DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY, CHHATRPATI SAMBHAJINAGR.

NAAC- 'A $^{+}$' Grade

CIRCULAR NO.SS/NEP/B.Sc. Honor's/Model College/18/2025

It is hereby inform to all concerned that, the syllabus recommended by the Board of Deans, the Academic Council at its meeting held on 21st July 2025 has been accepted the **following syllabi *under the Faculty of Science & Technology* as per *National Education Policy – 2020*** run at the Model College, Ghansawangi Dist.-Jalna as appended herewith.

This is effective from the Academic Year 2025-26 and onwards.

Sr.No.	Courses	Semester
1.	**Honor's Degree of B.Sc. Biotechnology**	Vth & VIth
2.	**Honor's Degree of B.Sc. Biochemistry**	Vth & VIth
3.	**Honor's Degree of B.Sc. Computer Science**	Vth & VIth

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar
431 004.
REF.NO.SS/B.SC.HONOR'S/ MODEL COLLEGE/ NEP/2025/ 1451-56
Date:- 31/07/2025

★★★★★

Deputy Registrar
Syllabus Section

Copy forwarded with compliments to :-

1] **The Principal, Model College, Ghansawangi Dist. Jalna**
2] The Director, Board of Examinations & Evaluation,
3] The Director, University Network & Information Centre, UNIC,
with a request to upload this Circular on University Website.
Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar.

Copy to :-

1] PA to the Hon'ble Vice-Chancellor, Office
2] PA to the Pro. Vice-Chancellor, Office
3] PA to the Registrar, Office
Dr. Babasaheb Ambedkar Marathwada University,
Chhatrapati Sambhajinagar.

JD*31072025/-

-=**=-

Dr. Babasaheb Ambedkar Marathwada University,
Aurangabad (M.S.), India

Structure and Syllabus for B.Sc. (Biotechnology)

(Four Years Multidisciplinary Degree Program with Multiple Entry and Exit Option)

FOUR YEAR BACHELOR OF SCIENCE (B.Sc.)
Biotechnology

(For Model College Ghansawangi Dist. Jalna)

Under the Faculty of
Science and Technology

Effective from Academic year 2025 – 2026

(As per NEP-2020)

B. Sc. Biotechnology Third Year (Semester V)

Teaching Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
					Theory	Practical	Total	Theory	Practical
Second Year Semester V	Major	DSC-9	NBT501T	Applied immunology	03	--	03	03	--
			NBT501P	Lab Based on Applied immunology	...	02	02	--	04
		DSE-1	NBT502T	Gene Based Diagnosis and Therapy	03	--	03	03	--
			NBT502P	Lab based on Gene Based Diagnosis and Therapy	---	02	02	---	04
	Supportive	Minor-5 Select any one course from Basket 1	NBT503T1	Principles of Genetic Engineering	02	--	02	02	--
			NBT503T2	Bioinformatics	02	--	02	02	--
			NBT503T3	Bioprocess Technology	02	--	02	02	--
		Generic Elective Select any one pool of courses offered as a major	NB504T1	Introduction to Stem cell Biology	02	--	02	02	
			NBT504T2	Systems Biology	02	--	02	02	
			NBT504T3	Renewable Energy Technology	02	--	02	02	
	Applied	SEC (Choose any one from pool of major)	NBT503P1	Lab based on Principles of Genetic Engineering		04	04		04

			NBT503P2	Lab based on Bioinformatics		04	04	--	04
			NBT503P3	Lab based on Bioprocess Technology		04	04	---	04
		VSC-5	NBT505T	Bio analytical Tools	04	-----	04	04	--
	VEC/Life Skill Curriculum	JOC-1/FP	NBT506P	JOC	04	----	04	04	---
		VOC-1	NBT507T	VOC	04	----	04	04	---

B. Sc. Biotechnology Third Year (Semester V)
Evaluation/Examination Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credit		Evaluation Method		Total Marks	Max mark	Min Mark
					Theory	Practical	CA	UA			
Semester V	Major	DSC-5	NBT501T	Applied immunology	03		20	30	50	50	20
			NBT501P	Lab Based on Applied immunology	.....	02	--	50	50	50	20
		DSE-1	NBT502T	Gene Based Diagnosis and Therapy	03		20	30	50	50	20
			NBT502P	Lab based on Gene Based Diagnosis and Therapy	-----	02	---	50	50	50	20
	Supportive	Minor-1 Select any one course from Basket	NBT503T1	Principles of Genetic Engineering	02	---	20	30	50	50	20
			NBT503T2	Bioinformatics							
			NBT503T3	Bioprocess Technology							
		Generic Elective Select any one pool of courses offered as a major	NB504T1	Introduction to Stem cell Biology	02	---	20	30	50	50	20
			NBT504T2	Systems Biology							
			NBT504T3	Renewable Energy Technology							
	Applied	SEC (Choose	NBT503P1	Lab based on Principles of	---	04	---	50	50	50	20

		any one from pool of major)		Genetic Engineering								
			NBT503P2	Lab based on Bioinformatics								
			NBT503P3	Lab based on Bioprocess Technology								
		VSC-3	NBT505T	Bio analytical Tools	04	--	20	30	50		50	20
	VEC/Life Skill Curriculum	JOC-1	NBT506P	JOC	04	---	20	30	50		50	20
		VOC	NBT507T	VOC	04	---	20	30	50		50	20
								Total Marks	500		500	200

B. Sc. Biotechnology Third Year (Semester VI)

Teaching Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credits Assigned			Teaching Scheme (Hrs/ week)	
					Theory	Practical	Total	Theory	Practical
Semester VI	Major	**DSC-10**	NBT601T	Recombinant DNA Technology	03	--	03	03	--
			NBT601P	Lab based on Recombinant DNA Technology	…	02	02	--	04
		DSE-2	NBT602T	Industrial Biotechnology	03	--	03	03	--
			NBT602P	Lab based on Industrial Biotechnology	---	02	02	---	04
	Supportive	**Minor-6** Select any one course from Basket 1	NBT603T1	Metabolism	02	--	02	02	--
			NBT603T2	Nanobiotechnology and Biosensor	02	--	02	02	--
			NBT603T3	Animal biotechnology	02	--	02	02	--
		IKS-2	NBT604T1	IKS in Biotechnology	02	--	02	02	
	Applied	SEC-6 (Choose any one from pool of major)	NBT603P1	Lab based on Metabolism		04	04		04
			NBT603P2	Lab based on Nanobiotechnology and Biosensor		04	04	--	04
			NBT603P3	Lab based on Animal biotechnology		04	04	---	04
		VSC-6	NBT605T	Plant Biotechnology	04	-----	04	04	--
	VEC/Life Skill Curriculum	JOC-4	NBT606T	JOC	04	----	04	04	---
		OJT/Project	NBT607T	Project	04	----	04	04	---

B. Sc. Biotechnology Third Year (Semester VI)

Evaluation/Examination Scheme

Year/ Semester and Level		Section	Course Code	Course Name	Credit		Evaluation Method		Total Marks	Max mark	Min Mark
					Theory	Practical	CA	UA			
Semester VI	Major	DSE-7	NBT601T	Recombinant DNA Technology	03		20	30	50	50	20
			NBT601P	Lab based on Recombinant DNA Technology	.....	02	--	50	50	50	20
		DSE-8	NBT602T	Industrial Biotechnology	03		20	30	50	50	20
			NBT602P	Lab based on Industrial Biotechnology	-----	02	---	50	50	50	20
	Supportive	Minor-2 Select any one course from Basket 1	NBT603T1	Metabolism	02	---	20	30	50	50	20
			NBT603T2	NANOBIOTECHNOLOGY and Biosensor							
			NBT603T3	Animal biotechnology							
		IKS-2	NBT604T1	IKS in Biotechnology	02	---	20	30	50	50	20
	Applied	SEC-2 (Choose any one from pool	NBT603P1	Lab based on Metabolism	---	04	---	50	50	50	20
			NBT603P2	Lab based on NANOBIOTECHNOLOGY and							

		of major)		Biosensor								
			NBT603P3	Lab based on Animal biotechnology								
		VSC	NBT605T	Plant Biotechnology	04	--	20	30	50	50		20
	VEC/Life Skill Curriculum	JOC	NBT606T	JOC	04	---	20	30	50	50		20
		OJT/Project	NBT607T	project	04	---	-	50	50	50		20
								Total Marks	**500**	**500**		**200**

Curriculum of Semester –V

B.Sc. Biotechnology Honours (Semester V)

NBT501T: Applied Immonology

Paper: DSC-9
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 30

Unit 1.MHC structure and function

MHC –polymorphism; MHC restriction, role of MHC in disease susceptibility/resistance. Antigen processing and presentation: generation of MHC class-I and class-II peptides and their association with antigenic peptides, antigenic cross presentation. Generation of immunological response and its genetic control. Transplantation immunology: Immunological basis of graft rejection; immunosuppressive therapy. Immunological tolerance: Central and peripheral tolerance, Clonal anergy, induction of tolerance, immunological privileged sites. Autoimmunity–systemic and localized autoimmunity and probable mechanisms to develop autoimmunity.

Unit 2. Complement system

Different pathways of Complement system activation and its regulation. Hypersensitivity reactions: Types of hypersensitive reactions as per Coombs and Gel classification: immunoprophylactic interventions. Immunodeficiency; primary, secondary immunodeficiency; SCID and AIDS. Tumor immunology - tumor antigens, immunological factors influencing the incidence of cancer, immune surveillance, effecter mechanisms in cancer immunity.

Unit 3.Vaccines

Historical perspective; bacterial, viral vaccines and vaccines against cancer and birth control vaccines. Industrial production of vaccines in prokaryotic and eukaryotic system. Antibody engineering; Chimeric and humanized antibody and their production. Monoclonal and polyclonal sera their role in clinical diagnosis; Production of monoclonal antibodies and their role in clinical diagnosis e.g.: blood group, pregnancy and doping tests. Immunotoxins.

References:

1. Richard A Goldsby, Thomas J Kindt, Barbara S Osborne : Kuby's Immunology. 5th Edition , W.H.Freeman & Coy , New York

2. Abbas , Basic Immunology: Functions& disorders of the immune system , WB Sanders Co. Philadelphia.

3. William Paul : Fundamental Immunology , Lippincot Raven, Philadelphia

4. Roitt : Essential Immunology :9th Edition, Blackwell Science ltd. London.

5. DP Stites, AL Terr, TG Parslow : Medical Immunology, 10th Edition, Appleton and Lange , New York

6. David Male, Jonathan Brostoff, David Roth & Ivan Roitt: Immunology: 7th Edition:Mosbey Title: Philadelphia

7. EP Diamandsis and Theodore K Christopoulos: Immunoassay , Academic press, Sandiego, USA

8. Ronald W Ellis : Vaccines- new approaches to immunological problems , Butterworth Henimann, Boston, USA 9. Hay, Frank C: Practical immunology: Blackwell ScienceLtd. London

NBT501P : Lab Based on Applied Immunology

Paper: Lab Course
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 50

1.Blood film preparation and identification of cells.
2. Lymphoid organs and their microscopic organization.
3. Immunization and collection of serum.
4. Radial immunodiffusion and double diffusion.
5. Immunoelectrophoresis.
6. Purification of IgG from serum.
7. Purification of mononuclear cells by Ficoll-Hypaque.
8. conA induced proliferation of thymocytes (By MTT method)
9. ELISA and Western blotting
10. Hapten conjugation and quantitation.
11. Preparation of tissue culture medium and role of serum in it.
12. Preparation of single cell suspension from spleen and thymus.

NBT502T: Gene Based Diagnosis and Therapy

Paper: DSE-1 | Total Credit: 03
Contact Hours: 45 (Clock Hours) | Marks: 30

Unit 1. History of human genetics Autosomal dominant inheritance (HD, MD, CDD etc), Autosomal recessive inheritance (SCA, CF, etc), Sex linked and mitochondrial (DMD, hemophilia, LHON), PKU, Alzheimer, Parkinsonism, Tay-Sachs, Mongolism, Cri-du-chat, Edwards, X and Y chromosomal, Prenatal and Postnatal studies, Chromosome analysis

Unit 2. Gene environment interaction in complex diseases Genetics of Alzheimer's disease-Causative genes for familial Alzheimer's disease (APP, PSEN1, PSEN2)-Alzheimer's disease susceptibility genes (APOE, BACE1, BACE2, NCSTN, PEN2, SORL1), Environmental factors in Alzheimer's disease pathogenesis, Genetics of Parkinson's disease-Causative genes for familial Parkinson's disease susceptibility genes, Environmental factors in Parkinson's disease pathogenesis, Genetics of Amyotrophic lateral sclerosis-Causative genes for familial Amyotrophic lateral sclerosis-Amyotrophic lateral sclerosis susceptibility genes and Environmental factors Amyotrophic lateral sclerosis pathogenesis, Role of environment on epigenetics of neurodegenerative diseases, Teratology, Molecular genetics of coronary heart disease, Schizophrenia,Diabetes mellitus.

Unit 3. Gene therapy: problem, solutions and future prospects Controversial issues in medical genetics In vitro fertilization, Prenatal sex determination, Surrogate therapy, Genetic counseling, Germline gene therapy, ELSI, NBAC, IPR, Patenting, Human transgene

Reference books

1. Human Molecular Genetics- Tom Strachan

2. Concepts of Genetics- William s. Klug

3. Emery's Elements of Medical Genetics- Robert F. Mueller & Ian D. Young

NBT502P : Lab Based on Gene Based Diagnosis and Therapy

Paper: Lab Course
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 50

1. Total DNA and RNA extraction & quantification.

2. Southern hybridization of bacterial genome with non-radioactive probe.

3. DNA fingerprinting using RFLP method

4. Single Nucleotide polymorphism analysis

5. Amplification of human gene with specific primer by PCR technique and analysis by agarose gel electrophoresis.

6. Demonstration of cloning of genomic DNA in standard plasmid vectors & measurement of gene expression using reporter assay

NBT503T1: Principles of Genetic Engineering

Paper: Minar
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit 1: DNA modifications and DNA cutting Systems

safeguarding DNA –in detail. Concept of restriction endonuclease action with reference to DNA modification. DNA cutting enzymes: Type I, Type II, and Type III with reference to properties, essential co-factors, mode of action –specificity and limitations of their applications. DNA modifying enzymes with reference to their structure, function, requirements, reaction and applications: Exonucleases, Endonucleases acting on both single strand and double strand, Polymerases, phosphorylating enzymes, Phosphate removing enzymes, Enzyme adding base/s to the end. Nucleic acid Joining Enzymes: RNA ligase, DNA ligases.

Unit 2: Vectors

Concept and types of vectors for genetic engineering, Review of plasmids and modifying natural plasmids to construct a plasmid vector –example of pBR322 –applications, versatility and limitations, cloning of DNA with gene disruption strategy. The pUC18/ pUC19 vectors –with reference to their desing, potential also as an inducible vector system. Viral vectors: M13 life cycle and use of M13 as vector, M13mp1 and M13mp2 design, potential and limitations. Single strand preparations for sequencing reactions. Study of λ-genome to estimate potential as vector system. Concept of insertion and replacement vectors –Two examples with design and application

Unit 3: Cloning and Sequencing

Shotgun cloning; with reference to use of plasmid as vector, mean of cloning foreign piece of DNA (Construction of Chimera), mean to construct genomic library, mean to select recombinant with the use of antibiotic marker –a direct selection example. Generalized strategy of obtaining cDNA from mRNA as a template for PCR (do not teach PCR) or piece of DNA to be cloned in desired vectors. DNA sequencing by chemical method, by Enzymatic method and Chemical synthesis of DNA.

References:

1. An introduction to Genetic Engineering –Desmond S T Nicholl

,Cambridge university press, 2nd Ed.

2. Recombinant DNA: A short Course, Watson J.D, CSHL press

3. Short course in Bacterial Genetics –J. H. Miller

4. Molecular Biotechnology Principles & Applications of Recombinant

DNA, Bernard R Glick & Jack J Pasternak, ASM press.

5. Old R.W & Primrose S.B., Principles of Gene manipulations, Blackwell

Scientific publications.

6. Ausbel S.M , Brent R, Current Protocols in Molecular Biology., Wiley

International New York.

7. Maniatis I, Fritchh E.F ,& Sambrook J, Molecular cloning.

8. D.M Glover , DNA cloning, A practical approach.

9. Methods in Enzymology series, vol 152, 185, Academic press inc,

Sandiego.

10. Genes V –Benjamin Lewin

NBT503T2: Bioinformatics

Paper: Minar
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT I History of Bioinformatics. The notion of Homology. Sequence Information Sources, EMBL, GENBANK, Entrez, Unigene, Understanding the structure of each source and using it on the web.

UNIT II Protein Information Sources, PDB, SWISSPROT, TREMBL, Understanding the structure of each source and using it on the web. Introduction of Data Generating Techniques and Bioinformatics problem posed by them- Restriction Digestion, Chromatograms, Blots, PCR, Microarrays, Mass Spectrometry.

UNIT III Sequence and Phylogeny analysis, Detecting Open Reading Frames, Outline of sequence Assembly, Mutation/Substitution Matrices, Pairwise Alignments, Introduction to BLAST, using it on the web, Interpreting results, Multiple Sequence Alignment, Phylogenetic Analysis. Searching Databases: SRS, Entrez, Sequence Similarity Searches-BLAST, FASTA, Data Submission. Genome Annotation: Pattern and repeat finding, Gene identification tools

References:

1. Developmental Biology-Gilbert
2. Foundations of Embryology – Patten
3. Cell and Developmental Biotechnology – Raj NarianDesikar
4. Text book of Bryophytes, Pteridophytes , Gymnosperms and Paleobotany - Subramurti
5. Plant Anatomy and Embryology- S.N. Pandey, A. Chadha
6. Teresa K Attwood and David J. Parry-Smith, Introduction to Bioinformatics, Pearson Education Asia, 2001
7. Bexavanis& Francis, Bioinformatics-A practical guide to the analysis of genes and proteins, John Wiley and Sons, 2001

8. Rushidi, Basics of Bioinformatics, CRC Publications, 2001

9. Irfan Khan and AtiyaKhanum, Emerging trends in Bioinformatics, Ukaaz Publishers, 2002

10. David M. Hill, Craig Martiz and Barke Mable, Molecular systematics

11. Khan Imtiyazalam ,Rai University, Hydrabad:- Elementry Bioinformatics

12. N. Gautam Bioinformatics- Databases and algorithm

13. Bioinformatics: A practical guide to the analysis of genes and proteins A.D. Baxevanis and B.F.F. Ouellette (Eds). 2002 John Wiley and Sons.

14. Bioinformatics: Sequence and Genome Analysis by D.W. Mount, 2001, Cold Spring Harbor Laboratory Press.

NBT503T3: Bioprocess Technology

Paper: Minar
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

UNIT I Introduction to bioprocess technology. Range of bioprocess technology and its chronological development. Basic principle components of fermentation technology. Types of microbial culture and its growth kinetics– Batch, Fedbatch and Continuous culture.

UNIT II Design of bioprocess vessels- Significance of Impeller, Baffles, Sparger; Types of culture/production vessels- Airlift; Cyclone Column; Packed Tower and their application in production processes. Principles of upstream processing – Media preparation, Inocula development and sterilization.

UNIT III Introduction to oxygen requirement in bioprocess; mass transfer coefficient; factors affecting KLa. Bioprocess measurement and control system with special reference to computer aided process control. Introduction to downstream processing, product recovery and purification. Effluent treatment. Microbial production of ethanol, amylase, lactic acid and Single Cell Proteins.

SUGGESTED READING

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.

NBT504T1: Introduction to Stem cell Biology

Paper: Generic Elective | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 30

Unit I: Introduction to stem cells Definition, properties, proliferation, culture of stem cells, medical applications of stem cells, ethical and legal issues in use of stem cells.

Unit II: Types of stem cells. Stem Cell biology and therapy, types embryonic stem cell, Adult stem cell, Stem Cell Biology and Therapy, Embryonic Stem Cells, culture and the potential benefits of stem cell technology.

Unit III: Therapeutic applications of stem cells Gene Therapy: Introduction, History and evolution of Gene therapy, optimal disease targets, Failures and successes with gene therapy and future prospects, Genetic Perspectives for Gene Therapy, Gene Delivery methods: Viral vectors and Non-viral Vectors Module

References

1.Stem Cell Biology, Daniel Marshak, Richard L. Gardener and David Gottlieb, Cold Spring Harbour Laboratory Press

2. Stem cell biology and gene therapy, Booth C., Cell Biology International, Academic Press

3. Stem Cell and Gene-Based Therapy: Frontiers in Regenerative Medicine, Alexander Battler, Jonathan Leo, Springer,

NBT504T2: System Biology

Paper: Generic Elective
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I :Fundaments of system biology, Transcription networks, metabolic networks, cell signalling network motifs, gene circuits, kinetic modelling of biochemical reaction and bimolecular networks.

Units II – Gene Prediction Methods, Computational methods of gene prediction, Comparative genomics, Structural and Functional genomics, Gene annotation.

Unit III – Introduction to system biology and its application in health and diseases, pathway databases like KEGG, EMP, STRING, MetaCyc; Gene ontology.

Reference

1.Orpita Basu and Simminder Kaur Thukral. Bioinformatics , Databases, Tool and Algorithm. Oxford University Press, USA

2.Zhumur Ghosh and Bibekanand Mallick. Bioinformatics, Principles and Applications. , Oxford University Press, USA

3. Search engines available on Web and user friendly softwares.

4. Andreas D. Baxevanis and B.F. Francis Ouellette. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins. Wiley & sons..

NBT504T3: Renewable Energy Technology

Paper: Generic Elective
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit1: An Introduction to Energy Sources: Energy sources (conventional & non-conventional), renewable energy resources, primary & secondary energy sources, energy chain, energy demand, national energy strategy & plan, energy management, energy audit & conservation, Energy storage. Biological fuel generation: Biomass as a renewable energy source; types of biomass – forest, agricultural and animal residues, industrial and domestic organic wastes; conversion of biomass to clean fuels and petrochemical substitutes by physicochemical and/or fermentation processes.

Unit 2. Sources of biomass; biogas from anaerobic digestion; thermal energy from biomass combustion; ethanol from biomass.

Unit 3. Solar energy: solar collectors, solar pond, photovoltaic cells, chemical storage. Geothermal energy and wind energy: Use of geothermal energy, operating principles of different types of wind energy mills. Tide and Wave energy. Ocean Thermal Energy Conversion (OTEC). Nuclear energy: nuclear reactions and power generating tidal wave energy.

References/Books:

1. J.E. Smith – Biotechnology, 3rd ed. Cambridge Univ Press.

2. S. Sarkar – Fuels and combustion, 2nd ed., University Press.

3. Abbasi, S.A. and Abbasi, N. (2005), Renewable Energy Sources and Environmental Impact, Prentice Hall of India Pvt. Ltd., Pp.134-136.

NBT503P1: Lab Based on Lab based on Principles of Genetic Engineering

Paper: SEC
Contact Hours: 30 (Clock Hours)

Total Credit: 04
Marks: 50

1. Isolation of plasmid DNA from resistant clinical isolates

2. Transformation of resistance from clinical strain to laboratory strain

(sensitive)

3. Blue-white selection assay

4. Study of restriction fragments of -DNA

5. Study of impact of methylation on restriction activity.

6. Shotgun cloning –demonstration of plasmid resistance transfer

7. Shotgun cloning –to introduce chimeric construct

8. Preparation and demonstration of cDNA

9. Shotgun cloning –cloning of cDNA

10. Cloning of DNA with gene disruption strategy

NBT503P2: Lab Based on Bioinformatics

Paper: SEC | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 50

1. Sequence information resource

2. Understanding and use of various web resources: EMBL, Genbank, Entrez, Unigene, Protein information resource (PIR)

3. Understanding and using: PDB, Swissprot, TREMBL

4. Using various BLAST and interpretation of results

NBT503P3: Lab Based on Bioprocess tehnology

Paper: SEC | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 50

1. Bacterial growth curve.

2. Calculation of thermal death point (TDP) of a microbial sample.

3. Production and analysis of ethanol.

4. Production and analysis of amylase.

5. Production and analysis of lactic acid.

6. Isolation of industrially important microorganism from natural resource.

NBT505T: BIO-ANALYTICAL TOOLS

Paper: VSC
Contact Hours: 30 (Clock Hours)

Total Credit: 04
Marks: 30

UNIT I Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy

UNIT II Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation, cell fractionation techniques, isolation of sub-cellular organelles and particles.

UNIT III Introduction to the principle of chromatography. Paper chromatography, thin layer chromatography, column chromatography: silica and gel filtration, affinity and ion exchange chromatography, gas chromatography, HPLC. Introduction to electrophoresis. Starch-gel, polyacrylamide gel (native and SDS-PAGE), agarose-gel electrophoresis, pulse field gel electrophoresis, immuno- electrophoresis, isoelectric focusing, Western blotting. Introduction to Biosensors and Nanotechnology and their applications.

SUGGESTED READING

1. Karp, G. 2010. Cell and Molecular Biology: Concepts and Experiments. 6th Edition. John Wiley& Sons. Inc.

2. De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia.

3. Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.

4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. 2009 The World of the Cell.7th edition. Pearson Benjamin Cummings Publishing, San Francisco.

NBT506T: JOC: Computer Networking

Paper:JOC | Total Credit: 04

Contact Hours: 30 (Clock Hours) | Marks: 30

Unit I **Introduction**

1.1 LAN
1.2 MAN
1.3 WAN
1.4 Topologies

Unit II **Physical Layer**

2.1 Transmission Media
2.2 Method of Communication.

Unit III **Medium Access Sublayer**

3.1 Cabling
3.2 Straight through and Cross Over.
3.3 Standard Color Coding – RJ-45, UTP.
3.4 Crimping Tools.

Unit IV **Network Layer**

4.1 Switches
4.2 Bridge
4.3 Router
4.4 WIFI Router

Unit V **Internetworking**

5.1 TCP/IP Addressing, MAC Address, Subnet.
5.2 Creating LAN, Set up WAN (Wi-Fi Router).
5.3 ICMP ping Command for Connection Verification.
5.4 Share and Access file/folders over network.

Reference Books:

- Guide to Network by Tamara Dean 6th Edition, Cengaye Leasnicey, June14, 2012.
- Computer Network, A. Tanenbaum, 5th Edition, Tata McGraw Hill Publication.

NBT507T: VOC: Project Report Writing

Paper:VOC
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I **Introduction to Project Report Writing**

1.1 Meaning and Definition of Project Report.
1.2 Steps of Ideal Project Report Writing.
1.3 Characteristics and Objectives of Project Report Writing.
1.4 Importance of Project Report Writing.

Unit II **Nature of Project Report Writing**

2.1 Selection of Project Title.
2.2 Issues and Challenges of Project Report Writing.
2.3 Outcomes of Project Report Writing.
2.4 Summery of Project Report.

Unit III **Basic of Project Report Writing**

3.1 Types of Project Report.
3.2 Duration of Project Report and Financial Support.
3.3 Format of Micro and Macro Project Report Writing.
3.4 Skills and Management of Project Writing.

Unit IV **Components of Project Report Writing**

4.1 Specification.
4.2 Use the various techniques.
4.3 Collection of Data and Facts.
4.4 Readability.

Unit V **Government Funding**

5.1 Introduction to Central and State Government Funding Institutions.
5.2 UGC
5.3 ICSSR
5.4 RUSA
5.5 Other Funding Institutions.

Reference Books:

- Garg R. K., Handbook on Project Reports, Bharat Law House, Delhi, 2017.
- Kalpesh Ashar, Project Management Essentials, 5th Edition, Vibrant Publishers, 2022.

Curriculum of Semester –VI

NBT601T: Recombinant DNA Technology

Paper: DSC
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 30

UNIT I Molecular tools and applications- restriction enzymes, ligases, polymerases, alkaline phosphatase. Gene Recombination and Gene transfer: Transformation, Episomes, Plasmids and other cloning vectors (Bacteriophage-derived vectors, artificial chromosomes), Microinjection, Electroporation, Ultrasonication, Principle and applications of Polymerase chain reaction (PCR), primer-design, and RT- (Reverse transcription) PCR.

UNIT II Restriction and modification system, restriction mapping. Southern and Northern hybridization. Preparation and comparison of Genomic and cDNA library, screening of recombinants, reverse transcription,. Genome mapping, DNA fingerprinting, Applications of Genetic Engineering Genetic engineering in animals: Production and applications of transgenic mice, role of ES cells in gene targeting in mice, Therapeutic products produced by genetic engineering-blood proteins, human hormones, immune modulators and vaccines (one example each).

UNIT III Random and site-directed mutagenesis: Primer extension and PCR based methods of site directed mutagenesis, Random mutagenesis, Gene shuffling, production of chimeric proteins, Protein engineering concepts and examples (any two).

Genetic engineering in plants: Use of Agrobacterium tumefaciens and A. rhizogenes, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants, Use of plant viruses as episomal expression vectors.

References:

1. Brown TA. (2006). Gene Cloning and DNA Analysis. 5th edition. Blackwell Publishing, Oxford, U.K.

2. Clark DP and Pazdernik NJ. (2009). Biotechnology-Applying the Genetic Revolution. Elsevier Academic Press, USA.

3. Glick, B.R., Pasternak, J.J. (2003). Molecular Biotechnology- Principles and Applications of recombinant DNA. ASM Press, Washington

4. Primrose SB and Twyman RM. (2006). Principles of Gene Manipulation and Genomics, 7th edition. Blackwell Publishing, Oxford, U.K.

5. Sambrook J, Fritsch EF and Maniatis T. (2001). Molecular Cloning-A Laboratory Manual. 3rd edition. Cold Spring Harbor Laboratory Press

NBT601P: Lab Based on Recombinant DNA Technology

Paper: DSC
Contact Hours: 45 (Clock Hours)

Total Credit: 03
Marks: 50

1.Isolation of chromosomal DNA from plant cells

2. Isolation of chromosomal DNA from E.coli

3. Qualitative and quantitative analysis of DNA using spectrophotometer

4. Plasmid DNA isolation 5. Restriction digestion of DNA

6. Making competent cells

7. Transformation of competent cells.

8. Demonstration of PCR

NBT602T: Industrial Biotechnology

Paper: DSE | Total Credit: 03
Contact Hours: 45 (Clock Hours) | Marks: 30

UNIT I Production of industrial chemicals, biochemicals and chemotherapeutic products. Propionic acid, butyric acid, 2-3 butanediol, gluconic acid, itaconic acid, Biofuels: Biogas, Ethanol, butanol, hydrogen, biodiesel, microbial electricity, starch conversion processes; Microbial polysaccharides; Microbial insecticides; microbial flavours and fragrances, newer antibiotics, anti cancer agents, amino acids.

UNIT II Microbial products of pharmacological interest, steriod fermentations and transformations. Over production of microbial metabolite, Secondary metabolism – its significance and products. Metabolic engineering of secondary metabolism for highest productivity. Enzyme and cell immobilization techniques in industrial processing, enzymes in organic synthesis, proteolytic enzymes, hydrolytic enzymes, glucose isomerase, enzymes in food technology/organic synthesis.

UNIT III Purification & characterization of proteins, Upstream and downstream processing, solids and liquid handling. Distribution of microbial cells, centrifugation, filtration of fermentation broth, ultra centrifugation, liquid extraction, ion-exchange recovery of biological products. Experimental model for design of fermentation systems, Anaerobic fermentations.

Rate equations for enzyme kinetics, simple and complex reactions. Inhibition kinetics; effect of pH and temperature on rate of enzyme reactions. Mathematical derivation of growth kinetics, mathematical derivations of batch and continuous culture operations; single stage CSTR; mass transfer in aerobic fermentation; resistances encountered; overall mass transfer co-efficient (Ka) determination, factors depending on scale up principle and different methods of scaling up. Metabolic engineering of antibiotic biosynthetic pathways.

References:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.

2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.

3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.

4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd. 5. Salisbury, Whitaker and Hall. Principles of fermentation Technology,

NBT602P: Lab Based on Industrial Biotechnology

Paper: DSE | Total Credit: 03
Contact Hours: 45 (Clock Hours) | Marks: 50

1. Random and strategic screening for a metabolite (screening for citric acid producing organisms)
2. Screening, enrichment and isolation for a secondary metabolite producer from the environment crowded plate technique for antibiotic producing organisms
3. Determination of TDP & TDT of *E.coli* for designing of a sterilizer
4. Determination of Growth curve of yeast and compute growth rate & growth yield
5. Strain improvement of the industrially important isolate (*A.niger* / yeast) using EtBr for higher yield of the product
6. Media balancing experiments: carbon and nitrogen as variables (in alcohol fermentation)
7. Alchohol Fermentation: using different substrates and its downstream processing.
8. Production of Organic acid/s by fermentation
9. Antibiotic fermentations Penicillin (upto bioassay)
10. Microbial Enzyme production and its characterization-Amylase
11. Bioinsecticide / Biofertilizers: isolation production purification and assay

NBT603T1: Metabolism

Paper: Minar-1
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit I: Carbohydrate Metabolism

Importance of glucose in metabolism, glucose transport, Definition, concept, Metabolic map with enzyme and overall Balance sheet of Net gain of ATP; Glycolysis, TCA, HMP, Gluconeogenesis. Electron transport & Oxidative phosphorylation, components involved in Electron transport, Respiratory chain, Oxidative phosphorylation & mechanism. Energies of oxidative phosphorylation.

Unit II: Lipid and Amino Acid Metabolism:

Fatty acid are activated and transported in Mitochondria. Oxidation of fatty acid (Palmitic acid) Fatty acid biosynthesis : Formation of malonyl COA from Acetyl COA, FAS – Multienzyme complex & Reaction of palmitic acid.

Biosynthesis of Amino Acid Metabolic fates of amino groups, Deamination, Decarboxylation & Transamination reactions. Biosynthesis of phenylalanine, Tyrosine & Tryptophan; Biosynthesis of Chorismate, Chorismate to Tryptophan, Phenylalanine & Tyrosine with chemical reaction and enzymes

Unit III: Biosynthesis of nucleotides: - Denovo & Salvage pathway (introductory). Denovo purine nucleotide synthesis from PRPP to IMP, IMP to AMP& GMP; Pyrimidine nucleotide biosynthesis Denovo.

References:

1.Biochemistry by Lubert Stryer,III edn,1988. W.H. Freeman & Co.

2.Principles of Biochemistry by Lehninger, II edn, 1978, Worth Publisher Inc.

3.Biochemistry by Zubay, III edn, 1933, W.C Brown Publisher.

4.Outline of Biochemistry by Cohn and Stump.

5.Practical Biochemistry by D. Plummer.

6.Practical Biochemsitry by J. Jayraman

NBT603T2: NANOBIOTECHNOLOGY and Biosensor

Paper: Minar
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit 1. Introduction to Nanobiotechnology -Nanotechnology and nanobiotechnology, History, -Broad perspective, and Today's World, -Significance of Nanoscale materials. - Synthesis and characterization of nanomaterials - One, two, and three dimensional structure of nanomaterials - Bio-mimetics

Unit.2. Application of Nanomaterials in medicine- -Drug delivery -Drug encapsulation -Tissue repair and implantation -Nanocoatings - Miniaturized devices/ Lab on a chip Toxic effects of nanomaterials.

Unit.3. Biosensors: -History of biosensors discovery - Components of a typical biosensor - Types of biosensors (Calorimetric, Potentiometric, amperometric, optical, Piezo-electric, Immuno based sensors) - Applications related to healthcare, bio-defense, food and water safety, agriculture and environment

BOOKS RECOMMENDED:

1. Biosensors and Nanotechnology, (Editors; Zeynep Altintas) John Wiley & Sons Inc, 2017, ISBN: 9781119065159, 9781119065159

2. Biosensors and Bioelectronics: D. Dharaneeshwara Reddy, O.M Hussain, DVR. Sai Gopal, Muralidhara Rao, and K.S Sastry. I. K International Publishing House Pvt. Ltd, New Delhi. ISBN 978-93-82332-19-0, Year?

3. C. M. Niemeyer, "Nanobiotechnology: Concepts, Applications and Perspectives", Wiley – VCH, 2006

4. David S Goodsell, "Bionanotechnology", John Wiley & Sons, 2004

5. Understanding Nanomedicine: An Introductory Textbook, Rob Burgess, Publisher: Pan Stanford Publishing; ISBN-13: 978-9814316385, year?

6. Introduction to Nanoscience, S.M. Lindsay, Oxford universal Press, First Edition, 2010 Nanotechnology: Understanding small system, Ben Rogers, SumitaPennathur and Jesse Adams, CRC Press, Second edition, 2011

7. Nanobiotechnology: Bioinspired Devices and Material of Future by Oded Shoseyov and Ilan levy, Human Press, First edition, 2007. The Nanobiotechnology Handbook (Editor; Yubing Xie) CRC press.

NBT603T3: Animal biotechnology

Paper: Minar
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 30

Unit 1:Animal Tissue culture:

Media, Natural, artificial, serum, serum free media, chemically defined media and protein free media Primary culture , Tissue disaggregation, secondary culture, cell lines and maintanence, Assesment of growth, measurement of cell death

Unit II: Methods in animal tissue culture

Monolayer culture: Roux bottle, roller bottle, multitray, synthetic hollow fiber, bead bed reactors, continuous flow cultures, Airlift fermentors Immobilized cultures Entrapment cultures, Porous carriers, Fixed bed (Parosphere and fluidized beds)

Unit III Transformation methods

DNA calcium phosphate coprecipitation method, Lipofection, electroporation, DEAE dextran method, Microinjection

References:

1. text book of genetic engineering by Desmond Nicoll
2. Principles of gene manipulation by Primrose
3. Animal cell culture by Jon Masters
4. Culture of Animal cells-3rd Edition Freshney Wiley liss
5. Mammalian Cell Biotechnologyy-Apractical Approach, M,Butler Oxford University press ,New York
6. Animal Cell culture techniques, Martin Springer

NBT604T: IKS in Biotechnology

Paper: IKS | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 30

Unit I

Origin of cultivated crops: Concepts of centre of origin, their importance with reference to Vavilov's work. Examples of major plant introductions; crop domestication and loss of genetic Diversity; evolution of new crops/ varieties, importance of germplasm diversity. • Cereals: Rice and wheat (origin, morphology, processing and uses) • Legumes: Origin, morphology and uses of gram and mung bean. Importance to man andEnvironment. • Drug-yielding plants: Therapeutic and habit forming drugs with special reference to Cinchona, Digitalis, Papavar, Cannabis and Tobacco (morphology, processing, uses and health hazards)

Unit II

General account about the microbes used as biofertilizers- Rhizobium- isolation, identification, Mass multiplication, carrier based inoculants, actinorrhizal symbiosis. • Organic farming- green manuring and organic fertilizers, recycling of biodegradable municipal, Agricultural and industrial wastes- biocompost making methods, types and methods of Vermicomposting- field application.

Unit III

Pharmacognosy- General account : Pharmacognosy and its importance in modern medicine, Crude drugs, Classification of Drugs- chemical and pharmacological, Drug evaluation– organoleptic, microscopic, chemical, Physical and biological. Major pharmacological groups of plant drugs and their uses. Secondary metabolites: Definition of secondary metabolites and difference with primary metabolites ,Interrelationship of basic metabolic pathways with secondary metabolite biosynthesis (outlines only), Major types–terpenoids, phenolics, flavonoids, alkaloids and their protective action against Pathogenic microbes and herbivores.

References:

1. The Cell: Cooper
2. Principles Of Cancer Biology: Pearson New International Edition
3. Introduction to the Cellular and Molecular Biology of Cancer" by L M Franks
4. The Biology of Cancer" by Robert A Weinberg

NBT603P1: Lab Based on Metabolism

Paper: SEC | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 50

1.Detection of Phospholipids content in oil.

2. Isolation & Detection of Succinate dehydrogenase.

3. Separation of DNA, RNA, Protein from tissue extract.

4. Estimation of amino acid by ninhydrin Method.

5. Estimation of aromatic amino acid by Folin-Phenol reagent.

NBT603P2: Lab Based on Nanobiotechnology and Biosensor

Paper: SEC | Total Credit: 02
Contact Hours: 30 (Clock Hours) | Marks: 50

1. Preparation of silver nanoparticles using sodium
2. Green synthesis of silver nanoparticles using bacteria/plant/fungi
3. Characterization of nanomaterials using Scanning Electron Microscopy.
4. Evaluation of antimicrobial activity of silver nanoparticles against Gram Positive and Gram negative microorganisms
5. Increasing bioavailability of drugs using nanostructured Beta-cyclodextrin
6. Entrapment of silver nanoparticles in alginate beads for remediation of water.
7. Study of principle and working of glucose biosensor
8. Study of conductivity of DNA for use in biosensor

NBT603P3: Lab based on Animal Biotechnology

Paper: SEC
Contact Hours: 30 (Clock Hours)

Total Credit: 02
Marks: 50

1. Preparation and Sterilization of Media.
2. Preparation of Explant
3. Animal cell culture
4. Cell suspension culture

NBT606T: Plant Biotechnology

Paper: VSC | Total Credit: 04

Contact Hours: 30 (Clock Hours) | Marks: 30

Unit 1.Plant tissue culture:

Media composition: Theory of limiting factor with respective to inorganic salts (Major and minor elements) organic chemicals (carbohydrates, vitamins)

Growth regulators (Auxin, cytokinin, gibberellins, ascorbic acid, ethylene) Amino acids (L-amino acids and its role in Tissue culture) Antibiotics (Ampicillin, Carbenicillin, Cefotaxime, Gentamycin sulphate, methylol urea, Polymixin B Ribavirin, Streptomycin) Uses Chemically undefined constituents and natural complexes (gelling agents, activated charcoal, casein HL, coconut milk, corn milk, corn starch, potato extract, yeast extract, antioxidants

Unit 2.Selection of media for specified application:

Callus induction media, chlorate selection medium, Embryo culture medium, Green algae medium, Propogation medium,Standardization of media and glassware ,Cellular Totipotency Callus culture and dynamics of callus growth:Organogenesis and its applications: Somaclonal variation and its application- Micropropogation and its application: MP through shoot and bud meristem Tip culture, in vitro tuberization, somatic embryogenesis

UNIT-3-Methods in Plant tissue culture

Organ culture: Root culture, shoot tip culture (meristem culture), flower bud culture,ovary culture, ovule culture, embryo culture, anther culture Callus culture and its dynamics Somatic embryogenesis and artificial seeds Protoplast culture, protoplast fusion and somatic hybridization – Application of Plant Tissue Culture

References

1. A text book of genetic engineering by Desmond Nicoll
2. Agrobacterium: From biology to Biotechnology by Tzvi Tzfira
3. Principles of gene manipulation by Primrose
4. Animal cell culture by Jon Masters
5. Plant cell and tissue culture – A tool in Biotechnology- by Ashwani Kumar
6. Laboratory manual of Plant Biotechnology By Purohit-2
7. Methods in Plant tissue culture By U Kumar-1
8. Plant tissue culture Bhojwani:
9. Introduction to Plant Tissue Culture Kalyan Kumar DE
10. Practical application of Plant Molecular Biology R.J.Henry,Chapman and Hall
11. Culture of Animal cells-3rd Edition Freshney Wiley liss
12. Mammalian Cell Biotechnologyy-Apractical Approach, M,Butler Oxford University press ,New York
13. Animal Cell culture techniques, Martin Springer

NBT607T: JOC: Office Management

Paper: JOC | Total Credit: 04
Contact Hours: 30 (Clock Hours) | Marks: 30

Unit I **Office Management**

1.1 Introduction of Office Management.
1.2 Meaning and Concept of Office Management.
1.3 Importance of Office Management.
1.4 Essential factors of Ideal Office Management.

Unit II **Office Arrangement**

2.1 Seating and Machine Arrangement.
2.2 Record Management- Meaning and Objectives.
2.3 Commercial Correspondence- Meaning and Importance.
2.4 Various types of Commercial Correspondence- Sales Letter, Trade Order, Office Memorandum and Reminder.

Unit III **Supervision in Office**

3.1 Meaning and Concept of Supervision.
3.2 Rule and Regulation of Supervision.
3.3 Importance of Supervision.
3.4 Skills and Functions of Supervisor.

Unit IV **Leadership and Motivation**

4.1 Meaning, Concept and Characteristics of Leadership.
4.2 Importance of Leadership.
4.3 Qualities of a Leader.
4.4 Definition, Characteristics and Types of Motivation.

Unit V **Discipline**

5.1 Nature of Office Discipline.
5.2 Work Distribution in Office.
5.3 Role of Discipline in Office.
5.4 Importance and Manner of Office Control.

Reference Books:

- Ankita Bhatiya & Dr. R. K. Chopra, Office Management.
- Dr. P. Rizwan Ahmed, Office Management.
- R. S. N. Pillai, Office Management.
- Ghosh & Agrawal, Office Management, S. Chand & Company, New Delhi.
- Agrawal R. C. & Siyaram Jaiswal, Navyug Sahitya Sadan, Agra, UP.

NBT608P: Project

Paper: Project

Total Credit: 04

Contact Hours: 30 (Clock Hours)

Marks: 50

Project : Guidelines

1) Project should be NOT less than 10000 word

2) One copy of the project should be hand-written

3) Other 3 copy typed and submit to Collage/ Institute / Department

4) Project should be written in International standard with at least or not less than

30 references.

5) References quoted should be from peer reviewed international journals, available on Scopus/ Research Gate/ Or Pubmed and should not be merely from www.google.com.

6) The dissertation preparation must be as per research article published in "CELL" http://www.cell.com/cell/authors . Please avoid guidelines provided for Resource article, Theory articles matters arising article or review.

7) Your dissertation may include figures and tables more than in number prescribed by Cell for a Research article. This is because, you are not additionally providing "Supplement information" all data is to be included in the dissertation.

8) Project may pertain to the above mentioned themes or relevant to any course studied during last year.