT.	CATEGORY	L	T	P	C	PREREQUISITE
1		MOELCULAR DIAGNOSTICS AND THERAPEUTICS	BTE	EC-PS	3	0	0	3	NIL
2		AGRICULTURE BIOTECHNOLOGY	BTE	EC-PS	3	0	0	3	NIL
3		MOLECULAR MODELING AND DRUG DESIGN	BTE	EC-PS	3	0	0	3	NIL
4		BIOPHYSICS	BTE	EC-PS	3	0	0	3	NIL
5		GENOMICS AND PROTEOMICS	BTE	EC-PS	3	0	0	3	NIL
6		GREEN BIOTECHNOLOGY AND POLLUTION ABETMENT	BTE	EC-PS	3	0	0	3	NIL
7		BIOPHARMACEUTICAL TECHNOLOGY	BTE	EC-PS	3	0	0	3	NIL
8		METABOLIC ENGINEERING	BTE	EC-PS	3	0	0	3	NIL

9		MARINE AND AQUACULTURE BIOTECHNOLOGY	BTE	EC-PS	3	0	0	3	\ NIL
10		PLANT AND ANIMAL TISSUE CULTURE	BTE	EC-PS	3	0	0	3	NIL
11		FOOD SCIENCE AND TECHNOLOGY	BTE	EC-PS	3	0	0	3	NIL
OPEN ELECTIVES (COURSES ON EMERGING AREAS...) CREDITS -(3)									
S. NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**		**PREREQUISITE**
1		SUSTAINABLE BUILT ENVIRONMENT	CIVIL	OE-EA	3	0	0	3	NIL
2.		ADVANCED CYBER SECURITY	CSE	OE-EA	3	0	0	3	NIL
3		SOLAR AND ENERGY STORAGE SYSTEM	EEE	OE-EA	3	0	0	3	NIL
4		METAL ADDITIVE MANUFACTURING	MECH	OE-EA	3	0	0	3	NIL
5		BIO MEMS	ECE	OE-EA	3	0	0	3	NIL
6		BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	**BME**	OE-EA	3	0	0	3	NIL

D. EMPLOYABILITY ENHANCEMENT COURSES AND COURSES FOR PRESENTATION OF TECHNICAL SKILLS RELATED TO THE SPECIALIZATION									
S.NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		PROJECT WORK PHASE I	BTE	EE-P	0	0	12	6	NIL
2.		PROJECT WORK PHASE II	BTE	EE-P	0	0	24	12	NIL
3.		INTERNSHIP	BTE	PI-I	0	0	0	1	NIL
4.		TECHNICAL SEMINAR	BTE	EE-S	0	0	0	1	NIL
5		RESEARCH PRESENTATION SKILLS	BTE	EE-D	0	0	0	1	NIL

E. AUDIT COURSES (0 CREDIT)									
ANY TWO COURSES ON:									
S.NO	**CODE**	**COURSE**	**OFFERING DEPT.**	**CATEGORY**	**L**	**T**	**P**	**C**	**PREREQUISITE**
1.		ENGLISH FOR RESEARCH PAPER WRITING	ENG	AC	0	0	2	0	NIL
2.		DISASTER MITIGATION AND MANAGEMENT	CIVIL	AC	0	0	2	0	NIL
3.		VALUE EDUCATION	HS	AC	0	0	2	0	NIL
4.		CONSTITUTION OF INDIA	LAW	AC	0	0	2	0	NIL
5.		PEDAGOGY STUDIES	HS	AC	0	0	2	0	NIL
6		PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTEN SKILL	ENG	AC	0	0	2	0	NIL
Total credits to be earned for the award of M.E /M.Tech degree									**75**

CURRICULUM

I SEMESTER

S. No.	Course Code	Subject Name	Dept. Offering the course	L	T	P	C
Theory							
1		Advanced Biochemistry	Biotechnology	3	0	0	3
2		Microbial Technology	Biotechnology	3	0	0	3
3		Applied Mathematics for Bioengineerrs	Mathematics	3	0	0	3
4		Principles of Chemical Engineering	Biotechnology	4	0	0	4
5		Biopharmaceutical Technology	Biotechnology	3	0	0	3
Practical							
6		Advanced Biochemistry Lab	Biotechnology	0	0	3	2
7		Microbiology Lab	Biotechnology	0	0	3	2
			TOTAL	**16**	**0**	**6**	**20**

II SEMESTER

S. No.	Course Code	Subject Name	Dept. Offering the course	L	T	P	C
Theory							
1		Genetic Engineering	Biotechnology	3	0	0	3
2		Immunotechnology	Biotechnology	3	0	0	3
3		Stem Cell Biology	Biotechnology	3	0	0	3
4		Plant and Animal Tissue Culture	Biotechnology	3	0	0	3
5		Agriculture Biotechnology	Biotechnology	3	0	0	3
6		Research Methodology and IPR	Biotechnology	2	0	0	2
7		Internship	Biotechnology	0	0	0	1
8		English for research paper writing	H&S	0	0	0	0
Practical							
9		Genetic Engineering Lab	Biotechnology	0	0	4	2
10		Immuno technology Lab	Biotechnology	0	0	4	2
			TOTAL	**17**	**0**	**8**	**22**

III SEMESTER

S. No.	Course Code	Subject Name	Dept. Offering the course	L	T	P	C
Theory							
1		Advanced Bioprocess Engineering	Biotechnology	3	0	0	3
2		Open Elective	Biotechnology	3	0	0	3
3		Diagnostics and therapeutics	Biotechnology	3	0	0	3
5		Food science and Technology	Biotechnology	3	0	0	3
6		Research paper writing seminar	H&S	0	0	0	1
7		Disaster mitigation and management	Civil	0	0	0	0
Practical							
8		Advanced Bioprocess Lab	Biotechnology	0	0	4	2
9		Project Work- Phase I & Viva Voce	Biotechnology	0	0	12	6
			TOTAL	**16**	**0**	**16**	**21**

IV SEMESTER

S. No.	Course Code	Subject Name	Dept. Offering the course	L	T	P	C
Practical							
1		Project Work- Phase II & Viva Voce	Biotechnology	0	0	24	12
			TOTAL	**0**	**0**	**24**	**12**

TOTAL CREDITS: 75

	APPLIED MATHEMATICS FOR BIO-ENGINEERING	CATEGORY	L	T	P	CREDIT
		FC-BS	3	0	0	3

PREAMBLE

This course offers the knowledge of solving problems involving matrices, Differentiation, Integration and to develop skills and knowledge of standard concepts in finding approximate solution of equations, Interpolation,ordinary differential equations and to develop an understanding of the methods of probability and statistics which are used to model engineering problems.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To recall the advanced matrix knowledge to Engineering problems.
2	To develop the knowledge in differential andintegral calculus.
3	To enable the students to solve ordinary and Partial differential equations.
4	To familiarize with numerical solution of equations
5	To learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests and how the analysis of variance procedure can be used to determine if means of more than two populations are equal.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Apply the concept of Matrices in engineering problems.	Apply
CO2. Apply tools to find area and volume	Apply
CO3 Apply knowledge of Ordinary and partial differential equations in biological processes	Apply
CO4. Apply the numerical methods in problems.	Apply
CO5. Apply the concept of Statistics and Probability.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	M	L	--	--	--	L	--	--	--	L	--	--	--
CO2	S	M	M	L	--	--	--	L	--	--	--	L	--	--	--
CO3	S	M	M	L	--	--	--	L	--	--	--	M	--	--	--
CO4	S	S	M	L	--	--	--	L	--	--	--	M	--	--	--
CO5	S	M	M	L	--	--	--	L	--	--	--	M	--	--	--

S-STRONG, M-MEDIUM, L-LOW

SYLLABUS

MATRIX THEORY:

Review of Matrices and Determinants, Solution of simultaneous equations using matrix inverse and Cramer's rules, Diagonalisation of Matrix using orthogonal transformation,Singular value decomposition

CALCULUS:

Review of Limits, Continuity, Differentiability, Meaning of derivatives, Mean Value Theorem. Taylor's Theorem, Maxima and Minima,Integration-Fundamental Theorem of Calculus, Bernoulli's formula, Improper Integrals, Applications to Area, Volume, Convergence of Sequences and Series, Power Series, Partial Derivatives, Gradient and Directional Derivatives, Chain Rule, Maxima and Minima of two variables.

ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS:

First order differential equations : Exact equations, Integrating factors and Bernoulli equations, First order and second order Partial Differential equations - Application to biology, Lagrange's method and Charpits method.

NUMERICAL METHODS :

Finite Differences – Newton's Forward and Backward differences formula, Lagrangian Interpolation (Problems only), Algebraic and transcendental methods, False position, Newton Raphson's method, Solutions of Linear simultaneous equations, Gauss Elimination Method, Gauss Jordan Method and Gauss - Jacobi method ,Gauss Seidel method(Problems only).

TESTING OF HYPOTHESIS

Hypothesis testing – Non parametric test – Sign test, Wilcoxon signed rank test, Mann-Whitney test, Run test, Kolmogorov – Smirnov test , Spearman's and Kendall's test

TEXT BOOKS

1. B.S.Grewal., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi (2020).
2. S.C. Gupta and V.K. Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi (2015).
3. B.S. Grewal and J.S. Grewal, "Numerical Methods in Engineering and Science", 6th edition, Khanna Publishers, New Delhi (2004).

REFERENCES

1. Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley and Sons (Asia) Pvt Ltd., Singapore (2012).
2. Joe D. Hoffman, Steven Frankel, "Numerical Methods for Engineers and Scientists", 3rd Edition, Tata Mc-Graw Hill.(New York) (2015).

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr. P.Sasikala	Professor	Mathematics	sasikala@vmkvec.edu.in
2.	Dr. A.K.Bhuvaneswari	Assistant Professor grade-II	Mathematics	bhuvaneswari@avit.ac.in

	RESEARCH METHODOLOGY AND IPR	CATEGORY	L	T	P	CREDIT
		FC-HS	2	0	0	2

PREAMBLE

The course on the Research Methodology and IPR ii the field of Biotechnology. The objective of this course is to understand and analyze Research Methodology and IPR protection.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To give an overview of the research methodology and explain the technique of defining a research problem
2	Problem formulation, analysis and solutions.
3	Technical paper writing / presentation without violating professional ethics
4	Patent drafting and filing patents

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understand research problem formulation	Understand
CO2. Analyze research related information	Apply
CO3. Follow research ethics	Analyze
CO4. Technology, but tomorrow world will be ruled by ideas, concept, and creativity	Evaluate
CO5. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis, the need of information about Intellectual Property Right to be promoted among students in general & Engineering in particular	Understand
CO6. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	-	L	-	-	-	-	-	-	-	-	L	-	-
CO2	M	M	L	L	-	M	-	-	-	-	-	-	L	-	-
CO3	S	M	S	M	-	L	-	M	-	-	-	-	M	L	-
CO4	S	M	S	-	L	-	-	-	-	-	-	-	M	L	-
CO5	L	L	-	L	-	-	-	-	-	-	-	-	L	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

RESEARCH PROBLEM AND SCOPE FOR SOLUTION

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

FORMAT

Effective literature studies approaches, analysis, Plagiarism, Research ethics. Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

PROCESS AND DEVELOPMENT

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, patenting under PCT.

PATENT RIGHTS

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

NEW DEVELOPMENTS IN IPR

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs..

TEXT BOOKS

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"Juta Publishers,1996.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" , Juta Publishers,2004.
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" .

REFERENCES

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

2. Mayall, "Industrial Design", McGraw Hill, 1992.

3. Niebel, "Product Design", McGraw Hill, 1974.

4. Asimov, "Introduction to Design", Prentice Hall, 1962.

5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.

6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Devika	Associate Professor	Biotechnology	devika@avit.ac.in

	ADVANCED BIOCHEMISTRY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Advanced Biochemistry uses the knowledge and understanding gained in the prerequisite course and provides understanding of central metabolic process and role of enzymes in modulating pathways.. This course also highlights the process of Biological oxidation involved in the energy production by burning the food materials and give awareness to the various diseases associated with the errors of metabolism of the biomolecules.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To discuss the metabolic pathways of major bio-molecules
2	To describe the starting, intermediate and ending molecule, enzymes and cofactors in the pathways
3	To differentiate biochemical basis of various disease processes
4	To outline the process of Biological oxidation involved in the energy production by burning the food materials
5	To discuss the metabolic pathways of major bio-molecules

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Explain the metabolic pathways of carbohydrates, amino acids, nucleic acids and lipids	Understand
CO2. Describe the causes of metabolic disorder	Understand
CO3. Examine the importance of molecules derived from amino acids	Apply
CO4. Illustrate the Integration of energy metabolism of macromolecules	Apply
CO5. Analyze and apply theoretical knowledge of biochemistry for designing of new	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	-	-	-	-	-	-	-	S	L	M
CO2	S	S	M	M	-	-	-	-	-	-	-	-	S	M	S
CO3	S	S	M	-	M	-	-	-	-	-	-	M	-	M	-
CO4	S	S	S	M	-	-	-	-	-	-	-	-	S	M	L
CO5	M	M	-	M	-	-	-	-	-	-	-	-	S	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

BIOMOLECULES

Biochemistry: The molecular logic of life, Buffering in biological systems, Types of biomolecules, Chemical nature and biological role, Bioenergy – Thermodynamic quantities and laws, Applications of free energy functions, ATP as the main carrier of free energy in biochemical systems, Biological oxidation - reduction reactions, Oxidative phosphorylation, Vitamins and coenzymes.

CARBOHYDRATES AND ITS METABOLISM

Carbohydrates: Definition, nomenclature, classification, structure, chemistry and properties, Storage and structural polysaccharides, Metabolism of carbohydrates; Glycolysis, TCA cycle, Gluconeogenesis, HMP pathway, Glycogen metabolism, Oxidative phosphorylation, Regulation of carbohydrate metabolism. Clinical Correlation – Glycogen storage disease, Diabetes mellitus, Galactosuria, Fructosuria.

LIPIDS AND ITS METABOLISM

Lipids: Classification, nomenclature and structure of fatty acids, Storage and structural lipid; triacylglycerols, sphingolipids and phospholipids, waxes, glycolopids and sterols; Transport of lipids in blood plasma, lipoproteins, Beta-oxidation of fatty acids, Biosynthesis of fatty acids and triacylglycerols; Regulation of lipid metabolism. Clinical Correlation – Hypercholesterolemia, Atherosclerosis, Fatty Liver, Gaucher's Disease, Niemann – Pick Disease, Refusme Disease

PROTEINS AND ITS METABOLISM

Proteins: Amino Acids: structure and functional group properties, essential and non-essential amino acids; non-protein amino acids, Acid base properties, Biosynthesis and degradation of following amino acids: alanine, serine, lysine cysteine, arginine, methionine, tryptophan, phenylalanine glutamine;. Proteins: peptides, primary, secondary, tertiary and quaternary structure of proteins; Hydrolysis of proteins: Action of different proteases; Regulation of amino acid metabolism and disorders of six essential amino acids (Met, Thr, Lys, Ile, Val, Leu).

NUCLEIC ACIDS AND ITS METABOLISM

Nucleic acids: General structure and functions of purines, pyrimidines, nucleosides and nucleotides; structure of DNA and RNA , Hydrolysis of nucleic acids; Biosynthesis of purines and pyrimidines, nucleosides and nucleotides; Degradation of purines and pyrimidines. Clinical Correlation – Gout , Lesch – Nyhan Syndrome, Orotic Aciduria.

TEXT BOOKS

1. Ambika Shanmugham. Text Book of Biochemistry for Medical Students.
2. Sathyanarayana, U. and Chakrapani, U., 2006. Biochemistry. 3rd Edn., *Uppala Author Publishers Interlinks*.
3. Jain, J.L., Sunjay Jain and Nitin Jain. Fundamentals of Biochemistry.
4. Rastogi, S.C. Biochemistry.
5. Chatterjea, M.N. and Rana Shinde, 2000. Text Book of Medical Biochemistry. 4th Edn., *Jaypee Brothers Medical Publishers Pvt. Ltd*.
6. Narayanan, L.M., Nallasingam, K., Arumugam, N., Dulsy Fathima, Meyyan Pillai, R.P. and Prasanna Kumar, S. Biochemistry.
7. Powar - Chatwal. Biochemistry.
8. Mallikarjuna Rao, M., 2002. Medical Biochemistry. *New Age International (P) Ltd. Publishers*

REFERENCES

1. David L. Nelson and Michael M. Cox, 1982. Lehninger Principles of Biochemistry. *W. H. Freeman and Company*, 4th Edn.
2. Jeremy M. Berg, John L. Tymoczke and Lubert Stryer, 2001. Biochemistry. *W. H. Freeman and Company*, 5th Edn.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr. B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
2.	Ms.C.Nirmala	Associate Professor	Biotechnology	Nirmala@vmkvec.edu.in

	MICROBIAL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Microbial Biotechnology deals with the study of Microbial products, organization and function of prokaryotes. As the pioneering field in the area of microbial it clearly shows that the industrially important microbes and metabolites. Industrially important microbial metabolites were identified and they were taken to the different steps for the production of antibiotics. Genetically modified organisms are concerned with the application of microbial metabolites in pharma industry and also the types of drugs, how the biofertilizers and biopesticides are useful to the agriculture for the enormous amount of production. Classically recovery and purification of microbial products were analysed for the application in agriculture.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To learn the basic principles of isolation and purification of microbial products
2	To understand the kinetics of microbial metabolites and their actions
3	To understand the recovery and product identification from the microbes
4	To know the importance and application of microbial metabolites in the Parma industry
5	To make the students to test and deepen their mastery of microbial products by applying this knowledge in a variety of problem-solving situations.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1: To describe the historical background and cultural characteristics of microbes	Remember
CO2: To describe the differences between culturing techniques, product purification and recovery process	Understand
CO3: To analyze the production of microbial metabolites	Analyse
CO4: To compare and contrast the production of primary and secondary metabolites	Analyse
CO5: Identify the factors that play a role in the production of antibiotics.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	L	L	L	-	L	-	-	-	-	-	L	-	-
CO2	-	M	S	S	L	-	S	-	-	-	L	-	-	-	-
CO3	-	-	L	L	S	-	-	M	-	-	L	M	-	M	-
CO4	-	-	-	-	-	-	S	-	-	-	L	M	-	M	-
CO5	-	-	L	-	M	-	-	-	-	-	-	S	S	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

MICRORGANISMS AND MICROSCOPY

Characteristics of microorganisms, Historical review of the foundation of microbiology, Taxonomy methods of studying microorganisms, Microscopy – Light, Electron, Phase contrast and Laser optics systems, Micrometry, Scope of Microbiology.

STRUCTURAL ORGANISATION AND REPRODUCTION OF MICROORGANISMS

Structure, Organization and Reproduction of Bacteria, Yeast, Fungi, Algae, Bacteriophage and Viruses.

MICROBIAL NUTRITION AND ENVIRONMENT

Nutritional requirements, Growth of microorganisms in Natural and Artificial Environment, Aerobic and anaerobic growth, Different methods of enumeration of multiplying microorganisms, Growth curve, Axenic culture, Synchronus culture, Continuous culture, Methods of preservation of microbes, Effects of physical and chemical factors on microbial growth.

CLINICAL MICROBIOLOGY

Bacterial, Fungal, Viral and Parasitic Diseases, Clinically important microorganisms and their role in infections and immunity, Formation of toxic Substances by microorganisms.

CONTROL OF MICROORGANISMS AND ITS ENVIRONMENTAL APPLICATIONS

Antimicrobial agents and disinfectants, Microbes in Air, Drinking water, Waste water and Extreme Environments, Recycling of biomaterials, Leaching of ores by Microorganisms, Microbial degradation of Recalcitrant Organic Pollutants, Biofouling, Production of biogas, Application of biofertilizers and biopesticides, Microbial indicators of pollution, Food preservation, Food spoilage, Food poisoning.

TEXT BOOKS

1. Pelzar, M.J., Chan, E.C.S and Krieg, N.R. Microbiology. *Tata McGraw Hill Edition.* New Delhi. India.
2. Ananthanarayan and Jayaram Paniker, 1999. Text Book of Microbiology. *Orient Longman Publishers.*

REFERENCES

1. Talaro, K., Talaro A. Cassida Pelza and Reid, 1993. Foundation in Microbiology. *W.C. Brown Publishers.*
2. Prescott, Harley and Klen, 2003. Microbiology. *McGraw Hill Publications.* 5th *Edition*

COURSE DESIGNERS

S.No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr. R. Balachandar	Assistant Professor	Biotechnology	balachandar.biotech@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	PRINCIPLES OF CHEMICAL ENGINEERING	CATEGORY	L	T	P	CREDIT
		CC	4	0	0	4

PREAMBLE

The course introduces the basic principles and calculation techniques in the field of chemical engineering. It provides a concrete understanding of fundamentals and applications of material balances and energy balances which help students to understand the concepts of thermodynamics and fluid mechanics. It also provides a basis for non-chemical engineers to realize the chemical engineering aspects of subsequent modules.

PREREQUISITE

17BTCC05- Unit Operations in Process Industries

COURSE OBJECTIVES

1	To express words into diagrams and mathematical expressions.
2	To describe problem-solving skills, specifically the ability to think quantitatively by including numbers and units.
3	To interpret vague and ambiguous language in problem statements.
4	To implement judicious use of approximations and reasonable assumptions to simplify problems.
5	To compare principles of operation and design for a range of items of plant.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Explain about correlation of mathematics, science and engineering principles for problem solving in process industries.	Understand
CO2. Demonstrate the fundamental concepts of dimensions, units, psychometry, steam properties and law of conservation of mass and energy.	Understand
CO3. Interpreting the problems in material and energy balances related to chemical and bioreactors	Understand
CO4. An ability to employ knowledge to spot and create simple engineering troubles linked to material balance, energy balance, thermodynamics and energy transformation	Apply
CO5. Practice material balances on unit operations and processes in various industries and to evaluate humidity with/without the use of psychrometric chart.	Apply
CO6. Formulating and optimizing various parameters with respect to the industrial processes.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	L	-	-	-	-	-	-	-	-	M	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	-	M	L	L	-	-	-	-	-	-	-	-	-
CO4	S	S	S	L		-	-	-	-	-	-	-	-	-	-
CO5	S	M	-	M	L	-	-	-	-	-	-	L	-	-	-
CO6	S	M	M	L	L	L	-	-	-	-	-	S	-	M	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION **11**

Role of chemical engineering in design and analysis of chemical processes, Historical and more recent developments in Chemical engineering and its role in Biological processes. Overview of unit operations and processes in the chemical industry. Units and conversion factor, Introduction to dimensional analysis (Pi – theorem).

THERMODYNANICS, MATERIAL AND ENERGY BALANCES **13**

Concepts of chemical thermodynamics, Relation to Vapour Liquid Equilibrium (VLE), Solution thermodynamics. Stoichiometry – Overall and component material balances, Material balances without chemical reactions, Conversion and yield, Material balance calculations with chemical reactions, Recycle operations, Energy balances – Entropy, Latent heat, Combustion calculations.

FLUID MECHANICS **13**

Classification and Properties of fluids, Fluid statics - forces at fluid surfaces, Pressure and measurement of pressure differences, Fluid flow concepts and basic equations of fluid flow – Continuity equation and Bernoulli's equation, Shear stress relationship and viscous effects in fluid flow – Non - Newtonian fluids, Significance of dimensionless groups in fluid flow operations

TRANSPORTATION OF FLUIDS **10**

Different types of pumps, Compressors and valves, Measurement of fluid flow using hydrodynamic methods, Direct displacement method, Types of agitators, Flow patterns in agitated vessels, Calculation of power consumption, Applications in bioreactor design.

FUNDAMENTALS OF HEAT AND MASS TRANSFER **13**

Heat Transfer : Mechanism of heat transfer – Conduction, Convection, Radiation, One Dimensional Steady state conduction – flat wall and cylinder, Convection – Forced and Natural Convection, Heat transfer by forced convection in laminar, turbulent flow - Empirical Equations, Heat transfer coefficients calculations, General equipments of heat transfer.

Mass Transfer : Molecular and Eddy diffusion, Role of diffusion in bioprocessing, Mass transfer theories, Liquid - solid mass transfer operations - Batch and Fixed bed adsorption, Gas - liquid mass transfer operations - Principles of Absorption, Industrial absorbers.

TEXT BOOKS

1. Bhatt, B. I. and Vora, S. M., 1977. Stoichiometry. *Tata McGraw Hill Publication*, 3rd Edn.
2. Hougen, O. A. and Watson, K. M. Chemical Process Principles. *C. B. S Publication*, Volume I.
3. Geankoplis, C. J., 2003. Transport Processes and Unit Operations. *Prentice – Hall*, India, 3rd Edn.

REFERENCE BOOKS

1. Himmelblau, D., 1994. Basic Principles and Calculations in Chemical Engineering. *Prentice Hall India Ltd.*, India, 5th Edn..
2. McCabe, W. L., Smith, J. C. and Harriot, P., 2004. Unit Operations in Chemical Engineering. *Tata McGraw Hill Internation Publication,* 7th Edn.
3. Treybal, R.E., 1981. Mass Transfer Operations. 3rd Edn., *Mc Graw Hill*.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Ms.Subathra	Assistant Professor	Biotechnology	subathra.biotech@avit.ac.in
2	Mrs.G.Arthi	Assistant Professor	Biotechnology	arthi@vmkvec.edu.in

	GENETIC ENGINEERING	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Genetic engineering has developed genetic recombination techniques to manipulate gene sequences in plants, animals and other organisms to express specific traits. Applications for genetic engineering are increasing as engineers and scientists work together to identify the locations and functions of specific genes in the DNA sequence of various organisms. Once each gene is classified, engineers develop ways to alter them to create organisms that provide benefits such as cows that produce larger volumes of meat, fuel- and plastics-generating bacteria, and pest-resistant crops.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To understand the principle of nucleic acid isolation, PCR and their uses in genetic engineering, nucleic acid hybridization
2	The students after completing this course would be aware of how to clone commercially important genes
3	The students would be aware Analysis of Gene expression
4	To discuss the gene cloning methods and the tools and techniques involved in gene cloning
5	To explain the heterologous expression of cloned genes in different hosts, production of recombinant proteins and its applications

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. . Gain knowledge on various recombinant DNA techniques and their applications.	Understand
CO2. Familiar with the problems they could encounter and how to trouble shoot them learn various types of host-vector systems and steps in creating a recombinant DNA molecule	Understand
CO3. Monitor both in-vitro and in-vivo activity.	Analyze
CO4. Give insight into the functioning of Recombinant DNA molecules, their constructions, analysis and fine tuning	Apply
CO5. Know about the production of commercially important recombinant proteins.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	S	S	L	-	-	-	-	-	-	-	-	M	-	-
CO2	S	M	S	M	-	-	-	-	-	-	-	-	S	-	-
CO3	M	L	M	S	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	L	S	-	-	-	-	-	-	-	-	-	-	-
CO5	M	M	S	L	-	-	-	-	-	-	-		-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

CLONING VECTORS

Concepts of recombinant DNA technology – Cutting (Restriction enzymes) and joining of DNA, Plasmid biology, Plasmids as vectors – pBR 322, Derivatives of pBR 322, pUC vectors, Lambda vectors, In vitro packaging, M13 vectors, Cosmids, Phasmids, Retroviral vectors, Baculovirus vectors, Cloning vectors in Gram positive bacteria (p1J101), Cloning vectors in Gram negative bacterium (Col E1, R1, pT181, pSC 101), Cloning vectors in Streptomyces (SLP and SCP), Expression vectors – Prokaryotic expression vectors (E. coli, Streptomyces) and Eukaryotic expression vectors

CLONING STRATEGIES AND RECOMBINANT DNA TECHNOLOGY

Preparation of competent cells, Transformation, Gene transfer methods in plants and animals, Construction and screening of genomic DNA and cDNA library, Analysis of gene expression, Chromosome walking, Chromosome jumping, Transcript mapping, Gene targetting, Transposon tagging

TECHNIQUES IN GENETIC ENGINEERING

DNA Labeling – Radioactive and non - radioactive methods, DNA amplification using PCR and it's applications, Random Amplified Polymorphic DNA (RAPD), RT - PCR, Ligase chain reaction, Heteroduplexing, DNA sequencing – Maxam and Gilbert method and Sanger and Coulson enzymatic chain termination method, Nucleic acid hybridization – Southern, Western and Northern, Gene targeting vectors : Gene replacement, Gene knockout, Gene addition – Reporter gene technology, Enhancer trap technology, Phage display technology, Baculovirus Display (BUDS), Yeast one hybrid and two hybrid vectors, iRNA technology : Therpeutic potential of RNAi in metabolic diseases, Gene synthesis

GENETIC ENGINEERING AND SAFETY GUIDELINES

Mutagenesis – Deletion mutagenesis, Oligonucleotide derived mutagenesis, Site directed mutagenesis and their applications, Molecular Markers – Variable Number Tandem Repeats (VNTR's), Minisatellite sequences, Short Tandem Repeats (STR), Microsatellite sequences, Restriction mapping, DNA fingerprinting – Restriction Fragment Length Polymorphism (RFLP) analysis, Gene therapy, Molecular diagnostic methods for genetic diseases, In situ methods to locate transgenes and transcripts, Safety guidelines for recombinant DNA technology and guidelines for the disposal of bio-waste

APPLICATIONS OF TRANSGENIC PLANTS AND ANIMALS

Gene products : Insulin, Human Gonadotrophic Hormone (HGH), BST, Factor VIII, Interferons, Production of antibodies by genetic engineering, Targetting gene therapeutics ribozymes, Triple helix therapeutics, Oligonucleotide aptemers, Intrabodies, Genetically engineered vaccines, Biofortification (Nutraceuticals), Plantibodies and Pharmaceutical pharming, Plastics from plants, Flavr Savr tomato, Blue roses, Golden rice, Transgenic animals – Mastitis resistant cattle, Tick resistant sheep, Fast growing sheep, Fast growing fish, Antimalarial mosquitoes, Antifreeze proteins, Fat Salomon, Mutation detection fish, Spider silk from goat milk, Low phosphorus Enron pig, Vaccination for animal health, Engineering food for animals.

TEXT BOOKS

1. Old, R. W. and Primrose, S. B., 1993. Principles of Gene Manipulation. An Introduction to Genetic Engineering. Blackwell Scientific Publication.
2. Freifelder, D., 1987. Molecular Biology. Jones and Bartlett Publishers Inc.
3. Brown, T.A.,2012 Gene Cloning. 6th Edition, Wiley-Blackwell Publication.
4. Purohit, S. S., 2002. Biotechnology: Fundamentals and Applications. Agrobios (Ind), Jodhpur.
5. Satyanarayana, U., 2008. Biotechnology. Books and Allied Pvt. Ltd.

REFERENCES

1. Sambrook and Elliot. Molecular Cloning. Vol. III.
2. Lewin, B. I. Genes VIII. John Wiley and Sons, New York.
3. Watson, J. Recombinant DNA Technology.
4. Winnacker. From Genes to Clones.
5. Ansubel, F. M., Brent, R., Kingston, R. E. and Moore, D. D., 1988. Current Protocols in Molecular Biology. Green Publishing Associates, New York.
6. Benjamin Lewin, 2000. Genes VI and Genes VII. Oxford University Press, Cambridge, UK, 7th Edition.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.A.Nirmala	Assistant Professor (Gr-II)	Biotechnology	Nirmalabt@avit.ac.in
2.	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	IMMUNOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

The course will provide the knowledge on the types and mechanism of immune systems, immune reactions and antibody engineering

PREREQUISITE NIL

COURSE OBJECTIVES

1	Acquire knowledge on types and structure of immune systems and diversity of antibody.
2	Elucidate cytokine and compliment based activation and regulation of immune mechanisms
3	Perceive knowledge on Immunodeficiencies.
4	Depict principles in diagnosis, HLA typing and tumor immunology.
5	Describe antibody engineering and uses of immunohistochemistry.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. . Acquire knowledge on types and structure of immune systems and diversity of antibody.	Understand
CO2. Elucidate cytokine and compliment based activation and regulation of immune mechanisms	Apply
CO3. Perceive knowledge on Immunodeficiencies.	Apply
CO4. Depict principles in diagnosis, HLA typing and tumor immunology.	Analyze
CO5. Describe antibody engineering and uses of immunohistochemistry.	Evaluate

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	M	S	M	L	-	-	-	-	-	-	-	M	L	-
CO4	M	S	S	M	L	-	-	-	-	-	-	-	S	S	-
CO5	-	S	S	M	M	-	-	-	-	-	-	M	L	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO IMMUNE SYSTEM

Phylogeny of immune system, Innate and acquired immunity, Hematopoiesis and differentiation, Organization and structure of lymphoid organs, Cells of immune system – B - Lymphocytes, T - Lymphocytes, Macrophages, Dendritic cells, Natural killer, Lymphocyte activated killer cells, Eosinophils, Neutrophils, Mast cells, Clonal nature of immune response, Antibody structure and function – Structural features and biological properties of IgG, IgM, IgA, IgD and IgE.

ASSESSMENT OF CELL MEDIATED IMMUNITY

Identification of lymphocytes and their subsets in blood, T - cell and B - cell activation, Macrophage activation, Macrophage microbicidal assays, Cytokines : Monokines, Lymphokines and Interleukines, In vitro experimentation – Application of the above technology to understand the pathogenesis of infectious diseases.

DISEASES AND IMMUNE SYSTEM

Immunity to virus, Bacteria, Parasites, Genetic control of immune response, MHC associated predisposition to disease, AIDS, Typhoid, Rabies, Tuberculosis, Leprosy, hepatitis virus, Malaria, Filariasis. HLASystem,Transplantation–Organ transplantation, Grafting–graft rejection and prevention, Immunosuppressive drugs, Autoimmunity– Auto antibodies in human, Pathogenic mechanism, Experimental models of Autoimmune disease, Treatment of Autoimmune disorders, Complement system, Hypersensitivity

IMMUNOTECHNIQUES

Antigen - antibody interaction, Agglutination and precipitation, Complement fixation test, Immunodiffusion, Radio Immuno Assay (RIA), Enzyme Linked Immunosorbent Assay (ELISA), Western blotting, Immunoelectrophoresis, SDS – PAGE, Purification and synthesis of antigen, Fluorescence immunoassay – Immuno Fluorescence (IF), Substrate Labelled Fluorescent Immunoassay (SLFIA), DELFIA, Fluorescence Activated Cell Sorter (FACS), Immunomics.

VACCINES AND IMMUNOTHERAPEUTICS

Basic principles of vaccine development, Protein based vaccines, DNA vaccines, Plant based vaccines, Recombinant antigens as vaccines, Reverse vaccinology, Engineered antibodies – Catalytic antibodies, Idiotypic antibodies, Combinatorial libraries for antibody isolation

TEXT BOOKS

1. Lydyard, P. M., Whelan, A. and Fanger, M. W., 2003. Instant Notes in Immunology. Viva Books Private Limited, 2nd Edition.
2. Talwar, G. P., and Gupta, S. K., 1992. A Handbook of Practical and Clinical Immunology. CBS Publications, Volume I and II.
3. Weir, D. M., 1990. Practical Immunology. Blackwell Scientific Publications, Oxford.
4. Dulsy Fatima. Immunology. Saras Publications.

REFERENCES

1.Talwar, G. P. and Gupta, S. K., 1992. A Handbook of Practical and Clinical Immunology. CBS Publications, Volume 12.

2.Richard, A., Goldsby, Thomas J. Kindt and Barbara A. Osborne, Kuby. Immunology. W. H. Freeman and Company, New York, 4th Edition.

3.Goding, J. W., 1983. Monoclonal Antibodies : Principles and Practice. Academic Press.

5 . Benjamin, E. and Leskowitz, S., 1991. Immunology – A Short Course. Wiley Liss., New York

COURSE DESIGNERS				
S.NO.	**NAME OF THE FACULTY**	**DESIGNATION**	**DEPARTMENT**	**MAIL ID**
1.	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
2.	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

	STEM CELL BIOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Stem cells in regenerative medicine holds promise for improving human health by restoring the function of cells and organs damaged due to degeneration or injury. Stem cell biology has potential application in several areas of biomedical research that includes drug development, toxicity testing, developmental biology, disease modeling, tissue engineering etc.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To define topics related to stem cells and regenerative biology
2	To execute technologies in engineering stem cells
3	To organize scaffold for tissue engineering
4	To provide ideas on the technologies implied in stem cell culturing and application
5	To Assess the ethical issues in stem cell research

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. To identify the basic applications of stem cell in regenerative medicine	Understand
CO2. To Illustrate the latest tissue engineering concepts	Apply
CO3. Students are trained to choose the correct method and solve the problem by applying	Apply
CO4. To develop the scaffold tissue using stem cell	Analyze
CO5. To validate the research in tissue engineering.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	-	L	L	-	-	-	-	L	-	L	L	S	S	M
CO2	S	M	S	S	-	M	-	-	-	-	L	L	-	M	-
CO3	M	-	M	M	L	S	-	M	M	-	M	L	S	L	M
CO4	L	L	L	-	S	L	-	-	-	-	L	M	-	-	-
CO5	S	M	L	L	M	M	M	S	M	-	S	L	M	-	-

SYLLABUS

STEM CELL AND ITS TYPES

Stem cell – Definition, Embryonic stem cells, Adult stem cells, Origin and characterization of human stem cells and potential applications for stem cell research, Plasticity of human stem cell research, Cord blood stem cells, Stem cell marker.

FIBROBLASTS AND THEIR TRANSFORMATIONS:

the connective-tissue cell family fibroblasts response to signals in the extracellular matrix, connective-tissue cell differentiation, fact cells signaling and production, bone remodeling, osteoblasts and bone matrix, osteoclasts and their ole to connective tissue framework and body structure.

ISOLATION AND CLONING OF STEM CELLS

Protocols for isolation and identification of stem cells, Culturing and subculturing human neurospheres, Differentiation of human – Neurospheres into neurons, Astocytes and Oligodentrocytes, Immunolabelling procedures, Stem cells and cloning.

HUMAN EMBRYONIC STEM CELLS

Human Embryonic Stem Cell Research : Possible sources for human embryonic stem cells, Growing embryonic stem cells in laboratory, Current advantages and limitations of human embryonic stem cells and human somatic stem cells, Developments regarding establishment of human stem cell banks and registries, Government of human embryonic stem cell research, Regulations in European member states and Non - European countries regarding human embryonic stem cell research, Human embryonic stem cell ethics and public policy.

STEM CELL TRANSPLANTATION AND APPLICATION

Types of stem cell transplantation – Autologous, Allogeneic, Syngeneic; Nuclear transplantation, Therapeutic transplantation, Embryonic stem cell transfer and Targetted gene transfer, Neural stem cells for Brain / Spinal cord repair, Miracle stem cell heart repair, Stem cell and future of regenerative medicine, Hematopoietic stem cell disorders-classification and manifestations of aplastic, myelodysplastic, myeloproliplastic disorders. Clinical applications of colony stems. Immunological principles, preservation and clinical use of blood and blood components, hemapheresis procedures and oxiplantation.

TEXT BOOKS

1. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey and Joseph D. Bronzino,
2005. Tissue Engineering, Principles and Applications in Engineering. C. R. C. Press.
2. John, R. and Master, W., 2004. A Practical Approach. Oxford University Press.

REFERENCES

1 Stewart Sell. Stem Cell Handbook. Humana Press.
2. Campbell, N. A. and Jane B. Reece, 2002. Biology.6th Edition. Pearson Education, Inc. San Francisco, California.
3. Freshney, R. and Ian. Alan, R. Culture of Animal Cells : A Manual of Basic Techniques. Liss Inc.
4. Gamborg, O. L. and Phillips, G. C., 1995. Plant Cell, Tissue, and Organ Culture :Fundamental Methods. Springer-Verlag, Berlin Heidelberg.
5. Modlinske, J. A., Reed, M. A., Wagner, T. E. and Karasiewicz, J., 1996. Embryonic Stem Cells : Developmental Capabilities and their Possible Use in Mammalian Embryo Cloning. Animal Reproduction Science 42 : 437 – 446.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1.	Dr.B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
2.	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

	ADVANCED BIOPROCESS ENGINEERING	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

This course aims to develop the skills of students in the area of Bioprocess engineering. This will also help the students to undertake project in Bioprocess technology

PREREQUISITE NIL

COURSE OBJECTIVES

1	To Interpret the kinetics of Microbial growth and product formation
2	To understand the media design and statistical media optimization for maximum production of metabolites
3	To acquaint students with the basics of sterilization and mass transfer coefficients
4	To understand the various growth kinetics, production kinetics, various reactors involved, scale up and scale down process in bioreactors
5	To Execute the Methods of Online and Offline monitoring of bioprocess.
6	To Perform the Mass transfer principles in bioreactor and scale-up criteria.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Identify the appropriate bioreactor configurations and operation modes based upon the nature of Bio products and cell lines and other process criteria.	Understand
CO2. Formulate medium using statistical tool for the maximum production of metabolites and biocatalyst for various commercial use	Apply
CO3 Design bioreactor configurations and operation modes based upon the nature of bio	Apply
CO4. Model the kinetics of living cells and to develop a strategy to solve the issues emerging during fermentation processes	Apply
CO5. Evaluate own model required for the microbial growth and can design own batch thermal sterilization	Analyze
CO5. Develop a research career or to get job in biotechnology industry with strong foundation in bioreactor design and scale-up or to become entrepreneur	Create

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	S	S	-	-	-	-	-	-	-	-	M	-	-
CO2	S	M	L	M	-	-	-	-	-	-	-	-	S	-	-
CO3	S	M	M	S	-	-	-	-	-	-	-	-	L	-	-
CO4	S	M	L	S	-	-	-	-	-	-	-	-	-	M	-
CO5	M	M	S	L	-	-	-	-	-	-	-		S	-	-
CO5	S	S	S	S	-	-	-	-	-	-	-	-	M	-	-

SYLLABUS

STERILIZATION AND INOCULUM DEVELOPMENT

Fermentation process – General requirements of fermentation processes – Bioreactor definition, Media requirements for fermentation processes – Examples of simple and complex media, Sterilization – Thermal death kinetics of micro organisms – Batch and continuous heat sterilization of liquid media – Filter sterilization of liquid media and air, Inocula development – Introduction – Criteria for the transfer of inoculum – Development of inocula for : Yeast processes, Bacterial processes, mycelial processes.

DESIGN AND ANALYSIS OF BIOREACTORS

Design and operation of Bioreactors- bioreactor design of agitator/agitator motor, power consumption in aerated bioreactor, design of sparger, mixing time estimation, oxygen mass transfer capability in bioreactor, Removal of Heat in bioreactor, Main parameters to be monitored and controlled in fermentation processes, Batch and continuous stirred tank reactor, Design and analysis of Packed bed and membrane bioreactors – Design and operation of Novel bioreactors – Airlift loop reactor, Fluidized bed and Trickle bed bioreactors, Immobilized enzyme bioreactors.

PROCESS CONTROL AND APPLICATIONS

Biologically important set points and their importance, Measurement of physical and chemical parameters in bioreactors – Monitoring and control of dissolved oxygen, pH, impeller speed and temperature in stirred tank fermenter, Types of controls, Monitoring, Control-loops, Feed back and feed forward, Self adapting controllers, Expert system approach.

CULTIVATION AND PRODUCT DEVELOPMENT

Culture phases, Monod kinetics, Michaelis - Menten kinetics – Modifications, Cell and product recovery and purification techniques – Micro and macro scale production – Fermentation of Ethanol, Antibiotics, Biofertilizer, Biosurfactants, Industrial enzymes, Interleukins, Interferon, Lymphokines

BIOPROCESS CONSIDERATIONS IN ANIMAL AND PLANT CELL CULTURE

Animal cell cultures – Methods used for the cultivation of animal cells, Bioreactor consideration and products. Plant cell cultures – Comparison to microbes, Bioreactor considerations – Economics of tissue culture.

TEXT BOOKS

1. James E. Bailey and David F. Ollis, 1986. Biochemical Engineering Fundamentals. 2nd Edition., *Tata McGraw Hill International Edition*, New York.
2. Stanbury, P.F., Whitaker, A. and Hall, S. J., 1997. Principles of Fermentation. Technology. 2nd Edition., *Aditya Books (P) Ltd.,* New Delhi.
3. Shuler, M. L. and Kargi, F., 2001. Bioprocess Engineering: Basic concepts. 2nd Edition., *Prentice – Hal.*
4. O.P. Ward, 1989. Fermentation Biotechnology: Principles, Processes, and Products .*Open University Press*, Milton Keynes, UK,
5. Atkinson, B. & Mavituna. F., 1993. Biochemical Engineering and Biotechnology. 2nd Edition., Handbook, *McGraw Hill.*

REFERENCES

1.SH. Aiba, A. E. Humphrey and Nancy F. Millis 1973, Biochemical Engineering Academic Press, 2nd Edition

2. Webb F.C, 1964. Biochemical Engineering. 1st Edition. Van Nostrand, London, H&G Antiquarian Books

COURSE DESIGNERS				
S.NO.	**NAME OF THE FACULTY**	**DESIGNATION**	**DEPARTMENT**	**MAIL ID**
1.	Ms.Subathra	Assistant Professor	Biotechnology	subathra.biotech@avit.ac.in
2.	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

	PROTEIN ENGINEERING	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

The aim of the course is to explain the molecular mechanisms at the basis of the structure-function relationships of proteins and the experimental approaches to modulate the protein functionality and to evolve a desired function or structure. The course is also aimed to provide the most updated knowledge/skills related to the production of recombinant proteins. This course is a blend of modern discoveries and applications in protein sciences.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To recall the translation and post translational modification processes.
2	To discuss the structure, functional correlation and the prediction of properties of protein based on its sequence.
3	To illustrate therole of analytical methods to determine protein structure and protein – protein interactions
4	To observe the similarities in structure at basal level in a group of having similar function, thereby predicting the strategies to modify and design novel proteins.
5	To provide updated knowledge about recombinant proteins and its application in therapeutics

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Recognize the structure and classification of proteins	Remember
CO2.Describe the amino acid sequence and structure of proteins, and relate this information to the function of proteins strategies.	Understand
CO3. Outline the characteristics of individual amino acids and their effect	Understand
CO4. Develop biotechnical methods to construct plasmids for the expression of natural and modified genes	Analyze
CO5. Validate a simple research plan for a protein engineering and design	Evaluate
CO1. Recognize the structure and classification of proteins	Remember

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	M	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	M	M	-		L	-	-	-	-	-	-	L	L	-	-
CO4	M	M	-	-	S	-	L	-	-	-	-	-	-	M	-
CO5	M	M	L	L	S	S	-	L	-	-	-	-	-	L	L

S- Strong; M-Medium; L-Low

SYLLABUS

BONDS AND ENERGIES IN PROTEIN MAKEUP

Covalent and Non-covalent interactions in Protein structure, Translation and Post Translational Modifications

PROTEIN ARCHITECTURE

Primary structure, Secondary structures, Super secondary structures, Topology diagrams, Nucleotide binding folds, Tertiary structures, Modular nature and Formation of complexes in Quaternary structures.

PROTEIN FOLDING AND STRUCTURE DETERMINATION

Protein Denaturation and Renaturation, Protein folding pathways, Stability of folded conformation of proteins, Methods to determine primary, tertiary and quaternary structure - Peptide mapping, Peptide sequencing, Circular Dichroism, Mass spectroscopy and X-ray diffraction.

PROTEIN STRUCTURE - FUNCTION RELATIONSHIP

Helix-turn-Helix motifs, Cro, Lamda and Trp repressor, Zn fingers, Tata Box binding proteins, Homeodomain, Leucine zippers, Enzyme - Understanding the catalytic design by engineering trypsin, chymotrypsin and elastase.

PROTEIN ENGINEERING AND PROTEIN DESIGN

Site directed mutagenesis, Engineering of T4 Lysozyme and Recombinant Insulin, Protein design - Principles and examples.

TEXT BOOKS:

1. Branden, C. and Tooze,J., 1999.Introduction to Protein structure. 2nd Garland Publishing, NY, USA. Edn.,
2. Daniel C. Liebler, "Introduction to Proteomics – Tools for the New Biology," Humana Press, 2001

REFERENCES:

1. Moody P.C.E. and Wilkinson A.J., 1990. Protein Engineer-ing. IRL Press,Oxford, UK.
2. DoanaldVoet and Judith Voet, G., 2001. Biochemistry. 3rd Edn., John Wiley and Sons, 2001.
3. Stefan Lutz and Uwe T. Bornscheuer, 2009. Protein Engineer-ing Handbook. Vol 1 & 2, 1st Edn., Wiley Publishers.
4. Berg, J. M., Tymoczko, J. L. and Stryer, L., 2002. Biochemis-try. 5th Edn., W.H. Freeman and Company.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1.	Dr.A.Nirmala	Assistant Professor	Biotechnology	Nirmalabt@avit.ac.in
2.	Mrs.S.Subriya	Assistant Professor	Biotechnology	subriya@vmkvec.edu.in

	PLANT AND ANIMAL DISEASES AND THEIR CONTROL	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Plant and animal diseases and their control deals with the study of different types of pests and their impact on agriculture and livestocks. Plant epidemiologists will study about the fungus, bacteria, virus or nematodes that can cause damages to the plant parts above or below the ground. The farmers challenges will be solved by identifying the proper ecofriendly control measures will pave the new path in the area of plant breeding. To familiarize the students with principles of insect pest management, including concept and philosophy of IPM. Knowledge of these principles will enable students to understand the different factors that threatens the agricultural productivity and humans..

PREREQUISITE NIL

COURSE OBJECTIVES

1	To acquaint the students with external morphology of the insect's body i.e., head, thorax and abdomen, their appendages and functions.
2	To introduce the students about the classification of insects up to the level of families
3	To familiarize the students about nature of damage and seasonal incidence of insect pests that causes loss to major field crops and their effective management by different methods.
4	To teach the students about the vector-plant pathogen interaction, management of vectors for controlling diseases.
5	To familiarize the students with principles of insect pest management, including concept and philosophy of IPM

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Analyze the impact of engineering solutions in a global and societal context	Apply
CO2. Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems	Apply
CO3 Highlight the importance of ecosystem and biodiversity	Apply
CO4. Ability to consider issues of environment and sustainable	Apply
CO5. Paraphrase the importance of conservation of resources.	Apply
CO6. Play an important role in transferring a healthy environment for future generations	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	-	M	S	S	M	M	-	S	-	-	-
CO2	S	-	-	-	-	S	S	S	-	-	-	S	-	-	-
CO3	S	-	-	-	-	M	S	M	L	-	-	S	-	-	-
CO4	S	-	-	-	-	M	S	S	M	M	-	S	-	-	-
CO5	S	-	-	-	-	M	S	S	M	M	-	S	-	-	-

S- Strong; M-Medium; L-Low

SYLLABUS

ENVIRONMENT AND NATURAL RESOURCES

Environment - Definition, scope & importance - Public awareness- Forest resources, mineral resources , water resources, food resources , energy resources (uses, over -exploitation & adverse effects in each case) - Scope & role of environmental engineers in conservation of natural resources - Sustainability development

ECOSYSTEMS AND BIO – DIVERSITY

Ecosystem - Definition, structure and function - Energy flow -Ecological succession - food chain, food web, ecological pyramids- Introduction, types, characteristics, structure and function of forest, grassland, desert and Aquatic ecosystems - Bio - Diversity :values and uses, hotspots, threats and conservation.

ENVIRONMENTAL POLLUTION

Pollution - Definition , man made impacts and control measures of air, water and land pollution - Water quality standards & characterization - Importance of sanitation -Nuclear hazards – Hazardous waste management : Solid waste, waste water and biomedical waste - Prevention of pollution and role of individual – Disasters management : Floods, earthquake, cyclone and land slides - Clean technology options.

SOCIAL ISSUES AND ENVIRONMENT

Urban problems related to energy - Water conservation – Resettlement and rehabilitation of people - Environmental ethics - Climate change - Global warming - Acid rain - Ozone depletion-Waste land reclamation, Environment Protection Act for air, water, wild life and forests - Pollution Control Board.

HUMAN POPULATION AND ENVIRONMENT

Population growth - Population explosion - Family welfare programme - Environment & human health - Human rights – Value education - Women and child welfare, Role of information technology in environment and human health

TEXT BOOKS

1. Environmental Science and Engineering by Dr.A. Ravikrishnan, Sri Krishna Publications, Chennai.

REFERENCES

1.Wager K.D. "Environmental Management", W.B. Saunders Co. Philadelphia, USA, 1998.

2. Bharucha Erach "The Biodiversity of India" Mapin Publishing Pvt Ltd, Ahmedabad, India

3. Trivedi R.K. “Handbook of Environmental Laws", Rules, Guidelines,Compliances and Standards Vol I & II, Enviro media.

4. Environmental Science and Engineering by Dr. J. Meenambal ,MJP Publication , Chennai Gilbert M. Masters : Introduction to Environmental Engineering and Science , Pearson Education PvtLtd., II Edition, ISBN 81-297-0277-0,2004

5.Miller T.G. Jr Environmental Science Wadsworth Publishing Co.

6. Townsend C. Harper J. and Michael Begon, Essentials of Ecology,Blackwell Science.

COURSE DESIGNERS				
S.NO.	**NAME OF THE FACULTY**	**DESIGNATION**	**DEPARTMENT**	**MAIL ID**
1.	Dr.A.Nirmala	Assistant Professor	Biotechnology	Nirmalabt@avit.ac.in
2.	Mrs.S.Subriya	Assistant Professor	Biotechnology	subriya@vmkvec.edu.in

	CANCER BIOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

Cancer Biology is to learn the foundation principles in cancer mechanisms. It creates a broad base of knowledge to differentiate normal and cancerous cell and also about different types of agents leading to carcinogenesis. It aims to provide the strength to acquire an advanced knowledge and understanding of the molecular mechanism, diagnosis, prevention and therapeutic management

PREREQUISITE NIL

COURSE OBJECTIVES

1	To define the basic principles in cancer biology.
2	To discuss about the carcinogens.
3	To demonstrate students on various genetic and molecular changes normal cells undergo during transformation into malignant cancer
4	To outline mechanism of cancer development and progression
5	To have an understanding in a multidisciplinary approach to *cancer treatment*

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Relate the hallmarks of cancer.	Remember
CO2. Differentiate the types of gene mutations and cancer formation	Understand
CO3. Demonstrate the molecular mechanisms underlying the development of cancer	Apply
CO4. Correlate the genomic knowledge.	Analyse
CO5. Infer the cancer progression, metastasis and new therapies.	Analyse

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	-	L	L	L	-	L	S	-	-	-	-	-	-
CO2	M	L	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	S	S	-	M	-	-	S	-	-	-	-	-	-	-	-
CO4	M	M	L	-	-	-	-	-	M	-	-	-	-	-	-
CO5	M	M	M	L	-	-	-	-	-	-	-	L	-	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Cell cycle and check points, Cancer mechanism, Receptors, Signal molecules, Signal transduction – Modulation study, Tumour suppressor gene, Different forms of cancers, Diet and cancer. Detection using biochemical assays, Tumor markers, Molecular tools for early diagnosis of cancer.

PRINCIPLES OF CARCINOGENESIS

Theory of carcinogenesis, Chemical carcinogenesis, Metabolism of carcinogenesis, Principles of physical carcinogenesis – X - ray radiation, Mechanism of radiation carcinogenesis...

PRINCIPLES OF MOLECULAR CELL BIOLOGY OF CANCER

Signal targets and cancer, Activation of kinases, Oncogenes, Identification of Oncogenes, Retroviruses and oncogenes, Detection of oncogenes. Oncogenes / Proto oncogene activity. Growth factors related to transformation. Telomerases.

PRINCIPLES OF CANCER METASTASIS

Clinical significances of invasion, Heterogeneity of metastatic phenotype, Metastatic cascade, Basement membrane disruption, Three step theory of invasion, Proteinases and tumour cell invasion, Angiogenesis..

NEW MOLECULES FOR CANCER THERAPY

X-ray diffraction technique, Scanning Electron Microscopy – environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS Nano-indentation

TEXT BOOKS

1. Maly, B.W.J., 1987. Virology A Practical Approach. IRLI Press, Oxford.
2. Dunmock, N.J. and Primrose, S.B., 1988. Introduction to Modern Virology. Blackwell Scientific Publications, Oxford.

REFERENCES

1. An Introduction Top Cellular and Molecular Biology of Cancer, Oxford Medical Publications, 1991.

2. Primrose, S.B. and Twyman, R.M., 2006. Principles of Gene Manipulation and Genomics. Blackwell Publishing.

3. Lewis J. Klein Smith, 2005. Principles of Cancer Biology. Benjamin Cummings.

4. Momna Hejmadi, 2000. Introduction to Cancer Biology. Asian Publishing Exchange Pvt. Ltd. 5. Leonard Maurice Franks L., Natalie N., 2007. Cellular and Molecular Biology of Cancer. Oxford University Press.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr. B.Prabasheela	Associate Professor	Biotechnology	prabasheela@avit.ac.in
2	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

	GOOD MANUFACTURING AND LABORATORY PRACTICE	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

The course will emphasis on good manufacturing and laboratory practices. Through knowledge on testing facilities, equipment, testing and controls, records, reports, and protocol for and conduct of non-clinical labs. Exposure on ethical issues and clnical regulations..

PREREQUISITE NIL

COURSE OBJECTIVES

1	Basic understanding of the regulatory requirement of GMP and GLP
2	To understand the significance of GMP and GLP
3	Thorough knowledge on testing equipment, procedures and maintain records and reports.
4	Exposure to clinical regulations and ethical issues

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understand that the areas that come under the Good Laboratory Practices are: personnel and organizational, testing facilities, equipment, testing and controls, records, reports, and protocol for and conduct of non-clinical labs	Remember
CO2. Understand the areas of GMP and GLP	Understand
CO3. Knowledge and practices of equipment production process control and packaging	Understand
CO4. Regulations of clinical practices	Understand
CO5. Knowledge about ethical issues and amendments	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M		M			L						M		-
CO2	M	L	L			L									-
CO3	S	M												L	-
CO4			M			M							L		-
CO5	M		M												-

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction to Good Manufacturing and Laboratory Practice

Introduction to Good Manufacturing and Laboratory Practice, Requirement of GLP and GMP compliance for regulatory approval,

concept of Design of Experiment

Introduction to the concept of Design of Experiment (DOE) Application of QBD principles in Biotech product development. Case studies: Example of QBD and DOE in Process Development, Example of DOE in analytical development

Guidelines of regulatory affairs

Introduction to ICH guidelines and their usage, National and international regulatory authorities and their function, Pharmaceutical Jurisprudence and Laws related to Product design, Drug Development & Approval Process.

Clinical and Preclinical Studies

Regulation of Clinical and Preclinical Studies, Good Manufacturing Practices, Formulation Production Management, Authorization and marketing of drugs

Principles and Ethics

Ethics in manufacturing and control, Principles of quality by design (QBD)

TEXT BOOKS

1. GMP starter guide: Principles in Good Manufacturing Practices for Beginners, Emmet P. Tobin, Createspace Independent Publishing Platform, April 2016.
2. Good Manufacturing Practices for Pharmaceuticals: GMP in Practice, B Cooper, Createspace Independent Publishing Platform, July 2017.
3. Sarwar Beg and Md Saquib Hasnain, Pharmaceutical Quality by design: Principles and application, Academic press, March 2019.
4. Ron S. Kenett, Shelemyahu Zacks, Daniele Amberti, Modern Industrial Statistics: with applications in R, MINITAB and JMP, 2nd Edition, Wiley, January 2014.
5. N Politis S, Colombo P, Colombo G, M Rekkas D.Design of experiments (DoE) in pharmaceutical development, Drug Dev Ind Pharm. 2017 Jun;43(6):889-901. doi: 10.1080/03639045.2017.1291672.

REFERENCES

1. Andrew Teasdale, David Elder, Raymond W. Nims, ICH quality guidelines- An implementation guide, Dec 2017.
2. Gajendra Singh, Gaurav Agarwal an Vipul Gupta, Drug regulatory affairs, CBS publication, 2005.
3. Marc P. Mathieu, New Drug Development: A regulatory overview, Nov 2000.
4. ICH guidelines available in the official website “https://www.ich.org

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Asst.Prof G-II	Biotechnology	balachandar.biotech@avit.ac.in
2	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

	BIOFUEL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

This course will provide an overview of existing energy utilization, production and infrastructure. We will also cover the consequences of our energy choices on the environment. The topics covered will include the chemistry of biofuels, the biology of important feed stocks, the biochemical, genetic and molecular approaches being developed to advance the next generation of biofuels and the economical and global impacts of biofuel production.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Students will recognize the types and differences between existing energy resources, understand their procurement and utilization, and their impacts on society and the environment
2	Students will be knowledgeable of the existing and potential future sources of renewable energy, and be able to intelligently analyze reported aspects of the energy and renewable energy fields.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Exposure To Understanding Of The Existing And Emerging Biomass To Energy Technologies	Remember
CO2. Understand The Concept Of 1st Generation, 2nd Generation And Advance Biofuels	Understand
CO3. Describe Techno-Economic Analyses Of Biofuel Conversion Technologies;	Understand
CO4. Understand The Concept Of A Biorefinery System And Be Able To Develop Major Unit Operations Of An Integrated Biorefinery	Apply
CO5. Understanding Of Environmental Implications	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	L	-	M	-	S	L	-	-	-	-	S	-	L
CO2	-	S	S	-	M	-	L	-	-	-	-	-	-	S	L
CO3	S	M	-	M	-	M	-	L	L	-	-	-	S	-	L
CO4	-	S	M	-	M	L	L	-	-	-	-	-	-	S	M
CO5	-	-	-	-	-	-	-	S	M	-	-	-	-	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF BIOFUELS

Generation of biofuels − Development of biological conversion technologies − Integration of biofuels into biorefineries − Energy security and supply − Environmental sustainability of biofuels − Economic sustainability of biofuels.

BIODIESEL

Biodiesel − Microorganisms and raw materials used for microbial Oil production − Treatment of the feedstocks prior to production of the Biodiesel − Current technologies of biodiesel production − Purification of biodiesel; Industrial production of biodiesel − Biodiesel production from single cell oil.

BIOETHANOL

Bioethanol – Properties – Feedstocks − Process technology − Pilot plant for ethanol production from lignocellulosic feedstock − Environmental aspects of ethanol as a biofuel.

BIOMETHANE AND BIOHYDROGEN

Biomethanol − Principles, materials and feedstocks − Process technologies and techniques − Advantages and limitations − Biological hydrogen production methods − Fermentative hydrogen production − Hydrogen economy − Advantages and limitations.

OTHER BIOFUELS

Biobutanol production − Principles, materials and feedstocks − Process technologies – Biopropanol – Bioglycerol − Production of bio-oils via catalytic pyrolysis − Life-Cycle environmental impacts of biofuels and Co-products.

TEXT BOOKS:

1. Luque, R., Campelo, J.and Clark, J. Handbook of biofuels production, Woodhead Publishing Limited 2011 2. Gupta, V, K. and Tuohy, M, G. Biofuel Technologies, Springer, 2013 3. Moheimani, N. R., Boer, M, P, M, K, Parisa A. and Bahri, Biofuel and Biorefinery Technologies, Volume 2, Springer, 2015

REFERENCES:

1. Eckert, C, A. and Trinh, C, T. Biotechnology for Biofuel Production and Optimization, Elsevier, 2016 2. Bernardes, M, A, D, S. Biofuel production – recent developments and prospects, InTech, 2011

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.R.Balalchandar	Assistant Professor – G-II	BioTechnology	balachandar.biotech@avit.ac.in
2	Ms.C.Nirmala	Associate Professor	Biotechnology	Nirmala@vmkvec.edu.in

	FOOD AND NUTRITION TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		CC	3	0	0	3

PREAMBLE

The course aims to enable the students to understand the physicochemical, nutritional, microbiological and sensory aspects, To familiarize the students about the processing and preservation techniques. To emphasize the importance of food safety, food quality, food plant sanitation, food laws and regulations, food engineering and packaging in food industry.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	Understand the tradition food processing techniques and the basics concept of food biochemistry
2	Demonstrate the product development technique, quality and contaminant check
3	To articulate their technical knowledge for industrial purpose
4	Describe national food laws and standards
5	Laws and qualities of standard for food products

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1: Recall the processing techniques practiced in olden days and the biological process	Remember
CO2. Illustrate the methods for animal product development, quality control and also screen the contaminant	Understand
CO3.Transfer the techniques in scaling up for industrial needs	Apply
CO4. Interpret and Troubleshoot instruments to maintain accuracy	Apply
CO5. Develop standards for food additives	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	L	M	S	M	L	-	-	-	-	-	-	-	M	L	-
CO4	M	S	S	M	L	-	-	-	-	-	-	-	S	S	-
CO5	-	S	S	M	M	-	-	-	-	-	-	M	L	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO FOOD BIOTECHNOLOGY

Introduction, History and scope of food Biotechnology, development and prospects of biotechnology in animal products, ancient and traditional food processing techniques; Biochemical and metabolic pathways of biological systems used in food production.

METHODS IN FOOD BIOTECHNOLOGY: Role of biotechnology in productivity of livestock, Modern biotechnological methods and processes in animal product development, chemical and physical factors required for growing microbial cultures in nutritive substrate; Meat species identification, Quality control, Screening products for contaminants

BIOTECHNOLOGY METHODS IN FOOD PROCESSING:

Use of biotechnology in the production of food additives, use of biotechnological tools for the processing and preservation and foods of animal origin, use of biotechnology improved enzymes in food processing industry, Basic principles of the industrial use of bio-reactions for production of biomass-upstream and downstream processing application of microorganisms as starter cultures in meat industry, microbial production of food ingredients; Biosensors and novel tools and their application in food science.

FOOD SAFETY & SECURITY:

Consumer concerns about risks and values, biotechnology & food safety, Ethical issues concerning GM foods; testing for GMOs; current guidelines for the production, release and movement of GMOs; Future and applications of food biotechnology in India.

TEXT BOOKS:

1. Potter, Norman. M. Food Science, 5th Ed. Springer US

2. Manay, S.; Shadakshara Swamy, M., (2004). Foods: Facts and Principles, 4 th Ed. New Age Publishers.

3. B. Srilakshmi., (2002) Food Science, New Age Publishers..

REFERENCES:

1. Meyer, (2004). Food Chemistry. New Age

2. Deman JM. (1990) Principles of Food Chemistry. 2 nd Ed. Van Nostrand Reinhold, NY

3. Ramaswamy H and Marcott M. Food Processing Principles and Applications. CRC Press

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1	Dr.A.Nirmala	Assistant Professor GII	Biotechnolgy	nirmalabt@avit.ac,in
2	Dr.M.Sridevi	Professor & Head, VMKVEC	Biotechnolgy	sridevi@vmkvec.edu.in

I YEAR / I SEM	ADVANCED BIOCHEMISTRY LAB	L	T	P	C
		0	0	4	2

AIM

To develop the skills of the students by providing hands on training in various biochemical analysis.

OBJECTIVES

At the end of this laboratory course, the students would have learnt about the

- Qualitative analysis.
- Biochemical analysis.
- Enzyme assay.
- Chromatography.

EXPERIMENTS

I. Qualitative Analysis

(i) Carbohydrates

(ii) Lipids

(iii) Proteins

(iv) Normal and abnormal constituents of urine.

II. Quantitative Analysis

(i) Estimation of glucose by ortho - Toluidine method

(ii) Estimation of blood urea by Nessler's method

(iii) Estimation of cholesterol by Zak's method

(iv) Estimation of bilirubin by Malloy and Erelyn method

(v) Estimation of protein by Lowry's method

(vi) Estimation of nucleic acids by spectrophotometric method

(vii) Estimation of haemoglobin by Shali's method.

(viii) Determination of Erythrocyte Sedimentation Rate by using Westergren Pipette

III. Chromatography

(i) Separation of sugars and amino acids by Paper chromatography

(ii) Extraction of lipids and analysis by TLC.

IV. Enzyme assay

(i) Determination of serum LDH activity

(ii) Determination of Serum Glutamate Oxaloacetate Transaminase (SGOT) by Mohn and Cook method.

(iii) Determination of Serum Glutamate Pyruvate Transaminase (SGPT) by IFCC Method

I YEAR / I SEM	MICROBIOLOGY LAB	L	T	P	C
		0	0	4	2

AIM

To give an opportunity of verifying the theoretical concept by experimentally in a more explicit and concentrated manner.

OBJECTIVES

The students would have learnt the

- Basic concepts of Microbiology,
- Skills in the preparation, identification and quantification of microorganisms.

EXPERIMENTS

i. Sterilisation Techniques.

ii. Culture Media Preparations
   a. Broth type media
   b. Solid type media
   c. Semi solid type media

iii. Culturing of Micro organisms
   a. Pure Culture techniques
   - Streak plate
   - Pour plate

iv. Identification of Micro organisms
   a. Staining techniques
   - Simple
   - Gram
   - Spore
   - Acid fast
   - Hanging drop
   b. Biochemical testing

v. Environmental Sample Analysis
   - Isolation and enumeration of microbes from sewage or soil samples.
   - Assay of Microbial growth by Substrate Utilisation Test

vi. Food Microbiology
   - Milk
   - Fermented food

vii. Clinical Microbiology
   - Normal Mouth Flora
   - Antibiotic Disc test Assay.

I YEAR / II SEM	GENETIC ENGINEERING LAB	L	T	P	C
		0	0	4	2

AIM

The course aim is to offer hands on training in the area of Cell culture and cell identification. This will serve as a prerequisite for Post graduate and specialized studies and Research.

OBJECTIVES

At the end of the course from various sources, the students would have learnt the methodology

- To isolate cells and to identify them by specialized Microscopy. This will be extremely beneficial to take up project work in Cellular biology.
- To familiarize with core Nucleic acid techniques such as extraction and nucleic acid separations.
- To amplify DNA using Polymerase Chain Reaction.
- To detect and characterize Nucleic acids, through the application of gene probes and blotting techniques.
- To acquire skills in Gene cloning and screening of recombinants.
- To analyze proteins through SDS-PAGE and Western blotting.

EXPERIMENTS

1. Leishman staining
2. Giemsa staining
3. Osmosis and tonicity
4. Tryphan blue assay
5. Staining for different stages of mitosis in Allium cepa (Onion)
6. Staining for different stages of meiosis using (Grasshopper)
7. Blue and White selection for recombinants
8. Isolation of Genomic DNA from Plant / Animal / Bacterial Cells
9. Isolation of Total RNA
10. Isolation of Plasmid DNA
11. Quantification of DNA and RNA
12. Gel Electrophoresis of DNA – Agarose Gel, Polyacrylamide gel.
13. Southern Blotting.
14. Polymerase Chain Reaction.
15. Elution of Plasmid DNA from Agarose gel.

16. Restriction digestion of Bacterial Genomic and Plasmid DNA.
17. Ligation of DNA.
18. Preparation of Competent Cells.
19. Transformation in E. Coli.
20. Screening and selection of Recombinants and Confirmation of Insert DNA in Plasmid.
21. SDS-PAGE.
22. Western Blotting.

REFERENCES

1. Kalaichelvan, P.T., 2006. Microbiology and Biotechnology. A Laboratory Manual. Lab Man Series, MJP Publishers.

2. Ralph Rapley and John M. Walker, 1998. Molecular Biomethods Handbook. Humana Press

I YEAR / II SEM	IMMUNOTECHNOLOGY LAB	L	T	P	C
		0	0	4	2

AIM

To develop skills of students in Immunology by performing simple experiments in the laboratory.

OBJECTIVES

At the end of the course the student would have gained knowledge to

- Perform test for blood grouping, ELISA and identification of T-cell, Immunofluorescence etc.

EXPERIMENTS

1. Handling of animals, immunization and raising antisera.
2. Identification of cells in a blood smear.
3. Identification of blood groups.
4. Immunodiffusion and immunoelectrophoresis.
5. Testing for Typhoid antigens by Widal test.
6. Enzyme Linked Immunosorbent Assay (ELISA).
7. Isolation and culture of peripheral blood mononuclear cells.
8. Isolation of monocytes from blood.
9. Immunofluorescence.
10. Identification of T-cell rossetting using sheep RBC.

REFERENCES

1. Rajasekara Pandian M , 2007 Immunology & Immunotechnology 1st Edition, Publisher: Panima Publishing Corporation, New Delhi, India.

II YEAR / III SEM	ADVANCED BIOPROCESS LAB	L	T	P	C
		0	0	4	2

AIM

To develop the skills of the students by providing hands on training in various concepts of Bioprocess Engineering.

OBJECTIVES

At the end of this laboratory course, the students would have learnt about the

- Sterilization and Inoculum development
- Design of Bioreactors.
- Process control of fermentation process
- Production of various fermentation products

List of Experiments

1. Demonstration of a Fermentor and its components.
2. Determination of KL a by sodium sulphite oxidation method
3. Centrifugation
4. Batch Sedimentation
5. Liquid-Liquid extraction
6. Batch Distillation
7. Ammonium Sulphate precipitation
8. Estimation of MM parameters
9. Effect of substrate concentration on growth of E.coli
10. Immobilization of Enzyme-_ amylase
11. Effect of temperature on enzyme activity
12. Effect of pH on Enzyme activity
13. Production of wine
14. Estimation of Biomass

REFERENCE

1. Kumar and Hartland. Ind. Eng. Chem. Res. 34, 3925 (1995).
2. Henry Z. Kister, 1992, Distillation Design**,** McGraw-Hill publications
3. Zuiderweg. F. J, 2009, Laboratory Manual of Batch Distillation, Interscience Publishers.
4. Karin Kovárová-Kovar and Thomas Egli,1998, Growth Kinetics of Suspended Microbial Cells: From Single-Substrate-Controlled Growth to Mixed-Substrate Kinetics, Microbiol Mol Biol Rev.
5. G. Szasz. 1974, The Effect of Temperature on Enzyme Activity and on the affinity of enzymes to their Substrates, Z Klin Chem Klin Biochem.

PROGRAM ELECTIVE

	MOLECULAR DIAGNOSTICS AND THERAPEUTICS	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

The Molecular Diagnostics and Therapeutics is to explore the fundamental mechanisms of disease and use the knowledge to test, design, formulate new drugs and develop innovative drug delivery system. It creates technologies and tools to combat disease, promote health and safeguard the environment

PREREQUISITE NIL

COURSE OBJECTIVES

1	List the nature of infection, procedural skills to collect and interpret data.
2	Classify the cause of major pathogenic infection and their diagnosis methods
3	Demonstrate the genetic nature of Human diseases.
4	Organize current Molecular diagnostics of infectious diseases
5	Assess the biosafety aspects involved in molecular diagnosis.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Demonstrate about collection, Transport, Processing of samples and Classify infection and interpret the result.	Understand
CO2. Explain about the most appropriate infectious agent.	Understand
CO3. Identify the microorganism and its role in disease diagnosis	Apply
CO4. Make use of the genomic knowledge.	Apply
CO5. Assume the tool for disease diagnosis andplan diagnostics based on the bio-safety aspects	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	L	L	L	-	M	-	L	M	S	S
CO2	L	M	L	L	-	L	-	-	-	L	-	-	M	S	-
CO3	M	S	M	M	-	L	M	L	L	-	-	L	S	M	S
CO4	M	S	L	S	M	M	-	-	-	-	-	M	S	-	-
CO5	M		M	M		M	S	S	S	-	L	M	M	M	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

History of infection, Mode of transmissions, Pre-disposing factors of microbial pathogenicity, Normal microbial flora of the human body, Types of infectious diseases, Host - Parasite relationships, Clinical specimens – Collection, Transport and Processing of samples, Interpretation of results.

MICROBIAL, FUNGAL & VIRAL INFECTIONS

Pathogenicity and diagnosis of major bacterial infections: *Streptococcus, Coliforms, Salmonella, Shigella, Vibrio* and *Mycobacterium*, Pathogenicity and diagnosis of major fungal infections: Dermetophytosis, Candidiosis and Aspergillosis, Pathogenicity and diagnosis of major Protozoan infections :Amoebiosis, Malaria, Trypanosomiosis, Leishmaniasis, DNA and RNA Viruses : Pox viruses, Rhabdo viruses, Hepatitis viruses, Adeno viruses and Retro viruses.

MEDICAL GENETICS

Organization of Human genome, Human Genome Project, Identifying human disease genes, Oncogenes, Tumour suppressor genes, Genetic disorders, Neonatal and Pre-natal disease diagnostics, Gender identification, Analysis of mitochondrial DNA for maternal inheritance, Gene therapy and other molecular based therapeutic approaches, Genetic counselling.

METHODS IN MOLECULAR DIAGNOSTICS

Isolation and purification of nucleic acids, Nucleic acid labelling, Hybridization, PCR and types, PCR based molecular typing, Molecular diagnosis of pathogens based on 18S and 16S rRNA sequences, PCR in Forensic science.

INSTRUMENTATION FOR MOLECULAR DIAGNOSTICS

Good Laboratory Practices, Automated DNA sequencing, Microarrays, Different levels of biosafety containments for rDNA experiments, Biosafety aspects of tissue / Cell transplantation.

TEXT BOOKS

1. Lele Buckingham and Maribeth L. Flaws, 2007. Molecular Diagnostics : Fundamentals, Methods & Clinical Applications.
2. David E. Bruns, Edward R. Ashwood and Carl A. Burtis, 2007. Fundamentals of Molecular Diagnostics.
3. Griffiths, A. J. F., Miller, J. H. and Suzuki, D. T., 2000. An Introduction to Genetic Analysis.
4. Jeremy M. Berg, John L. Tymoczko and LubertStryer, 2002. Biochemistry. *W.H. Freeman and Company*. 5th Edition.

REFERENCES

1. Turner, P. C., McLennan, A. G., Bates, A. D. and White, M. R. H., 2003. Instant Notes in Molecular Biology. *Viva Books Private Limited*.
2. Brown, T. A. Genetics – A Molecular Approach.
3. Lodish, Berk, Zipursky, Matsudaira, Baltimore Darnell, 2000. Molecular Cell Biology. *W.H. Freeman and Company*. 4th Edition.
4. JamesWatson *et al.,* 1987. Molecular Biology of Gene. *The Benjamin / Cummings Publication Co. Inc.*, California.
5. Benjamin L., 2008. Genes IX. *Jones and Bartlett.*

COURSE DESIGNERS				
S.NO.	**NAME OF THE FACULTY**	**DESIGNATION**	**DEPARTMENT**	**MAIL ID**
1	DrB.Prabasheelaa	Associate Professor	BioTechnology	prabasheela@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	AGRICULTURAL BIOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

This course deals about the biology of plants, plant microbe's interaction, genetic manipulation of crops, different vectors, their applications and how plant act as factories for the production of various compounds. This course will prepare the students for a variety of careers, including modern plant biotechnology processes, breeding of healthy plants, plants with improved characteristics and plants for biomolecule production

PREREQUISITE NIL

COURSE OBJECTIVES

1	To state the basic of cell structure and function
2	To describe the interaction of microbes and plants
3	To perform the novel techniques used in genetic manipulation of crops
4	To categories the uses of different vectors in biotechnology
5	To produce the different organic compounds using Plants as Factories

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Summarize the basic information about cell structure ,functions and their nutrients	Understand
CO2. Demonstrate the plant and microbes interactions	Understand
CO3. Apply the novel techniques used in genetic engineering and genetic manipulation in	Apply
CO4. Identify the uses of different vectors and their application in biotechnology field	Apply
CO5. Examine the different organic compounds like vitamins, amino acids and proteins etc, using plant as a major source.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L	L	-	-	-	-	-	-	-	L	-	-	
CO2	L	M	L	L	-	L	-	-	-	-	-	L	-	-	M
CO3	S	S	M	S	M	M	M	-	-	-	-	-	M	S	S
CO4	S	S	M	S	M	M	M	L	-	-	-	-	M	S	S
CO5	M	S	M	M	M	L	S	L	L	M	-	-	M	S	M

S- Strong; M-Medium; L-Low

SYLLABUS

BIOLOGY OF PLANTS

Plant cell structure and functions. Plant nutritition, Water and mineral availability and uptake. Growth regulators- Phytohormones, auxins, cytokinens, Gibberillins, Abscisic acid, ethylene.

PLANT –MICROBES INTERACTIONS

Biotic and Abiotic stress. Plant response to pathogens. Toxins of fungi, algae and bacteria. Systemic and induced resistance, pathogen derived resistance. Genetic engineering for biotic stress resistance

GENETIC MANIPULATION IN CROPS

Genetic engineering- scope and methods. Gene guns, electroporation, transformation, microinjections, CRISPR, TALEN. Types of modifications- Transgenic, cisgenic, subgenic. Stress resistance, pest resistance, herbicide tolerance and other modified traits..

PLASMIDS AND PROMOTERS

Ti and Ri plasmids, Antisense and RNAi in crop improvement. Disarming Ti plasmid, opines and their significance. Co integrate and binary vectors. Screenable and selectable markers. Promoters and poly A signals

PLANTS AS BIO –FACTORIES

Seed storage proteins, essential amino acids, vitamins and minerals, heterologous protein production in transgenic plants for agriculture, industry and pharmaceuticals uses, biodegradable plastics.

TEXT BOOKS

1. Ahindra Nag. Textbook of Agricultural Biotechnology.PHI Publisher. 2008

REFERENCES

1. Adrian Slater, Nigel Scott and Mark Fowler. 2003. Plant Biotechnology: The genetic manipulation of plants. I edition, Oxford University Press.
2. Vidhyasekaran P. 2005.Bacterial disease resistance in plants. Molecular Biology and Biotechnological applications. Haworth food and agricultural products press. New York.
3. Pessarakti M. 1999. Handbook of planrt and crop stress, 2nd edition. Marcel Dekkar Inc. New York.
4. Melvin J oliver. Agricultural Biotechnology.Wiley Blackwell. 2009

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Assistant Professor – G-II	BioTechnology	balachandar.biotech@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	MOLECULAR MODELLING AND DRUG DESIGNING	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

This course enables the students to broaden their interests to use structure-based and non-linear classification methods in drug design. This course will show how industry-leading computational molecular modeling tools are used to aid in drug discovery and design.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To list concepts involved in molecular modeling
2	To summarize molecular mechanisms involved in energy minimization
3	To execute the molecular dynamics using different models
4	To develop basic steps involved in modeling of proteins
5	To justify the molecular dynamics in drug designing and discovery

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Recognize about molecular modeling concepts	Understand
CO2. Classify molecular mechanisms behind energy minimization problems	Apply
CO3. Illustrate the models to study the molecular dynamics	Analyze
CO4. Compare molecular dynamics with drug designing concepts	Apply
CO5. Design new techniques for the discovery of drugs	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	-	-	-	-	-	-	-	-	-	-		-	-
CO2	L	L	-	-	-	-	-	-	-	-	-	-		M	-
CO3	L	M	-	L	-	-	-	-	-	-	-	-		-	-
CO4	S	S	M	S	M	-	-	-	-	-	-	L		M	-
CO5	S	S	S	S	M	L	-	-	-	-	-	L		-	-

S- Strong; M-Medium; L-Low

SYLLABUS

QUANTUM MECHANICS & CONCEPTS IN MOLECULAR MODELING

Introduction – coordinate systems – potential energy surfaces – introduction to quantum mechanics – postulates – Schrodinger wave equation – hydrogen molecule – Born-Oppenheimer approximation, introduction to computer

hardware and software.

MOLECULAR MECHANICS AND ENERGY MINIMIZATION

Empirical force field models – Bond stretching – angle bending – torsional term – nonbonding interactions – thermodynamics properties using a forcefield – derived and non-derived energy minimization method – simplex – sequential univariate method – steepest descent method – conjugate gradient method- Newton-Rapson method.

MOLECULAR DYNAMICS AND MONTE CARLO SIMULATION

Introduction – Using single Model – time steps – Multiple steps – Setting up MD – energy conservation in MD Simulation Examples – Monte Carlo – Random number generation – Difference in MD & MC

HOMOLOGY MODELING

Comparative modeling of proteins – comparison of 3D structure – Homology – steps in homology modeling – tools – databases – side chain modeling – loop modeling.Advantage and disadvantage. Ramachandran plot. Applications.

DRUG DESIGN

General approach to discovery of new drugs –drug targets, lead discovery – lead modification – physiochemical principles of drug action – drug stereo chemistry –drug action - 3D database search – computer aided drug design – Mechanism based drug design – ligand based drug design– structure based drug design – pharmacophores - QSAR

TEXTBOOKS:

1. Leach R. (1996), "Molecular Modeling Principles and Application", 2nd edition, Longman Publications.
2. Baxivanis D. and Foulette - Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition edition, Wiely-Blackwell Publishers
3. Kothekar V. (2001), "Essentials of Drug Designing", Indian Edition, Dhruv Publications
4. Gerhard Edwin Seibold, Alexander Hillisch, Rolf, (2002) "Modern Methods of Drug Discovery", Hilgenfeld Publisher.

REFERENCES:

1. Attwood, T K , parry-Smith, D J (2005), " Introduction to Bioinformatics", Pearson Education, 1st Edition, 11th Reprint
2. Alan Hinchliffe, (2003), " Molecular Modelling for Beginners", John-Wiley
3. "Drug Design: Cutting Edge Approaches". AngewandteChemie, International Edition,Vol.42

"Advanced Drug Design and Development" Kourounakis Taylor and Francis

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Assistant Professor – G-II	BioTechnology	balachandar.biotech@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	BIOPHYSICS	CATEGORY	L	T	P	CREDIT
		EC (PS)	3	0	0	3

PREAMBLE

The course lightens the structural knowledge of biological system and the properties.

PREREQUISITE – NIL

COURSE OBJECTIVES

1	To gain structural knowledge of biological systems
2	To understand transport and dynamic properties of biological systems.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. To analyze the various forces responsible for biological molecular structure	Remember
CO2. To be familiar with different levels of conformation in biomolecules	Remember
CO3. To gain the knowledge of cellular permeability and ion transport	Understand
CO4. To understand the ionic conduction and transportation among the cellular structures	Understand
CO5. To gain knowledge in the dynamics of biological systems	Understand

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		M			L			L						-
CO2	L	L			L			L							-
CO3	L			M			L								-
CO4	M		L		L										-
CO5		L				L		L							-

S- Strong; M-Medium; L-Low

SYLLABUS

MOLECULAR STRUCTURE OF BIOLOGICAL SYSTEMS

Intramolecular bonds – covalent – ionic and hydrogen bonds – biological structures –general features – water structure – hydration – interfacial phenomena and membranes – self assembly and molecular structure of membranes.

CONFORMATION OF NUCLEIC ACIDS

Primary structure – the bases – sugars and the phosphodiester bonds- double helical structure – the a b and z forms – properties of circular DNA – topology – polymorphism and flexibility of DNA – structure of ribonucleic acids –

hydration of nucleic acids.

CONFORMATION OF PROTEINS

Conformation of the peptide bond – secondary structures – Ramachandran plots – use of potential functions – tertiary structure – folding – hydration of proteins – hydropathy index.

CELLULAR PERMEABILITY AND ION – TRANSPORT

Ionic conductivity – transport across ion channels – mechanism - ion pumps- proton transfer – nerve conduction – techniques of studying ion transport and models.

ENERGETICS & DYNAMICS OF BIOLOGICAL SYSTEMS

Concepts in thermodynamics – force and motion – entropy and stability – analyses of fluxes – diffusion potential – basic properties of fluids and biomaterials – laminar and turbulent flows

TEXT BOOKS:

1. Biophysics ; R. Glaser, Springer Verlag , 2000. 2. Biophysics: Molecules In Motion ; R. Duane. Academic Press , 1999

REFERENCE:

1. Cantror, Charles R. and Paul R. Schimmel "Biophysical Chemistry". 1-3 Vols. W.H.Freeman& Co.,1980

COURSE DESIGNERS

S. NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.A Nirmala	Asst.Professor Gr II	Biotechnology	nirmalabte@avit.ac.in
2	Mrs.S.Subriya	Assistant Professor	Biotechnology	subriya@vmkvec.edu.in

	GENOMICS AND PROTEOMICS	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

Genomics and Proteomics deals with a rapidly evolving scientific area that introduces students into genomes, proteomes and databases. Students would learn about genomics, proteomics and bioinformatics and offer basic knowledge of genome sequencing, major differences between prokaryotic and eukaryotic genomes, basic proteomics and its applications. Students would gain skills in applied bioinformatics, comparative, evolutionary, human genomics and functional genomics. The acquired knowledge during the course would be helpful to those students who want to work in core facilities and commercial biological and medical laboratories as well as in their postgraduate studies.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To explain advanced theoretical knowledge on the organization and function of genomes
2	To execute different mapping techniques.
3	To Perform gene identification and gene expression studies
4	To outline the identification, separation and sequencing of proteins
5	To evaluate the principles of bioinformatics and databases

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. To describe the organizations genes in prokaryotes and eukaryotes	Understand
CO2. To illustrate various genome mapping techniques and its strategies	Apply
CO3. To relate the flow of genetic information from DNA to RNA to protein	Analyze
CO4. To compare the advantages and the drawbacks of various proteomics technologies with the emerging technologies	Analyze
CO5. To evaluate the role of proteomics in drug discovery	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	PSO1	PSO2	PSO3
CO1	L	L	-	L	-	-	-	-	L	L	-	-	-	M	-
CO2	L	-	--	L	-	L	L	-	L	L	L	L	M	M	M
CO3	M	S	S	S	M	-	L	-	-	M	M	-	M	S	M
CO4	-	M	S	S	-	M	M	-	M	-	M	M	-	S	-
CO5	M	M	--	--	M	M	M	L	S	-	M	--	S	S	-

S- Strong; M-Medium; L-Low

SYLLABUS

OVERVIEW OF GENOMES OF PROKARYOTES, EUKARYOTES AND HUMAN

Organization of genes, Coding and non-coding chromosomes and high order structures, Genome relatedness, Introduction of genomics

MAPPING TECHNIQUES

Mapping strategies, Maps – Physical and Genetic maps, Comparative map, Integrated map, Top down and bottom up approach, linking and jumping of clones, STS maps, Human Genome Project

FUNCTIONAL GENOMICS

Gene identification and prediction, Annotation, Functional prediction, Gene expression and micro arrays, Substractive DNA library screening, differential display and representational difference analysis, SAGE.

PROTEOMIC TOOLS

Edman protein microsequencing, Proteome analysis, 2D gel electrophoresis, Metabolic labeling, Detection of protein on SDS gels. Mass spectrometry – MALDI - TOF, Tandem MS - MS, Peptide mass finger printing.

PROTEIN PROFILING AND APPLICATION OF PROTEOMICS

Protein – protein interaction, Post translational modification, Proteomics in drug discovery

TEXTBOOKS:

1. Rastogi, S.C., Mendiratta, N. and Rastogi, P, 2008. Bioinformatics Methods and Applications. Prentice-Hall of India (Private), Limited.
2. Andreas D. Baxevanis and Francis Oueliette, B.F, 2004. Bioinformatics A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition. *John Wiley and Sons Inc*.

REFERENCES:

1. Liebler, 2002. Introduction to Proteomics. *Humana Prem*.
2. Primrose and Twyman, 2003. Principles of Genome Analysis and Genomics. *Blackwell Publishing Co*.
3. David W. Mount, 2001. Bioinformatics, Sequence and Genome Analysis. *Cold Spring Harbor Laboratory Press*.
4. Pennington and Dunn, 2001. Proteomics. *BIOS Scientific Publishers*.
5. Ignacimuthu, S., 2005. Basic Bioinformatics. *Narosa Publishing House*. Westhead, D.R., Parish, J.H. and Twyman, R.M., 2003. Instant Notes Bioinformatics. 1stEdn.,*Viva Books Private Limited*.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Assistant Professor – G-II	BioTechnology	balachandar.biotech@avit.ac.in
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	GREEN BIOTECHNOLOGY AND POLLUTION ABETMENT	Category	L	T	P	Credit
		EC(PS)	3	0	0	3

PREAMBLE

This is a multidisciplinary course deals with various aspects like Environmental Biotechnology, Bioremediation of various problems, Ecofriendly Bioproducts from renewable biosources to educate students within the field of Biotechnology. Students will gain theoretical and practical competence within the broad field of Biotechnology as well as with its applications.

PREREQUISITE - NIL

COURSE OBJECTIVES

1	To understand how Biotechnology can help in monitoring or Removing the pollutants
2	To Describe the novel techniques used in production of Biofuels, renewable energy sources
3	To understand the knowledge to Develop the stress- tolerant plants which can minimize the harmful impact of pollutants
4	To Describe the techniques of Bioremediation and Bioresoration
5	To execute the use of genetically engineered organisms in environment

COURSE OUTCOMES

On the successful completion of the course, students will gain knowledge about

CO1. Outline the basic information about maintaining the Environment	Understand
CO2. Demonstrate the various novel techniques for production of Biofuels	Understand
CO3. Apply the different methods for the waste management	Apply
CO4.Apply the technologies in Bioremediation and Green Energy	Apply
CO5. Employ the uses of genetically engineered organism in Environmental issues	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	-	-	-	-	-	-	-	-	-	-	-	-	L
CO2	L	L	L	-	L	-	L	-	-	-	-	L	L	-	L
CO3	S	S	M	M	M	-	M	-	-	-	-	-	M	M	M
CO4	S	S	S	L	M	L	M	M	-	-	-	-	M	M	S
CO5	S	S	M	M	S	L	S	S	L	-	-	-	M	S	S

S- Strong; M-Medium; L-Low

SYLLABUS

BIOLOGICAL WASTE TREATMENT

Principles and design aspects of various waste treatment methods with advanced bioreactor configuration: Solid waste management: landfills, recycling and processing of organic residues, minimal national standards for waste disposal. Fundamentals of composting process: scientific aspects and prospects of biofuel production: bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides.

BIODEGRADATION OF XENOBIOTIC COMPOUNDS

Xenobiotic compounds–Definition, examples and sources. Biodegradation- Introduction, effect of chemical structure on biodegradation, recalcitrance, co metabolism and biotransformation. Factors affecting biodegradation, microbial degradation of hydrocarbons.

BIOTRANSFORMATIONS AND BIOCATALYSTS

Basic organic reaction mechanism- Common prejudices against enzymes, advantages & disadvantages of biocatalysts, isolated enzymes versus whole cell systems, biocatalytic application, catalytic antibodies; stoichiometry.

BIOREMEDIATION AND BIORESTORATION

Introduction and types of bioremediation, bioremediation of surface soil and sludge, bioremediation of subsurface material, In situ and Ex-situ technologies, phytoremediation- restoration of coal mines a case study. biorestoration: reforestation through micropropagation, use of mycorrhizae in reforestation, use of microbes for improving soil fertility, reforestation of soils contaminated with heavy metals.

ECO-FRIENDLY BIOPRODUCTS FROM RENEWABLE SOURCES

Fundamentals of composting process: scientific aspects and prospects of biofuel production: bioethanol, biohydrogen and biodiesel; biofertilizers and biopesticides. Biotechnology in Environment Protection: Current status of biotechnology in environment protection and its future, release of genetically engineered organisms in the environment.

TEXT BOOKS

1. Introduction to Wastewater Treatment- R. S. Ramalho, Academic Press.

2. Elements of Water Pollution Control Engineering – O.P. Gupta, Khannabooks.

3. Energy Technology – O.P. Gupta, Khannabooks, 2018.

4. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd.

5. Environmental Microbiology & Biotechnology, D.P. Singh, S.K. Dwivedi, New Age International Publishers, 2004.

6. Biodegradation and Bioremediation 1999 (2nd edition). Martin Alexander, Elsevier Science & Technology.

REFERENCE BOOKS

1. Environmental Biotechnology by Bruce Rittmann and Perry McCarty.

2. Environmental Processes I-III, J. Winter, 2nd ed., Wiley Publications

3. Environmental Biotechnology, B.C. Bhattacharya & Ritu Banerjee, Oxford Press, 2007.

4. Environmental Biotech, Pradipta Krimar, I.K. International Pvt. Ltd., 2006.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.S.Anandakumar	Assistant Professor	Biotechnology	anandakumars@vmkvec.edu.in
2.	Dr.R. Devika	Profeesor & Head	Biotechnology	devika@avit.ac.in

	BIOPHARMACEUTICAL TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

Biopharmaceutical Technology is the study that how the pharmaceutical expression of certain drugs can impact their pharmacokinetic and pharmacodynamics behavior. It is branch of pharmaceutical science and technology that utilizes the concept of both biotechnology and pharmaceutical science to design, develop and manufacture pharmaceutical drugs to satisfy the constant growing demand of medicines and save the mankind from the deadly clutches of known and unknown diseases. This course is designed to prepare Professionals for employment in pharmaceutical manufacturing and related industries.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To state the basics of biopharmaceuticals and their sources
2	To describe the mechanism of drug actions
3	To perform the bulk drug manufacturing and their regulatory aspects
4	To organize the product formation in manufacturing industry like growth factors and hormones
5	To outline the therapeutics like vitamins, Antibiotics and Hormones.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Recall the basic information about drug industry, drug developments and different sources	Understand
CO2. Describe the mechanism of drug action , pharmacokinetics and pharmacodynamics	Understand
CO3. Illustrate the different steps and process involved in bulk drug manufacturing	Analyze
CO4. Appraise the product developed from manufacturing industry	Analyze
CO5. Estimate the therapeutics developed from pharma industry like vitamins, Antibiotics and Hormones	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PSO	PSO3
CO1	M	L	-	L	-	L	-	-	-	-	-	-	-		-
CO2	L	L	-	-	L	-	-	-	-	-	-	-	-		M
CO3	M	L	L	L	L	L	-	-	-	-	-	-	-		M
CO4	S	M	-	-	M	L	L	L	-	-	-	S	S		-
CO5	S	-	-	L	M	L	-	S	-	-	-	S	S		M

S- Strong; M-Medium; L-Low

SYLLABUS

Current status and future prospects of biopharmaceuticals – Pharmaceuticals of animal origin, plant origin and microbial origin – Sources of biopharmaceuticals.

Drug – Definition, Mechanism of drug action, Principles of drug metabolism, Drug discovery – Gene chips, Proteomics, Structural Genomics, Pharmacokinetics – Plant as a source of drugs, microbial drugs – Pre-clinical trial – Pharmacokinetics and pharmacodynamics – Toxicity studies – Clinical trial, clinical trial design, trial size and study population – Randomized control studies

Compressed tablets, Dry and wet granulation, Slugging or direct compression, Tablet presses, Coating of tablets, Capsule preparation, Oral liquids – Vegetable drugs – Topical applications, Preservation of Drugs, Analytical methods and other tests used in drug manufacture, Packing techniques, Quality management, Good Manufacturing Practice (GMP).

Haemopoietic growth factors – Granulocyte and macrophage colony stimulating factor – Insulin like growth factors – Epidermal growth factor – Platelet growth factor – Neurotrophic factors – Hormones of therapeutic interest – Insulin, glucagon – Human growth hormones – Gonadotrophins, Disease transmission – Whole blood, platelets and red blood cells – Blood substitutes – Haemostasis – Antithrombin – Thrombolytic agents

Enzymes of therapeutic value Polyclonal antibody – Monoclonal antibodies – Tumour immunology – Vaccine technology, Adjuvant technology – Anti-sense oligonucleotides, uses, advantages and disadvantages of 'oligos', vitravene, an approved anitsense agent – Antigene sequences and ribozymes

TEXTBOOKS:

1. Gareth Thomas, 2000. Medicinal Chemistry. An introduction. *John Wiley*
2. Katzung, B.G., 1995. Basic and Clinical Pharmacology. *Prentice Hall of International Publication.*

REFERENCES:

1. Dutton R. and Scharer J., "Advanced Technologies in Biopharmaceutical processing", Blackwell Publishing, 2007.
2. Gary W., "Biopharmaceuticals: Biochemistry and Biotechnology", Second Edition, John Wiley, 2003.
3. Leon Lachman, 1986. Theory and Practice of Industrial Pharmacy. 3rd Edition.,*Lea and Febger*. Remington, 1991. Pharmaceutical Science. *Mark Publishing and Co*.
4. http://ocw.kyoto-u.ac.jp/en/pharmaceutical/course01/lecturenote.htm

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.A.Nirmala	Assistant Professor GII	Biotechnology	nirmalabt@avit.ac,in
2	Ms.C.Nirmala	Associate Professor	Biotechnology	Nirmala@vmkvec.edu.in

	METABOLIC ENGINEERING	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

Metabolic engineering involves the redesign of metabolism to enable cells to produce new products such as valuable chemicals and biofuels, and/or remediate toxins. Biotechnology industry requires skilled engineers with knowledge of how to apply engineering principles to metabolic pathways in order to analyse, design and alter cell functions. The introduction of basic concepts, current technologies, and challenges within the field will provide students with a valuable toolset to address metabolic engineering problems that are relevant to the emerging biotechnology industry.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To define the appropriate host and/or metabolic pathways to produce a desired product or remediate a toxin
2	To describe and compare the potential metabolic engineering strategies using quantitative metabolic modeling – concepts
3	To analyze metabolic flux and to determine metabolic pathway utilization using 13C-labeling strategies
4	To assess and derive effective combinatorial metabolic engineering strategies
5	To produce those strategies to implement genetic manipulations

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Translate the energetics of cellular metabolism	Understand
CO2. Describe the structure and regulation of metabolic networks	Understand
CO3. Establish the optimal strategy for introducing directed genetic changes in the	Apply
CO4. Relate the modern biology with engineering principles.	Apply
CO5. Write Case studies on metabolically engineered products and processes in various expression systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PSO	PSO3
CO1	L	-	-	-	-	-	-	-	L	L	-	-	-	M	-
CO2	L	L	-	L	-	-	-	-	-	M	-	-	M	M	-
CO3	M	S	M	S	M	L	M	M	M	-	M	-	S	-	M
CO4	S	M	S	M	M	M	L	L	M	M	M	M	M	S	M
CO5	M	M	S	S	M	M	M	M	M	M	M		S	M	S

S- Strong; M-Medium; L-Low

SYLLABUS

REVIEW OF CELLULAR METABOLISM

An overview of cellular metabolism, Transport processes, Fuelling reactions : Glycolysis, Fermentative pathways, Biosynthetic reactions, Polymerization, Cellular energetic

MATERIAL BALANCES AND DATA CONSISTENCY

Comprehensive models of cellular reactions, Stoichiometry of cellular reactions, Reaction rates, Dynamic mass balances, Yield co-efficients and linear rate equations, Analysis of over determined systems – Identification of gross measurement errors.

METABOLIC FLUX ANALYSIS

Theory, Over-determined systems, Under-determined systems – Linear programming, Sensitivity analysis, Methods for the experimental determination of metabolic fluxes by isotope labelling, Applications of metabolic flux analysis.

METABOLIC FLUX ANALYSIS

Theory, Over-determined systems, Under-determined systems – Linear programming, Sensitivity analysis, Methods for the experimental determination of metabolic fluxes by isotope labelling, Applications of metabolic flux analysis.

ANALYSIS OF METABOLIC NETWORKS

Control of flux distribution at a single branch point, Grouping of reactions, Case studies, Extension of control analysis to intermetabolite, Optimization of flux amplifications, Consistency tests and experimental validation.

TEXTBOOKS:

1. Stephanopoulas, G., *et al*., 1996. Introduction to Metabolic Engineering – Principles and Methodologies. *Elsevier Science*.
2. Lee, S. Y. and Papoutsakis, E. T., 1998. Metabolic Engineering. *Marcel Dekker*.
3. Nielsen, J. and Villadsen, J., 2007. Bioreaction Engineering Principles. 2. ed., Kluywer Plenum, New York

REFERENCES:

1. Voit, E. O., 2000. Computational Analysis of Biochemical Systems : A Practical Guide for Biochemists and Molecular Biologist. *Cambridge University Press*.

2. Scheter, T., 2001. Metabolic Engineering.(Advances in Biochemical Engineering, Biotechnology).*Springer*.Vol. 73.

3. Rhodes, P. M. and Stanbury, P. F., 1997. Applied Microbial Physiology Practical Approach.*IRL Press.*

4. Caldwell, D. R., 1995. Microbial Physiology and Metabolism.*Wm.C.Brown.*

5. Rehm, H. J. and Reed, G., 1997. Biotechnology : Products of Primary Metabolism (Vol. 6), Biotechnology : Products of Secondary Metabolism (Vol. 7)., VCH / Wiley.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.A.Nirmala	Assistant Professor GII	Biotechnology	nirmalabt@avit.ac,in
2	Ms.C.Nirmala	Associate Professor	Biotechnology	Nirmala@vmkvec.edu.in

	MARINE AND AQUACULTURE BIOTECHNOLOGY	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

This course aims to provide adequate knowledge on the Marine microbial diversity, applications of biotechnology in aquaculture, Bio Medical importance of marine organism, Biomaterials and Genetically engineered microorganism and their various applications in environment. Thus, the student will have an insight into the theoretical aspects of marine organism which will be very useful when they work on real situation

PREREQUISITE NIL

COURSE OBJECTIVES

1	To impart knowledge on marine microbial diversity
2	To describe about aquatic animals and their breeding methods
3	Focus on the importance of marine organism in biomedical field
4	To discuss about biomaterials, bioprocess and their various uses.
5	To evaluate the genetically engineered microorganism and their uses in waste degradation

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Describe about basic concepts of diversity of marine microbes	Understand
CO2. Interpret the aquatic animals and their breeding mechanism	apply
CO3. Examine the applications of marine organism in Biomedical field microorganisms with the aim of obtaining better production strains	Analyze
CO4. Inspect about biomaterials and their potential uses	Analyze
CO5. Utilize the different microorganism for the degradation of waste various expression systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PSO	PSO3
CO1	L	--	--	--	M	--	S	S	--	--	--	-	S		
CO2	--	--	M	--	S	L	S	S	L	--	--	--			
CO3	L	M	S	--	S	M	L	S	L	---	--				
CO4	M	--	L	M	M	L	--	L	--	--	--				
CO5	L	L	M	M	L	--	M	S	L	--	---	--			

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO MARINE MICROBES IN THE OCEAN

Marine Microbial Diversity – Criterion Habitats – Presences of other organisms : Symbiotic, Free Living , Biofilm, Proximity to the ocean surface or sediments – Euphotic, Mesopelagic, Bathopelagic, Benthos (Sediments) – Concentration of Nutrients and required growth substrates : Oligotrophic, Abundance and distribution of Bacterial and Viral Pathogens - Metabolic Capabilities of Marine Microbes : Adapting to Extreme Environments – Algal Blooms – Marine Bacteria. Major Fisheries in India, Fisheries Management and Fisheries related Marketing Strategies.

BIOTECHNOLOGY OF AQUATIC ANIMALS

Shell Fish and Crustacean Culture : Aqua Culture – Shrimps, Corals, Pearl Oyster, Sea weeds, Edible Mussels, Crabs, Fish Breeding and Mass Production, Induced Breeding, Artificial insemination, Transgenic Breeding, Fish Farming and Culture, Developments of Healthy Fish Diets, Disease Prevention in Fish and GM Fish and Shell Fish. Aquaculture of Marine Invertebrates such as Bryozoans, Sponges and Tunicates. Isolation, Cultivation and Fermentation of Microorganisms from their Invertebrate hosts.

Disease Associated with Cultured Shrimps and Fishes : Disease Management – Vaccines, Antibiotics, Immunostimulants, Immunomodulants, Diagnostic Kits, Probiotics.

BIOMEDICAL IMPORTANCE OF MARINE ORGANISMS

Marine Pharmocology : Pharmaceutical and Bioactive Natural Products – Microalgae as a source of Bioactive Molecules – New Antibiotics, Antiviral and Anticancer Drugs, Anti-Fungal drugs, Medicines and Marine Organisms – Potentialities in the treatment of Infectious Diseases, Osteoporosis and Alzheimer's Disease.

Cynaobacterial Biotechnology – Secondary Metabolites and Biosynthetic Gene clusters of Marine Cyanobacteria – Applications in Biotechnology – Secondary Metabolites from Marine derived Fungi.

BIOMATERIALS AND BIOPROCESSING

Polymers and Biomaterials :Agarose, Agar, Alginates, Carrageaas, chitin, Chitosan, Carotene, Heparin, Marine Flavourants – Environemtnatlly Friendly Antifouling Compuounds.

Biopotential Uses of HalophilicOrganisms, Role of Halophilic Bacteria and Artemia in salt purification.

Tetrodotoxins, Conotoxins, extremozymes from Microbes, Nucleases form Marine Microbes, Exoenzymes from Benthic Flora.

ENVIRONMENTAL AND BIOTECHNOLOGY

Oil spillage and Oil degradation in coastal waters, Genetically Engineered Marine Organisms, algal blooms and phosphate removal, biodegradation of pesticides and heavy metals discharged coastal waters, management of solid wastes disposed into coastal waters, water quality management in Hatcheries and grow out ponds - Biofilters in recycling of water, use of microcosm.

TEXTBOOKS:

1. Attaway, D. H. and Zaborsky, O. R., 1993. Marine Biotechnology : Pharmaceuticals and Bioactive Natural Products. Plenum, New York, Volume 1.
2. Weber, P., 1993. Abandoned Seas : Reversing the Decline. *World Watch.*
3. Powers, D. A., 1995. New Frontiers in Marine Biotechnology : Opportunities for the Twenty First Century. In : Marine Biotechnology in the Asian Pacific Region. C. G. Lundin and R. A. Zilinskas. (Eds.). *The World Bank and SIDA,* Stockholm

REFERENCES:

1. Rhodina, A. G., 1996. Aquatic Biotechnology.
2. S.Felix., 2010 .Marine and Aquaculture Biotechnology, Agrobios.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Assistant Professor GII	Biotechnology	balachandar.biotech@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	PLANT AND ANIMAL TISSUE CULTURE	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

The course is customized to provide a perceptive of the basic concepts, techniques and methods underlying plant and animal tissue culture. The course exposes the students to understand the sterilization techniques involved in tissue culture, plant tissue culture methods, animal cell culture methods and its typesand tissue engineering.

PREREQUISITE NIL

COURSE OBJECTIVES

1	Basic concepts in animal tissue culture with understanding of different physicochemical requirements, variations in techniques.
2	To understand the different types of cell and plant cultures techniques.
3	To illustrate theorigin and characterization of different cell types
4	To give an overview on cell quantification techniques
5	To make students to understand and apply the tissue engineering techniques

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Explain the basics of tissue culture techniques	Understand
CO2. Demonstrate the techniques for the development artificial seed, embryo development and Production of haploids	Apply
CO3. Appraise the origin and characterization of different cell types	Analyze
CO4. Inspect the growth kinetics and scaling up factors	Analyze
CO5. Utilize the tissue engineering techniques various expression systems	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PSO	PSO3
CO1	L	L	L	L	S	L	-	-	-	-	-	L	S	S	
CO2	S	M	S	M	S	L	-	S	-	-	L	-	S	M	
CO3	M	-	M	L	S	-	-	M	-	-	-	-	M	-	
CO4	S	M	L	S	M	-	-	-	-	-	-	-	-	M	
CO5	S	S	S	M	S	S	M	M	-	-	-	M	S	M	

S- Strong; M-Medium; L-Low

SYLLABUS

Laboratory organization, Sterile techniques, Nutrition medium, Explant culture, Callus culture, Cell and organ differentiation, Cell culture, Suspension cultures - Batch and continuous cultures, Growth measurements, Photobioreactors.

Organogenesis, Somatic embryogenesis Micro propagation, Protoplast - isolation culture, regeneration, somatic hybridization, cybrid technology, Embryo culture and embryo rescue, artificial seeds overcoming crossing barriers, Somaclonal variation, *in vitro* selection of mutants, Production of haploids – Anther and Pollen culture, Triploid Production: *In vitro* Pollination and Fertilization, Germplasm storage and cryopreservation.

Origin and characterization of different cell types - differentiation - organ culture - Subculture - cell clines - Selection of medium - chemically defined and serum free media - Role of serum in cell culture - Strategies of medium optimization - commercially available medium for mammalian cell culture - different methods - long term cultivation of human adult tissue, Insect cell culture.

Cell quantification - practical consideration - growth kinetics - medium and nutrients - Types of culture system monolayer culture - Roller bottle - modification - fermenter system - Suspension culture - adaptation - static suspension culture - Scaling up factors - stirred fermenters - Air lift fermenters - Encapsulated cells, Preservation and characterization of cell lines, cytotoxicity and viability assays.

TISSUE ENGINEERING

Developmental biology, Tissue engineering : Basic principles and consideration – Cell type and source, metabolic requirements of cells, reconstruction of connective tissues, reconstruction of epithelial or endothelial surfaces – Cell embedded in extracellular matrix material, Culture on a single surface and sandwich configuration, Scaffolds and tissue engineering – Basic properties, Bioreactor design on tissue engineering – Hollow fibre systems, Microcarrier based systems, Tissue engineering of the liver.

TEXTBOOKS:

1. Walton, P. D., 1988. Principles and Practices. Plant cell culture. *Prentice Hall*.
2. Bhowjwani, S. S., 1990. Plant Tissue Culture : Applications and Limitations.
3. Gupta, P. K. 1998. Elements of Biotechnology. Rastogi Publications.

Chawla, H. S., 2002. Introduction to plant Biotechnology.*Oxford and IBH Publishing Co. Pvt. Ltd*., New Delhi

REFERENCES:

1. John R. W. Master, 2004. Animal Cell Culture – A Practical approach. Oxford University Press.
2. Bernhard Palsson, Jeffery A. Hubble, Robert P. Lonsey and Joseph D. Bronzino, 2005. Tissue Engineering, Principles and Applications in Engineering. CRC Press.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.R.Balalchandar	Assistant Professor GII	Biotechnology	balachandar.biotech@avit.ac.in
2	Dr.M. Sridevi	Professor & Head	Biotechnology	sridevim@vmkvec.edu.in

	FOOD SCIENCE AND TECHNOLOGY	CATEGORY	L	T	P	CREDIT
		EC(PS)	3	0	0	3

PREAMBLE

The main aim of this course to impart knowledge to students on various areas related to Food science and technology, enable the students to understand food composition and its physicochemical, nutritional, microbiological, sensory aspects and also familiarize the students about the processing and preservation techniques.

PREREQUISITE NIL

COURSE OBJECTIVES

1	To understand the basic constituents of food and their functional properties
2	To study the sources and activities of microorganisms associated with food.
3	To understand the processing technology involved in food industries.
4	To choose the appropriate preservation methods
5	To apply the various techniques in food industry

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Explain about the various food constituents and functional properties	Understand
CO2. Utilize laboratory techniques to identify different microorganisms in food.	Evaluate
CO3. Know the principles involving food processing methods	Analyze
CO4. Able to identify and apply the suitable preservation method in industry	Apply
CO5. Utilize advanced instruments and technologies in food process and analyze food products.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	PSO1	PSO2	PSO3
CO1	M	-	L	L	S	M	S	-		-	-	M	L	-	M
CO2	S	-	S	M	S	M	M	L	-	-	-	M			-
CO3	-	L	S	M	S	L	M	-	-	-	-	-	M	-	-
CO4	-	S	M	S	S	M	L	-	-	-	-	-	-		-
CO5	S	M	M	L	S	M	L	M	-	-	-	-	M	-	L

S- Strong; M-Medium; L-Low

SYLLABUS

FOOD CHEMISTRY

Constituents of food – Carbohydrates, Lipids, Proteins, Water, Vitamins and Minerals, Texture, Flavour and Organoleptic properties of food, Dietary sources, Role and functional properties in food, Biotechnology in relation to the food industry.

FOOD MICROBIOLOGY

Sources and activity of microorganisms associated with food, Bacteria, Yeast and Molds – Sources, Types and Species of importance in food processing and preservation, Fermented foods – Dairy products, Meat, Fishery, Non-beverage plant products, Beverages and related products, Single cell protein, Food fermentation, Food chemicals, Food borne diseases – Infections and intoxications, Food spoilage – Causes.

FOOD PROCESSING AND FOOD ADDITIVES

Raw material characteristics, Cleaning, Sorting and grading of foods, Physical conversion operations – Mixing, Emulsification, Extraction, Filtration, Centrifugation, Membrane separation, Crystallization, Heat processing, Classification, Intentional and non-intentional additives, Functional role in food processing – Meat, Fisheries, Vegetables, Food colourants – Natural and artificial, Food flavours, Enzymes as food processing aids

FOOD PRESERVATION AND FOOD BORNE DISEASES

Principles involved in the use of high temperatures – Sterilization, Pasteurization, Blanching, Thermal death curves of microorganisms, Canning, Frozen storage – Freezing characteristics of foods, Microbial activity at low temperature, Factors affecting quality of frozen foods, Irradiation preservation of foods, Classification, Food infections – Bacterial and other types, Food intoxications and poisonings.

APPLICATIONS OF FOOD BIOTECHNOLOGY

Fermented food – Batter and baked goods, Diary products – Milk processing, Cheese, butter, Yoghurt, Ice-cream, Vegetable and fruit products, Edible oils and fats, Meat, Poultry and fish products, Confectionery and beverages

TEXTBOOKS:

1. Coultate, T.P., 1992. Food – The Chemistry of Its components. 2nd Edition., Royal Society, London.
2. Sivasankar, B., 2002. Food Processing and Preservation, *Prentice Hall of India Pvt. Ltd.*, New Delhi.

REFERENCES:

1. Frazier, W.S. and Weshoff, D.C., 1988. Food Microbiology, 4th Edition.,*McGraw Hill Book Co.*, New York.
2. Jay, J.M., 1987. Modern Food Microbiology, *CBS Publications*, New Delhi.
3. Lindsay, 1988. Applied Science Biotechnology. Challenges for the flavour and Food Industry. *Willis Elsevier.*
4. Roger, A., Gordon, B. and John, T., 1989. Food Biotechnology.

George, J.B., 1987. Basic Food Microbiology. *CBS Publishers and Distributors*

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
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2	Ms.C.Nirmala	Associate Professor	Biotechnology	Nirmala@vmkvec.edu.in

OPEN ELECTIVE

	SUSTAINABLE BUILT ENVIRONMENT	CATEGORY	L	T	P	CREDIT
		OE-EA	3	0	0	3

PREAMBLE

Approaches towards energy saving methods through utilization of sustainable materials. Energy management by monitoring of CO2 consumption and emission in buildings.

PREREQUISITE NIL

COURSE OBJECTIVES

1	Explaining the role of sustainable architecture to avoid soil erosion & pollution control measures.
2	Efficiency of waste management with respect to water balance and water efficiency.
3	Impart knowledge on green concepts in design, construction & operation of buildings.
4	Intending the exposure to the latest Green Building trends & technologies to the students.
5	To learn about the importance and Need of Indoor air quality management.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understand the importance of site selection in achieving sustainable environment.	Understand
CO2. Applying the efficient water balance concept to achieve the water efficiency.	Apply
CO3. Applying the energy efficiency methods to achieve energy efficiency in building.	Apply
CO4. Analyzing the sustainable building materials in achieving energy efficiency in building.	Analyze
CO5. Analyzing the Internal air quality with respect to the Indian Codes and its Standards. various expression systems.	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	M	L	-	S	-	M	-	-	-	-	L	L	L
CO2	S	M	L	L	-	S	L	-	-	-	-	-	M	L	--
CO3	S	M	M	L	-	S	-	-	-	-	-	-	S	L	--
CO4	S	L	S	L	-	S	-	-	M	-	-	-	-	-	M
CO5	L	M	L	L	-	M	-	-	L	-	-	-		-	M

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION TO GREEN BUILDING DESIGN:

Universal Design: Key accessibility issues and Design guidelines - Integrated Approach for Green Building design: Factors for Site selection, Understanding the importance of Site Ecology & Site Analysis - Microclimate: Factors affecting microclimate & heat Islands - Strategies to handle heat island in built environment, Designing Green Spaces and Enhancing Biodiversity in built environment.

WATER RESOURCE AND WASTEWATER MANAGEMENT

Rainwater harvesting and utilization, Groundwater recharge techniques: Designconsiderations - Water Balance and approach for water efficiency: 3R Approach for water efficiency – Efficiency towards waste water management - Wastewater treatment & reuse, wastewater treatment technologies.

ENERGY EFFICEINECY IN SUSTAINABLE BUILDINGS

Introduction, Performance Evaluation and Approach for Energy Efficiency in Buildings - Energy Efficiency Standards & Codes: ECBC 2017 & EPI, ASHRAE 90.1, ASHRAE 62.1,ASHRAE 55, ASHARE 170, ISHRAE 1001, Star labelling for appliances - Efficient Building Envelope: Heating loads in buildings, Building orientation and form, Envelope Heat Transfer & Material Specifications.

SUSTAINABLE BUILDING MATERIALS

Attributes of Sustainable Building Materials: Recycled content, Regional material, Renewable material, Embodied energy, Embodied carbon, Material performance, Recyclability, Elimination of hazardous materials - Waste management during construction & post-occupancy: Segregation strategies, Types of waste management – organic, inorganic, e-waste, hazardous waste.

INDOOR ENVIRONMENTAL QUALITY

Indoor Air quality: Codes and Standards, Fresh air requirements, Design considerations - Approach for improving Indoor air quality: Measures to reduce sick building syndrome, Demand control ventilation, CO2 monitoring in buildings, Air quality monitoring - Enhancing occupants' Comfort, Health and Wellbeing: Thermal Comfort, Visual Comfort, Acoustics, Ergonomics, Olfactory Comfort.

TEXT BOOKS:

1. Guide on Green BuiltEnvironment, IGBC, 2021.
2. IGBC Green Homes ratingsystem, IGBC, 2019.
3. IGBC Green New Buildingsrating system, IGBC, 2016.

REFERENCES:

1. ECBC, Bureau ofEnergy Efficiency, 2017.
2. National Building Code, Bureau ofIndian Standards, Bureau of Indian Standards, 2016.
3. ASHRAE 90.1, 62.1, 55, ASHRAE, 2010.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.S.P.Sangeetha	Professor	Civil	sangeetha@avit.ac.in

	ADVANCED CYBER SECURITY	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

To understand the need for Cyber Security in real time and to study techniques involved in it.

PREREQUISITE : NIL

COURSE OBJECTIVES

1.	To understand the basic terminologies related to cyber security and current cyber security threat landscape.
2.	To unserstand the cyberattacks that target computers, mobiles and persons
3.	To understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes
4.	To study the data privacy and security issues related to Social media platforms.
5.	To understand the main components of cyber security plan

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1: able to understand the basic terminologies related to cyber security and curre cyber security threat landscape.	Understand
CO2: Able to complete u n d e r s t a n d i n g of the cyberattacks that target computers, mobiles and persons	Apply
CO3: able to understand the legal framework that exist in India for cyber crimes and penalties and punishments for such crimes, It will also expose students to limitations of existing IT Act,2000 legal framework that is followed in other countries and legal and ethical aspects related to new technologies.	Apply
CO4: Able to get insight into the Data Protection Bill,2019 and data privacy and security issues related to Social media platforms.	Apply
CO5:Able to understand the main components of cyber security plan.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	PSO2	PSO3
CO1	M	M	M	M	-	-	-	-	-	-	-	-	M	M	M
CO2	M	M	M	M	M	-	-	-	-	-	-	-	M	M	M
CO3	M	M	S	M	M	-	-	-	-	-	-	-	M	M	M
CO4	S	M	M	M		-	-	-	-	-	-	-	M	M	S
CO5	S	M	M	M	S	-	-	-	-	-	-	-	M	M	S

S- Strong; M-Medium; L-Low

SYLLABUS:

Overview of Cyber security **9 hours**

Cyber security increasing threat landscape, Cyber security terminologies- Cyberspace, attack, attack vector, attack surface, threat, risk, vulnerability, exploit, exploitation, hacker., Non-state actors, Cyber terrorism, Protection of end user machine, Critical IT and National Critical Infrastructure, Cyberwarfare, Case Studies.

Cyber crimes **9 hours**

Cyber crimes targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach., Online scams and frauds- email scams, Phishing, Vishing, Smishing, Online job fraud, Online sextortion, Debit/ credit card fraud, Online payment fraud, Cyberbullying, website defacement, Cybersquatting, Pharming, Cyber espionage, Cryptojacking, Darknet- illegal trades, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft, job scams, misinformation, fake newscyber crime against persons - cyber grooming, child pornography, cyber stalking., Social Engineering attacks, Cyber Police stations, Crime reporting procedure, Case studies.

Cyber Law **9 hours**

Cyber crime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cyber crime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IoT, Blockchain, Darknet and Social media, Cyber Laws of other countries, Case Studies.

Data Privacy and Data Security **9 hours**

Defining data, meta-data, big data, nonpersonal data. Data protection, Data privacy and data security, Personal Data Protection Bill and its compliance, Data protection principles, Big data security issues and challenges, Data protection regulations of other countries- General Data Protection Regulations(GDPR),2016 Personal Information Protection and Electronic Documents Act (PIPEDA)., Social media- data privacy and security issues.

Cyber security M a n a g e m e n t , Compliance and Governance **9 hours**

Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.

REFERENCES

1. Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives by Sumit Belapure and Nina Godbole, Wiley India Pvt. Ltd.
2. Information Warfare and Security by Dorothy F. Denning, Addison Wesley.
3. Security in the Digital Age: Social Media Security Threats and Vulnerabilities by Henry A. Oliver, Create Space Independent Publishing Platform.
4. Data Privacy Principles and Practice by Natraj Venkataramanan and Ashwin Shriram, CRC Press.
5. Information Security Governance, Guidance for Information Security Managers by W. KragBrothy, 1st Edition, Wiley Publication.
6. Auditing IT Infrastructures for Compliance By Martin Weiss, Michael G. Solomon, 2nd Edition, Jones Bartlett Learning.

COURSE DESIGNERS

S. No.	Name of the Faculty	Designation	Department	Mail ID
1.	Dr.R.Jaichandran	Assistant professor G-II	CSE	rjaichandran@avit.ac.in
2.	Mr. B. Sundharamurthy	Assistant Professor	CSE	sundharamurthy@vmkvec.edu.in

	SOLAR AND ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

PREAMBLE

This subject deals with the general concept of Solar and Energy Storage Systems, and improvement.

PREREQUISITE : Nil

COURSE OBJECTIVE

1.	explain basics of solar photovoltaic systems and energy storage system
2.	understand the concepts and various components of stand-alone system
3.	gain the sound knowledge about grid connected PV system
4.	know the design of various PV-interconnected systems.
5.	provide the knowledge about the various applications of solar system

COURSE OUTCOMES

On the successful completion of the course, students will be able to	Understand
CO1: Describe the basics of solar system.	Understand
CO2:Recognize the concepts of standalone PV system.	Analysis
CO3: Design the grid connected system for various applications.	Analysis
CO4: Select the suitable storage system for particular applications.	Analysis
CO5: Recognize the various applications of solar system.	Create

Mapping with programme outcomes and programme specific outcomes

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M	-	-	M	S	S	M	-	-	L	-	M	-	M
CO2	S	S	-	-	M	S	S	M	-	-	L	-	L	-	L
CO3	S	S	L	-	S	S	S	M	-	-	M	-	M	L	L
CO4	S	M	L	M	S	S	M	M	-	-	M	-	M	-	-
CO5	S	M	L	M	S	S	M	L	L	-	M	-	M	-	M

S-STRONG ,M-MEDIUM,L-LOW

Introduction

Characteristics of sunlight: the sun and its radiation, Solar radiation, Direct and diffusion radiation, greenhouse effect, solar isolation data and estimation-semiconductors and P-N junctions: semiconductors and types, absorption of light, recombination and PN junctions –behavior of solar cells – cell properties: efficiency and losses, Top contact design, Laser grooved, Buried contact solar cell – PV cell interconnection: Module and circuit design, Environmental and thermal protection.

Stand-alone PV System

Solar modules – storage systems: Types, applications, requirements, efficiency, Lead acid batteries – power conditioning and regulation: Diodes, Regulators, Inverters- Balance of system components - protection – standalone PV systems design – sizing: Reliability maps, sizing for high reliability, existing methods.

Grid Connected PV Systems

PV systems in buildings – Utility applications for photo voltaic – design issues for central power stations – safety– Economic aspect – Efficiency and performance - International PV programs – Integration of PV and Wind –Indian Specific Standard for Integration.

Energy Storage Systems

Impact of intermittent generation: Wind, gas and coal integration, impacts of cycling, PSCO case studies – Battery energy storage – solar thermal energy storage – pumped hydroelectric energy storage.

Applications

Water pumping – battery chargers – solar car – direct-drive applications –Space – Telecommunications.

Total Hours = 45

Text book(s):

1. Solar Energy – S.P. Sukhatme, Tata McGraw Hill, 2017.
2. Stuart R.Wenham, Martin A.Green, Muriel E. Watt and Richard Corkish, “Applied Photovoltaics”, 2011.

Reference(s):

1. Frank S. Barnes & Jonah G. Levine, “Large Energy storage Systems Handbook”, CRC Press, 2017.
2. S. Sumathi, “Solar PV and Wind Energy Conversion Systems (Green Energy and Technology)”, L. Ashok Kumar , P. Surekha, 2015.
3 https://nptel.ac.in/courses/112/105/112105051/
4 https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf

COURSE DESIGNERS

S.No	Name of the faculty	Designation	Department	Mail-id
1.	Mr.A.Balamurugan	AP	EEE	balamurugan@vmkvec.edu.in
2.	Mr.V.Rattan Kumar	AP(Gr-II)	EEE	rattankumar@avit.ac.in

	METAL ADDITIVE MANUFACTURING	Category	L	T	P	Credit
		OE-	3	0	0	3

Prerequisite:-Nil

Course Objective

1	Understand the basic principles, methods, areas of usage, possibilities and limitations and the environmental effects of the metal additive manufacturing
2	Select suitable materials for development of parts using additive manufacturing with sound mechanical properties
3	Select suitable processes from various metal additive manufacturing processes as per the product requirement
4	Develop and select suitable parameter for manufacturing and post processing techniques for metal additive manufacturing parts
5.	Design the parts for metal additive manufacturing

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

CO1.	Understand the basic principles, applications and limitations metal additive manufacturing system	Understand
CO2.	Understand how to select suitable materials from the existing or develop new materials for additive manufacturing	Understand
CO3.	Understand the working principle of various methods in MAM and their applications and limitation	Understand
CO4.	Produce a defect free MAM parts with suitable material selection and post processing techniques	Apply
CO5.	Understand the design and optimization techniques to design and develop parts using MAM techniques	Apply

Mapping with Programme Outcomes and Programme Specific Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO	PSO	PSO3
CO1	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO2	M	-	-	-	M	-	M	-	-	-	-	L	L	-	-
CO3	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO4	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M
CO5	M	-	-	-	M	-	M	-	-	-	-	L	L	-	M

S-Strong;M-Medium;L-Low

Syllabus

Module 1	**Introduction**	9

Introduction to metal additive manufacturing – classification and challenges – applications- CAD for additive manufacturing – file formats, CAD CAM software, modelling and data processing – STL format – slicing – design consideration- machine set up

Module 2	Materials and properties of AM printed parts	9
Manufacturing of metallic materials - Conventional vs AM process - Solidification of Metals Equilibrium and Non-equilibrium phases for solidification for AM Phase diagrams - Iron-Carbon - Aluminum alloy - Titanium alloy - Nickel alloy Methods of Powder Particles Production and Powder Properties - Wire Properties for Direct Energy Deposition - Mechanical properties of AM printed parts		
Module 3	**Basic processes in metal additive manufacturing**	9
Powder bed fusion – direct energy deposition – binder jetting – metal extrusion – material jetting - sheet lamination Laser theory - Continuous vs pulsed laser - Laser types - Laser beam properties Basics of electron beam - Electron beam powder bed fusion and mechanism Powder feeders and their classification - Delivery Nozzles - Powder bed delivery and spreading system Wire Fed Systems - Positioning Devices - Print-heads		
Module 4	**AM process parameters**	9
Beam Scanning Strategies and Parameters for PBF and DED - Powder Properties for PBF, DED, and BJ - Ambient Parameters for PBF and DED - Geometry-Specific Parameters, Support Structures (PBF) Defects in AM Printed Parts - Need of Post Processing - Need for Surface Finishing Common Post Processing for MAM - Potential Hazards of Additive Manufacturing – economics of MAM		
Module 5	**Design for Additive Manufacturing**	9
Fundamentals and principle -design techniques and steps - design optimization, material selection and consideration in application field - Part decomposition and Decomposition methods Topology optimization techniques - Overhangs, and Bridging and cavities in design Key characteristics and considerations in topology optimization - Topology optimization under material uncertainty and manufacturability - Industry 4.0 future with AM		

Text Books

1	Milewski, J.O., 2017. Additive manufacturing of metals. Cham: Springer International Publishing.
2	Balasubramanian, K.R. and Senthilkumar, V. eds., 2020. Additive Manufacturing Applications for Metals and Composites. IGI Global.

Reference Books

1	Leach, R. and Carmignato, S. eds., 2020. Precision Metal Additive Manufacturing. CRC Press.
	Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003
3	Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
4	Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.

CourseDesigners

S.No	FacultyName	Designation	Department/ College	Emailid
1	Mr.A.Elanthirayan	Asst. Prof. G-II	AVIT	aleanthirayan@avit.ac.in

	BIO MEMS	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The rapid development of the integrated circuit (IC) industry has led to the emergence of micro electronics process engineering as a new advanced discipline. The combination of MEMS and integrated intelligence has been put forward as a disruptive technology.Gives brief knowledge about applications of Bio-MEMS technology for therapeutics and diagnostics.

PREREQUISITE Nil

COURSE OBJECTIVES

1	To train the students in the design aspects of Bio MEMS devices and Systems.
2	To learn the basic principles of BioMEMS/Microfluidic device manufacturing.
3	To make the students aware of applications in various medical specialists especially the Comparison of conventions methods and Bio MEMS usage.
4	To Classify the different mechanisms of micro sensors and actuators.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Understand the Micro fluidic Principles and study its applications.	Understand
CO2. Explain the principles and applications of Micro Total Analysis.	Understand
CO3. Discuss and realize the MEMS applications in Bio Medical Engineering	Understand
CO4. Classifying the principles of Micro Actuators and Drug Delivery system	Apply
CO5.Utilizing the concept of MEMS with biological applications	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	L	L	L	L	-	-	-	-	-	-	-	-	-	-
CO2	S	L	L	L	M	-	-	-	-	-	-	-	-	-	-
CO3	S	L	M	L	M	-	-	-	-	-	-	-	-	L	-
CO4	S	M	M	L	M	-	-	-	-	-	-	L	L	L	-
CO5	S	S	M	L	M	-	-	-	-	-	-	L	L	L	-

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction-The driving force behind Biomedical Applications – Biocompatibility - Reliability Considerations-Regularity Considerations – Organizations - Education of Bio MEMS-Silicon Micro fabrication-Soft Fabrication techniques

Micro fluidic Principles- Introduction-Transport Processes- Electro kinetic Phenomena-Micro valves –Micro mixers-Micro pumps.

SENSOR PRINCIPLES and MICRO SENSORS: Introduction-Fabrication-Basic Sensors-Optical fibers-Piezo electricity and SAW devices-Electrochemical detection-Applications in Medicine

MICRO ACTUATORS and DRUG DELIVERY: Introduction-Activation Methods-Micro actuators for Micro fluidics-equivalent circuit representation-Drug Delivery

MICRO TOTAL ANALYSIS: Lab on Chip-Capillary Electrophoresis Arrays-cell, molecule and Particle Handling-Surface Modification-Microsphere-Cell based Bioassay Systems Detection and Measurement Methods-Emerging Bio MEMS Technology-Packaging, Power, Data and RF Safety-Biocompatibility, Standards

Text Books/ References Books :

1. Steven S. Saliterman, Fundamentals of Bio MEMS and Medical Micro devices, Wiley Interscience, 2006.
2. Albert Folch , Introduction to Bio MEMS, CRC Press, 2012
3. Gerald A. Urban, Bio MEMS, Springer, 2006
4. Wanjun wang, steven A. Soper, Bio MEMS, 2006.
5. M. J. Madou, "Fundamentals of Micro fabrication",2002.
6. G.T. A. Kovacs, "Micro machined Transducers Sourcebook", 1998.

COURSE DESIGNERS

S.No	Name of the Faculty	Designation	Department	Mail ID
1	Mrs.A.Malarvizhi	Assistant Professor	ECE	malarvizhi@vmkvec.edu.in
2	Dr.T.Muthumanickam	Professor & Head	ECE	muthumanickam@vmkvec.edu.in

	BIOMEDICAL PRODUCT DESIGN AND DEVELOPMENT	Category	L	T	P	Credit
		OE-EA	3	0	0	3

PREAMBLE

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

PREREQUISITE – Nil

COURSE OBJECTIVES

1	To understand the global trends and development methodologies of various types of products and services.
2	To conceptualize, prototype and develop product management plan for a new product based on the type of the new product and development methodology integrating the hardware, software, controls, electronics and mechanical systems.
3	To understand requirement engineering and know how to collect, analyze and arrive at requirements for new product development and convert them in to design specification.
4	To understand system modeling for system, sub-system and their interfaces and arrive at the optimum system specification and characteristics.
5	To develop documentation, test specifications and coordinate with various teams to validate and sustain up to the EoL (End of Life) support activities for engineering customer.

COURSE OUTCOMES

On the successful completion of the course, students will be able to

CO1. Define, formulate and analyze a problem for the product design.	Apply
CO2 Obtain the domain knowledge of product development and regulatory requirements for the design of prototype.	Apply
CO3. Explain the process of manufacturing, testing and validation for scalable product development.	Apply
CO4 Gain knowledge of the Innovation & Product Development process in the Business Context.	Apply
CO5 Discuss the economics in product development and business strategies for turnover from commercialization.	Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO2	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO3	S	S	M	L	--	--	--	M	--	--	--	M	S	L	M
CO4	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M
CO5	S	S	S	L	--	--	--	M	--	--	--	M	S	L	M

S- Strong; M-Medium; L-Low

SYLLABUS

PRODUCT DESIGN

Definition, History and Modern Practice – Designs; Design and Product Life Cycle; Design Process; What is a medical device, Challenges in medical device, Understanding the innovation cycle, Good Design Practice. Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements, Concept

Generation – Innovation Survey Questionnaire, Morphological Matrix, QFD, Concept Analysis and validation, Concept Modelling, Concept Screening & Validation.

PRODUCT DEVELOPMENT AND REGULATORY

Breakthrough Products, Platform Products, Front End of Innovations / Fuzzy Front End, Generic Product Development Process (Concept Development, System Design, Detailed Design, Test & Refinement, Production Ramp-up), Variants of Development Processes (Market Pull, Technology Push, Platform, Process-Intensive, Customized, High-Risk, Quick Build, Complex Systems), Good Documentation Practice, Prototyping Specifications, Prototyping, Medical Device standards, Quality management systems, Medical Device Classification, Design of Clinical Trials, Design Control & Regulatory Requirements, Documentation in Medical Devices, Regulatory pathways.

CALABLE PRODUCT DEVELOPMENT

Design for manufacturing, Design for assembly, Design for Serviceability, Design for usability, Medical Device Verification & Validation, Product Testing & Regulatory compliance, Clinical trial & validation, Device Certification.

MANUFACTURING AND BUSINESS STRATEGIES

Lean Manufacturing – Toyota Production System, Good Manufacturing Practices, Framework for Product Strategy – Core Strategic Vision (CSV), Characteristics of good CSV, Opportunity Identification Process & Generating Opportunities, Quality of Opportunities – Real-Win-Worth It (3M RWW), Product Planning Process, Technology S-Curve, Evaluating and Prioritizing Projects, Product-Process Change Matrix, Resource Planning, Total Available Market (Segmentation, Targeting & Positioning), Served Available Market, Product Platform Strategy, Market Platform Plan (Product Platform Management, Product Line Strategy).

PRODUCT ECONOMICS AND MARKET INFUSIONS

Economics/Finance in Product Development (Sales Forecasting – ATAR Model/ Bases Model, Pricing the product, Cash flow in Product Development, Categorizing the costs, Structuring Manufacturing Costs, Prototyping Costs, Development Costs, Cost Volume Profit Analysis, Breakeven Analysis, Common Return Metrics – Payback/ NPV/ IRR, Common Comparison Metrics – WACC/ RRR/ MARR). Business Model Canvas, Marketing Channels, Sales Models, Post Commercialization Surveillance, End of Life support.

REFERENCES:

1. Jones, J.C., Design Methods, John Wiley, 1981.
2. Cross, N., Engineering Design Methods, John Wiley, 1994.
3. Pahl, G., and Beitz, W., Engineering Design, Design Council, 1984.
4. Michael E. McGrath, Product Strategy for High-Technology Companies, 2nd Edition, McGraw Hill.
5. Ulrich, K.T., and Eppinger, S.D., Product Design and Development, Tata McGraw Hill, India.
6. Ehrelspiel. K, and Lindemann U Cost Efficient Design, Springer, 2007.
7. Paul H king, Richard C. Fries, Arthur T. Johnson, Design of Biomedical Devices and Systems. Third edition, ISBN 9781466569133.
8. Peter J. Ogrodnik, Medical Device Design: Innovation from Concept to Market, Academic Press Inc; Edition (2012), ISBN- 10:0123919428.
9. Stefanos Zenios, Josh Makower, Paul Yock, Todd J. Brinton, Uday N. Kumar, Lyn Denend, Thomas M. Krummel, Biodesign: the Process of Innovating Medical Technologies, Cambridbge University press; Edition (2009), ISBN- 10:0521517427.

COURSE DESIGNERS				
S.No.	**Name of the Faculty**	**Designation**	**Department**	**Mail ID**
1	Dr.L.K.Hema	Professor & Head	BME & ECE	hodbme@avit.ac.in
2	Dr.N.Babu	Professor	BME	babu@vmkvec.edu.in
3	Dr.R.Ezhilan	Assistant Professor	BME	ezhilan@vmkvec.edu.in

CATEGORY E

MANDATORY COURSES/AUDIT COURSES

	ENGLISH FOR RESEARCH PAPER WRITING	CATEGORY	L	T	P	CREDIT
		AC	0	0	2	0

PREAMBLE

PREREQUISITE NIL

COURSE OBJECTIVES

1	To understand research problem formulation.
2	Need to analyze research related information
3	Evaluate and Follow research ethics

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO1 0	PO1 1	P O	PSO1	PSO 2	PSO3
CO1			L	L	S	L	-	-	-	-	-	L	S	S	
CO2			S	M	S	L	-	S	-	-	L	-	S	M	
CO3		-	M	L	S	-	-	M	-	-	-	-	M	-	
CO4		M	L	S	M	-	-	-	-	-	-	-	-	M	
CO5		S	S	M	S	S	M	M	-	-	-	M	S	M	

S- Strong; M-Medium; L-Low

SYLLABUS

Research

Meaning of research problem - Sources of research problem- Criteria Characteristics of a good research problem - Errors in selecting a research problem - Scope and objectives of research problem

Data Analysis

Approaches of investigation of solutions for research problem - data collection, analysis, interpretation - Necessary instrumentations

Plagiarism

Effective literature Reviews - approaches, analysis Plagiarism – Definition of Plagiarism – Consequences of Plagiarism – Unintentional Plagiarism – Forms of Plagiarism - Related Issues - Research ethics

Research Paper Format

Effective technical writing, how to write report, Paper Developing a Research Proposal

Format

Format of research proposal – Margin – Text Formatting - Heading and Title – Page Numbers –Tables and Illustrations – Corrections and Insertions –Binding – Bibliography

REFERENCES:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr. Premkishor	Assistant Professor	AVIT	PREM.ENGLISH@avit.ac.in
2	Dr.Jennifer G Joseph	HoD-H&S	AVIT	jennifer@avit.a.cin

	DISASTER MITIGATION AND MANAGEMENT	CATEGORY	L	T	P	CREDIT
		AC	0	0	2	0

PREAMBLE

PREREQUISITE NIL

COURSE OBJECTIVES

1	To study about the Disaster Management Cycles
2	To Study about the Disaster Community and planning
3	To Understand the Challenges posed by Disasters to the community
4	To study about coping concepts for both natural and man made disasters
5	To study about strengthening techniques for structural and non structural measures

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1. Understanding Disasters, man-made Hazards and Vulnerabilities	Understandand Apply
CO2.. Understanding disaster management mechanism	Apply
CO3. To gain knowledge about organizations involved in disaster community	Apply
CO4. To build skills to respond to disasters	Apply
CO5. Understanding capacity building concepts and planning of disaster managements various expression systems	Understand and Apply

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PS	PSO	PSO
CO1	**L**	L	**L**	**L**	**L**	L	M	**L**	**L**	**M**	**L**	**M**	M	**L**	**L**	**M**
CO2	**M**	M	L	L	**M**	L	S	**L**	**L**	**M**	**M**	**S**	S	**L**	**L**	**S**
CO3	**S**	M	L	L	**M**	L	M	**L**	**L**	**M**	**S**	**S**	M	**L**	**L**	**S**
CO4	**M**	M	L	L	**M**	L	M	**L**	**L**	**S**	**S**	**S**	S	**L**	**L**	**M**
CO5	**S**	S	**L**	**L**	**S**	L	S	**L**	**L**	**S**	**M**	**M**	S	**L**	**L**	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

Overview of Disaster Management – Distinguishing between an emergency and a Disaster situation. Disaster Management Cycle – Disaster management Act and Policy in India; Organisational structure for disaster management in India; Preparation of state and district disaster management plans- Phase I: Mitigation, and strategies; hazard Identification and vulnerability analysis. Disaster Mitigation and Infrastructure, impact of disasters on development programmes, vulnerabilities caused by development, developing a draft country-level disaster and development policy Phase II: Preparedness, Disaster Risk Reduction(DRR), Emergency Operation Plan (EOP) Phases III and IV: Response and recovery, Response aims, Response Activities, Modern and traditional responses to disasters, Disaster Recovery, and Plan

DISASTER PLANNING

Disaster Planning-Disaster Response Personnel and duties, Community Mitigation Goals, Pre-Disaster Mitigation Plan, Personnel Training, Volunteer Assistance, School-based Programmes, Hazardous Materials, Ways of storing and safely handling hazardous materials, Coping with Exposure

DISASTER COMMUNITY

Disaster Community-Community-based Initiatives in Disaster management, need for Community-Based Approach, categories of involved organizations: Government, Nongovernment organizations (NGOs), Regional And International Organizations, Panchayaths, Community Workers, National And Local Disaster Managers, Policy Makers, Grass-Roots Workers, Methods Of Dissemination Of Information, Community-Based Action Plan, Advantages/Disadvantages Of The Community Based Approach

COPING WITH DISASTER

Coping Strategies; alternative adjustment processes - Changing Concepts of disaster management - Industrial Safety Plan; Safety norms and survival kits - Mass media and disaster management

CAPACITY BUILDING

Concept - Structural and Nonstructural Measures Capacity Assessment; Strengthening Capacity for Reducing Risk - Counter-Disaster Resources and their utility in Disaster Management - Legislative Support at the state and national levels

TEXT BOOKS:

1. Manual on Disaster Management, National Disaster Management, Agency Govt of India.
2. Ayaz,. "Disaster Management: Through the New Millennium", Anmol Publications. (2009)
3. Dave, P. K.. "Emergency Medical Services and Disaster Management: A Holistic Approach", New Delhi: Jaypee Brothers Medical Publishers (P) Ltd., 2009
4. Disaster Management by Mrinalini Pandey Wiley 2014.
5. Goel, S. L., "Disaster Management", New Delhi: Deep & Deep Publication Pvt. Ltd. ,2008

REFERENCES:

1. Narayan, B. "Disaster Management", New Delhi: A.P.H. Publishing Corporation ,2009

2. Kumar, N.. "Disaster Management". New Delhi: Alfa Publications. ,2009

3. Ghosh, G. K., "Disaster Management", New Delhi: A.P.H Publishing Corporation. , References

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	MrsJ.Srija	Assistant Professor - I	AVIT	srija.civil@avit.ac.in

	CONSTITUTION OF INDIA	CATEGORY	L	T	P	CREDIT
		AC	0	0	2	0

PREAMBLE

PREREQUISITE NIL

COURSE OBJECTIVES

1	To understand the nature and the Philosophy of the Constitution.
2	To understand the outstanding Features of the Indian Constitution and Nature of the Federal system.
3	To Analyse Panchayat Raj institutions as a tool of decentralization.
4	To Understand and analyse the three wings of the state in the contemporary scenario.
5	To Analyse Role of Adjudicatory Process.
6	To Understand and Evaluate the recent trends in the Indian Judiciary.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1.	
CO2..	
CO3.	
CO4.	
CO5 various expression systems	

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

CO	PO	PO2	PO3	PO4	PO	PO	PO	PO	PO9	PO1	PO1	P	PSO1	PS	PSO	PSO
CO1	**L**	L	**L**	**L**	**L**	L	M	**L**	**L**	**M**	**L**	**M**	M	**L**	**L**	**M**
CO2	**M**	M	L	L	**M**	L	S	**L**	**L**	**M**	**M**	**S**	S	**L**	**L**	**S**
CO3	**S**	M	L	L	**M**	L	M	**L**	**L**	**M**	**S**	**S**	M	**L**	**L**	**S**
CO4	**M**	M	L	L	**M**	L	M	**L**	**L**	**S**	**S**	**S**	S	**L**	**L**	**M**
CO5	**S**	S	**L**	**L**	**S**	L	S	**L**	**L**	**S**	**M**	**M**	S	**L**	**L**	**S**

S- Strong; M-Medium; L-Low

SYLLABUS

INTRODUCTION

The Constitution - Introduction

The Historical background and making of the Indian Constitution –Features of the Indian Constitution- Preamble and the Basic Structure - Fundamental Rights and Fundamental Duties –Directive Principles State Policy

Government of the Union

The Union Executive- Powers and duties of President –Prime Minister and Council of Ministers - Lok Sabha and Rajya Sabha

Government of the States

The Governor –Role and Powers - Cheif Minister and Council of Ministers- State Legislature

Local Government

The New system of Panchayats ,Municipalities and Co-Operative Societies

– Elections

Powers of Legislature -Role of Chief Election Commissioner-State Election Commission

TEXT BOOKS:

Ethics and Politics of the Indian Constitution Rajeev Bhargava Oxford University Press, New Delhi, 2008
2 The Constitution of India B.L. Fadia Sahitya Bhawan; New edition (2017)
3 Introduction to the Constitution of India DD Basu Lexis Nexis; Twenty-Fourth 2020 edition Suggested.

Software/Learning Websites:

1. https://www.constitution.org/cons/india/const.html
2. http://www.legislative.gov.in/constitution-of-india
3. https://www.sci.gov.in/constitution
4. https://www.toppr.com/guides/civics/the-indian-constitution/the-constitution-of india/

Alternative NPTEL/SWAYAM Course:

S.NO	**NPTEL ID**	**NPTEL Course Title**	**Course Instructor**
1	12910600	CONSTITUTION OF INDIA AND ENVIRONMENTAL GOVERNANCE: ADMINISTRATIVE AND ADJUDICATORY PROCESS	PROF. M. K. RAMESH NATIONAL LAW SCHOOL OF INDIA UNIVERSITY

COURSE DESIGNERS

S.NO.	**NAME OF THE FACULTY**	**DESIGNATION**	**DEPARTMENT**	**MAIL ID**
	Dr.Sudheer	Principal	AV School of Law	Sudheersurya18@gmail.com

	PEDAGOGY STUDIES	CATEGORY	L	T	P	CREDIT
		AC	0	0	2	0

PREAMBLE

The course is designed to provide pedagogical practices towards academic, research activities and professional developments.

PREREQUISITE : NIL

COURSE OBJECTIVES

2	To familiarize with pedagogical practices in formaland informal classrooms in developing countries
3	To identify evidence on the effectiveness of the pedagogical practices for enhancing teaching and learning methods
4	To understand the learning and resource barriers while handling large classes
5	To identify critical evidence gaps to guide the development

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

CO1.Identify theories and methodologies related to curriculum development and research	Remember
CO2.Interpret pedagogical practices in formaland informal classrooms in developing countries	Understand
CO3.Draw a chart on the effectiveness of the pedagogical practices for enhancing teaching and learning methods	Apply
CO4.Explore the learning and resource barriers while handling large classes	Analyze
CO5.Examine critical evidence gaps to guide the development	Analyze

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	PSO1	PSO2	PSO3	PSO4
CO1	L	L	-	-	-	-	-	-	-	L	-	-	-	-	-	
CO2	L	L	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO3	L	L	M	-	-	-	-	-	-	-	-	L	L	L	-	
CO4	L	S	-	-	-	-	-	-	-	-	-	-	-	-	-	
CO5	L	S	M	-	-	-	-	-	-	L	-	-	L	L	-	

S- Strong; M-Medium; L-Low

SYLLABUS

Introduction and Methodology,Aims and rationale, Policy background, Conceptual framework andterminology, Theories of learning, Curriculum, Teacher education, Conceptual framework, Research questions, Overview of methodology and searching.

Thematic overview: Pedagogical practices are being used by teachers in formaland informal classrooms in developing countries, Curriculum, Teacher education.

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies, How can teacher education (curriculum and practicum) and the schoolcurriculum and guidance materials best support effective pedagogy, Theory of change, Strength and nature of the body of evidence for effective pedagogicalpractices, Pedagogic theory and pedagogical approaches, Teachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and followupsupport, Peer support, Support from the head teacher and the community, Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Research gaps and future directions, Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Text Books/ References Books :

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal ofCurriculum Studies, 36(3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher educationresearch project(MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning ofbasicmaths and reading in Africa: Does teacher preparation count? International JournalEducational Development, 33 (3): 272– 282.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1				

	Personality Development Through Life Enlighten Skills	**HSS**	2	0	0	0
		AC		0	2	0

PREAMBLE.

PREREQUISITE : NIL

COURSE OBJECTIVES

1	To help the learner understand the basics of Personality and its correlation to society.
2	To understand the role of Attitude and motivation in the enhancement of personality.
3	To apply the concepts learnt in heightening the self esteem.
4	To analyse the most efficient method to develop the personality and prepare for employment.

COURSE OUTCOMES

After the successful completion of the course, learner will be able to

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO	PSO1	PSO2	PSO3	PSO4
CO1																
CO2																
CO3																
CO4																
CO5																

S- Strong; M-Medium; L-Low

SYLLABUS

- Introduction to Personality Development

The concept of personality - Dimensions of personality – Theories of Freud & Erickson-Significance of personality development. The concept of success and failure: What is success? - Hurdles in achieving success - Overcoming hurdles -Factors responsible for success – What is failure - Causes of failure. SWOT analysis.

- Attitude & Motivation

Attitude - Concept - Significance - Factors affecting attitudes - Positive attitude – Advantages – Negative attitude- Disadvantages - Ways to develop positive attitude - Differences between personalities having positive and negative attitude. Concept of motivation - Significance – Internal and external motives - Importance of self- motivation- Factors leading to de-motivation

-Self-esteem

Term self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self-esteem - Symptoms - Personality having low self esteem - Positive and negative self esteem. Interpersonal Relationships – Defining the difference between aggressive, submissive and assertive behaviours - Lateral thinking.

-Other Aspects of Personality Development

Body language - Problem-solving - Conflict and Stress Management - Decision-making skills - Leadership and qualities of a successful leader – Character building -Team-work – Time management - Work ethics –Good manners and etiquette.

Employability Quotient

Resume building- The art of participating in Group Discussion – Facing the Personal (HR & Technical) Interview - Frequently Asked Questions - Psychometric Analysis - Mock Interview Sessions.

Total: 45 Periods

Text Books: 1. Hurlock, E.B (2006). Personality Development, 28th Reprint. New Delhi: Tata McGraw Hill. 2. Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behavior 16th Edition: Prentice Hall.

COURSE DESIGNERS

S.NO.	NAME OF THE FACULTY	DESIGNATION	DEPARTMENT	MAIL ID
1	Dr.Jennifer G Joseph	HoD-H&S	AVIT	Jennifer@avit.a.cin
2	Mr. Tyndale Cicil	Assistant Professor	AVIT	tyndale.english@avit.ac.in