Final

DIPLOMA CURRICULUM OF BIOTECHNOLOGY (SECOND YEAR) (3rd Semester)

(To be implemented from 2025-26)

Prepared by;

National Institute of Technical Teachers' Training & Research Kolkata
Block – FC, Sector – III, Salt Lake City, Kolkata – 700106

Vetted by:
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Near Raj Bhawan, Unit-VIII, Bhubaneswar, Odisha

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PROGRAMME TITLE: BIO-TECHNOLOGY

SEMESTER - III

SL. No	Category of Course	Code No	Course Title	Teaching Scheme				Evaluation Scheme				Total Marks	Credits
				Pre-requisite	Contact Hours/ week			Theory		Practical			
					L	T	P	End Exam	Progressive Assessment	End Exam	Progressive Assessment		
1	Programme core	BTPC 201 TH:1	Basic Microbiology		3	0	0	70	30	-	-	100	3
2		BTPC 203 TH:2	Biochemistry		3	0	0	70	30	-	-	100	3
3		BTPC205 TH:3	Instrumentation		3	0	0	70	30	-	-	100	3
4		BTPC207 TH:4	Molecular Biology		3	0	0	70	30	-	-	100	3
5		BTPC209 TH:5	Cell Biology		3	0	0	70	30	-	-	100	3
6		BTPC211 PR:1	Microbiology lab		0	0	4	-	-	15	35	50	2
7		BTPC213 PR:2	Biochemistry lab		0	0	4	-	-	15	35	50	2
8		BTPC215 PR:3	Instrumentation lab		0	0	4	-	-	15	35	50	2
9		BTPC217 PR:4	Cell and molecular biology Lab		0	0	4	-	-	15	35	50	2
11	Summer Internship	SI201	Summer internship – I*		0	0	0	-	-	15	35	50	2
TOTAL					15	0	16	350	150	75	175	750	25

CONTENT DETAILS OF SEMESTER - III

TH:1- BASIC MICROBIOLOGY

L	T	P		Course Code: BTPC 201	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE: This course will equip students with foundational knowledge of microorganisms, their behavior, classification, interactions with humans, and their role in health and disease. It is designed to provide students with an understanding of microbiology concepts crucial for various fields such as healthcare, food industry, pharmaceuticals, environmental science, and biotechnology.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Explain the role of microorganisms in the environment and human health.
- Classify microorganisms based on their morphology, physiology, and genetic makeup.
- Identify common microorganisms
- Explain the process of microbial growth, metabolism, and control.
- Illustrate microbial pathogenesis and immunity
- Apply knowledge of microbiology to real-world applications in healthcare, food safety, and environmental studies.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Microbiology: definition and scope of microbiology, history of microbiology, branches of microbiology.	**5**
II	Classification of Microorganisms: microbial taxonomy, classification systems, domains of life (Archaea, Bacteria, and Eukarya), characteristics of prokaryotes and eukaryotes.	**8**
III	Microbial Cell Structure and Function: bacterial cell structure, eukaryotic microorganisms (structure of fungi, protozoa, and algae), viruses (structure, types, and replication cycles), microbial metabolism.	**10**
IV	Microbial Growth and Control: microbial growth phases (lag phase, exponential phase, stationary phase, and death phase) factors affecting microbial growth, control of microbial growth, antibiotic resistance Microbial Genetics: DNA replication and protein synthesis in bacteria. genetic recombination in bacteria (transformation, transduction, and conjugation)	**12**
V	Microorganisms in Human Health: Pathogenic Microorganisms, Infectious Diseases, Industrial and Environmental Microbiology: Microorganisms in Food Industry, Microorganisms in Waste Treatment, Applications of Microorganisms in Biotechnology,Nitrogen fixation	**10**
	Total	**45**

REFERENCES:

1.	G. Tortora, B. Funke and C. Case,Microbiology,An Introduction (International Edition), 8th Ed, Pearson Education, 2003.
2.	M. Madigan, J. Martinko and J. Parker, Brock Biology of Microorganisms, 10th Ed, Prentice Hall, 2002.
3.	R. Y. Stanier, J. L. Ingraham, M.L. Wheelis and P. R. Painter, General Microbiology, 5th Ed, Macmillan Press, 1987.
4.	L. M. Prescott, J. P. Harley and D. A. Klein, Microbiology, 6th Ed, McGraw Hill, 2005.
5.	J. G. Black, Microbiology: Principles & Explorations. 5th Ed, John Wiley & Sons Inc., 2002.
6.	Textbook of Microbiology by Dr. R.C. Dubey, Dr. D .K. Maheshwari

TH:2- BIOCHEMISTRY

L	T	P		
3	0	0		**Course Code: BTPC 203**
Total Contact Hours				**Theory Assessment**
Theory		: 45Hrs		End Term Exam 70
			Total Marks: 100	Progressive Assessment 30
Pre Requisite		**: Nil**		
Credit		**3**		Category of Course : PC

RATIONALE: Biochemistry bridges the gap between biology and chemistry, providing an understanding of the chemical processes within and related to living organisms. This subject is essential for students to comprehend the molecular basis of life, the structure-function relationship of biomolecules, and metabolic pathways that sustain life processes. It lays a foundation for advanced studies in biotechnology.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Explain the structure, properties, and functions of biomolecules such as carbohydrates, proteins, lipids, and nucleic acids.
- Illustrate the principles of enzyme action, kinetics, and regulation.
- Interpret metabolic pathways and energy production mechanisms in cells.
- Analyze the biochemical basis of diseases and the role of biomolecules in health.
- Apply biochemical concepts in laboratory settings and real-world scenarios.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Biochemistry: definition, scope, and importance of biochemistry, overview of biomolecules and metabolism, water and its role in biological systems	**5**
II	Carbohydrates: Classification (Monosaccharides, disaccharides, polysaccharides), Glycolysis, gluconeogenesis, and the citric acid cycle Proteins and Enzymes: Amino acids, Protein structure, Enzymes (Types, mechanisms of action, enzyme kinetics, factors affecting enzyme activity)	**12**
III	Lipids: Classification and structure, Functions of lipids in biological systems Nucleic Acids: Structure and function of DNA and RNA	**10**
IV	Metabolism and Bioenergetics: Overview of metabolism: Anabolism and catabolism, ATP: The energy currency of the cell, Electron transport chain and oxidative phosphorylation	**8**
V	Clinical Biochemistry and Applications: Biochemical basis of diseases (diabetes, obesity, genetic disorders), Diagnostic enzymes and biomarkers, Role of biochemistry in medicine, nutrition, and environmental science	**5**
	Total	**45**

REFERENCES:

1.	W. W. Parson, D. E. Vance and G.L.Zubay, Principles of Biochemistry, Wm. C. Brown Publishers
2.	R. K. Murray, D. K. Granner, P.A. Mayes and V. W. Rodwell, Harper's Biochemistry, McGraw Hill,
3.	D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 6th Ed., Macmillan Worth,
4.	J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Ed., W. H. Freeman.

TH:3- INSTRUMENTATION

L	T	P		Course Code: BTPC207	
3	0	0			
Total Contact Hours			**Total Marks: 100**	**Theory Assessment**	
Theory		: 45Hrs		End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE: Instrumentation is a vital subject that focuses on the principles and applications of measurement instruments and control systems in biotechnology and related industries. This subject equips students with the knowledge of monitoring, controlling, optimizing bioprocesses to ensure efficiency, safety, and product quality, detection and quantification of biomolecules, cells, and microorganisms at very low concentrations.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Explain the basic concepts, working principles, and classifications of measurement instruments used in biotechnology and related industries.
- Demonstrate knowledge of different measurement techniques for physical, chemical, and biological parameters
- Analyze and interpret data obtained from various analytical and process instruments to make informed decisions in bioprocess optimization.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Simple microscopy, phase contrast microscopy, florescence and electron microscopy (TEM and SEM), pH meter, absorption and emission spectroscopy	**5**
II	Principle and law of absorption fluorimetry, colorimetry, spectrophotometry (visible, UV, infrared), centrifugation and its types, cell fractionation techniques, isolation of sub-cellular organelles and particles.	**10**
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.	**10**
IV	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. PCR ,RT- PCR	**20**
	Total	**45**

REFERENCES:

1.	De Robertis, E.D.P. and De Robertis, E.M.F. 2006. Cell and Molecular Biology. 8th edition. Lippincott Williams and Wilkins, Philadelphia
2.	Cooper, G.M. and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C.; Sinauer Associates, MA.
3.	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.

TH:4- MOLECULAR BIOLOGY

L	T	P		**Course Code: BTPC207**	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE: Molecular Biology explores the molecular mechanisms that govern the structure, function, and regulation of genes and biomolecules within living organisms. This subject equips diploma students with foundational knowledge crucial for careers in biotechnology, genetics, bioinformatics, and biomedical sciences.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Explain the structure and function of DNA and RNA
- Illustrate the process of Protein Synthesis
- Interpret the processes of replication, transcription, and translation.
- Apply molecular biology techniques in laboratory experiments.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Molecular Biology: Definition, history, and scope of molecular biology, Central dogma of molecular biology	**5**
II	DNA Replication: Replication process in prokaryotes and eukaryotes, DNA damage and repair mechanism	**10**
III	Transcription and RNA Processing: Mechanism of transcription in prokaryotes and eukaryotes	**10**
IV	Translation and Protein Synthesis: Genetic code and its characteristics, Process of translation: prokaryotic translation, eukaryotes translation	**10**
V	Molecular Biology Techniques: PCR (Polymerase Chain Reaction), Gel electrophoresis, Southern, Northern, and Western blotting	**10**
	Total	**45**

REFERENCES:

1.	B. R. Glick and J.J. Pastemak, Molecular Biotechnology: Principles and applications of recombinant DNA, 4rth Ed.
2.	Jordanka Zlatanova, Kensal van Holde, Molecular Biology
3.	Nancy Craig, Rachel Green, Carol Greider, Gisela Storz, Cynthia Wolberger, and Orna Cohen-Fix Molecular Biology, Principles of Genome Function
4.	Cell & molecular biology by P.K. Gupta
5.	Text book of Biotechnology by B.D. Singh

TH:5- CELL BIOLOGY

L	T	P		Course Code: BTPC209	
3	0	0			
Total Contact Hours				**Theory Assessment**	
Theory		: 45Hrs	**Total Marks: 100**	End Term Exam	70
				Progressive Assessment	30
Pre Requisite		**: Nil**			
Credit		**3**		Category of Course : PC	

RATIONALE: Cell Biology is the study of the structure, function, and behavior of cells, which are the fundamental units of life. This subject provides a comprehensive understanding of cellular components, processes, and interactions that govern biological systems. Knowledge of cell biology is crucial for fields such as biotechnology, biomedical sciences, genetics, and pharmacology, enabling students to understand health, disease mechanisms, and applications in research and industry.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Explain the structure and function of prokaryotic and eukaryotic cells.
- Identify the roles of cell organelles.
- Illustrate the processes of cell division, growth, and differentiation.
- Apply basic cell biology techniques in laboratory settings.

COURSE CONTENT DETAILS:

Unit No.	Topic/Sub-Topic	Allotted Time (Hours)
I	Introduction to Cell Biology: History and scope of cell biology, Cell theory and the significance of cells, Differences between prokaryotic and eukaryotic cells	**5**
II	Cell Structure and Organelles: Structure and functions of the plasma membrane, Cytoplasm and cytoskeleton, Organelles: Nucleus, mitochondria, endoplasmic reticulum, Golgi apparatus, lysosomes, peroxisomes, ribosomes, chloroplasts (in plant cells)	**10**
III	Membrane Structure and Transport: Fluid mosaic model of the cell membrane, Passive and active transport, Endocytosis and exocytosis	**5**
IV	Cell Cycle and Cell Division: Overview of the cell cycle: Phases and checkpoints, Mitosis and meiosis: Processes, differences, and significance, Regulation of the cell cycle and its implications in cancer	**10**
V	Techniques in Cell Biology: Microscopy: Light, electron, and fluorescence microscopy. Cell culture techniques, Staining methods and flow cytometry	**10**
VI	Cell signalling Signaling molecules and their receptors, function of cell surface receptors, pathways of intracellular signal transduction, signal transduction and the cytoskeleton, Development and causes of cancer, oncogenes, tumor suppressor genes.	**5**
	Total	**45**

REFERENCES:

1.	B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter, Molecular Biology of the Cell
2.	H. Lodish, A. Berk, C. A. Kaiser, M. Krieger, M. P. Scott, A Bretscher, H. Ploegh, and P. Matsudaira, Molecular Cell Biology, 6th Ed., W. H. Freeman & Co., 2007.
3.	The Cell by Cooper. ASM Press
4.	Cell and Molecular Biology by Karp. John Wiley & Sons

PR:1- MICROBIOLOGY LAB

L	T	P		Course Code: BTPC211	
0	0	4			
Total Contact Hours			**Total Marks: 50**	**Practical Assessment**	
Practical		: 60Hrs		End Term Exam	15
				Progressive Assessment	35
Pre Requisite		**: Nil**			
Credit		**2**		Category of Course : PC	

RATIONALE: Microbiology Lab is a fundamental course designed to provide diploma students with hands-on experience in microbiological techniques essential for the study of microorganisms. This subject emphasizes the practical skills needed for microbial isolation, identification, cultivation, and characterization. Students will learn aseptic techniques, staining procedures, microbial enumeration, and the application of microbiology in biotechnology, healthcare, and environmental sciences.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Apply aseptic techniques to prevent contamination during microbiological procedures.
- Develop culture media for microbial growth.
- Identify microorganisms using staining and biochemical techniques.
- Explain the significance of microbiological quality control in industrial and clinical settings.

LIST OF EXPERIMENTS:

Sl No.	Name of Experiments
1	Introduction to Microbiology Lab
2	Preparation and sterilization of culture media
3	Staining techniques (Gram, spore, negative staining)
4	Isolation of pure cultures and observation of colony morphology
5	Enumeration of microorganisms using serial dilution and plating methods
6	Biochemical tests for microbial identification
7	Antibiotic susceptibility testing

REFERENCES:

1.	1. Benson HJ. 2002. Microbiological applications: a laboratory manual in general microbiology:McGraw-Hill New York, NY.
2.	Harley JP. 2004. Laboratory exercises in microbiology: McGraw-Hill Science/Engineering/Math

PR:2- BIOCHEMISTRY LAB

L	T	P		Course Code: BTPC213	
0	0	4			
Total Contact Hours			**Total Marks: 50**	**Practical Assessment**	
Practical		: 60Hrs		End Term Exam	15
				Progressive Assessment	35
Pre Requisite		**: Nil**			
Credit		**2**		Category of Course : PC	

RATIONALE: The Biochemistry Lab course is designed to provide diploma students with hands-on experience in fundamental biochemical techniques. This practical exposure helps students understand the principles of biomolecule analysis, enzyme activity, and metabolic processes. The course aims to develop laboratory skills, data analysis abilities, and an understanding of biochemical applications in health, industry, and research.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Perform qualitative and quantitative analyses of biomolecules (carbohydrates, proteins, lipids).
- Demonstrate proficiency in enzyme assays and understand enzyme kinetics.
- Prepare and handle buffers and solutions with accurate pH measurements.
- Apply chromatographic techniques for biomolecule separation.
- Interpret experimental data and maintain laboratory records effectively.

LIST OF EXPERIMENTS:

Sl No.	Name of Experiments
1	Laboratory Safety and Basics
2	pH measurements and preparation of buffers.
3	Qualitative tests for Carbohydrates.
4	Qualitative and quantitative tests for sugars.
5	Qualitative tests for proteins
6	Colour reaction of amino acid.
7	Determination of saponification number of lipids.
8	Estimation of Amino acids.
9	Separation of amino acids
10	Separation of sugars - Paper chromatography
11	Quantitative estimation of protein by Lowry method
12	Biochemical estimation of DNA /RNA using Spectrophotometer

REFERENCES:

1.	Lab Manual of Biochemistry by Joy P Surya S. and Aswathy C.

PR:3- INSTRUMENTATION LAB

L	T	P		
0	0	4		**Course Code: BTPC215**
Total Contact Hours				**Practical Assessment**
Practical		: 60Hrs	**Total Marks: 50**	End Term Exam 15
				Progressive Assessment 35
Pre Requisite		**: Nil**		
Credit		**2**		Category of Course : PC

RATIONALE: The Instrumentation l Lab is designed to provide students in biotechnology with practical knowledge and hands-on experience in using various instruments.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Demonstrate proficiency in the operation and calibration of different instrumentation.
- Apply principles of Chromatography in purification of biomolecules.
- Explain the principles of spectrophotometry and quantification of biomolecules.

.**LIST OF EXPERIMENTS:**

Sl No.	Name of Experiments
1	pH Measurement and Control
2	Conductivity Measurement
3	Native gel electrophoresis of proteins
4	SDS-polyacrylamide slab gel electrophoresis of proteins under reducing conditions.
5	Preparation of protoplasts from leaves.
6	Separation of amino acids by paper chromatography.
7	To identify lipids in a given sample by TLC.
8	To verify the validity of Beer's law and determine the molar extinction coefficient of NADH.
9	Sedimentation of blood components by centrifugation method
10	Separation of fat from milk

REFERENCES:

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

PR:4- CELL AND MOLECULAR BIOLOGY LAB

L	T	P		Course Code: BTPC217	
0	0	4			
Total Contact Hours				**Practical Assessment**	
Practical		: 60Hrs	**Total Marks: 50**	End Term Exam	15
				Progressive Assessment	35
Pre Requisite		**: Nil**			
Credit		**2**		Category of Course : PC	

RATIONALE: The Cell and Molecular Biology Lab course is designed to provide diploma students in biotechnology with hands-on experience in essential techniques related to the study of cells and molecular processes.

LEARNING OUTCOMES: After completion of the course, the students will be able to

- Demonstrate proficiency in basic cell biology techniques, including microscopy and cell staining.
- Apply techniques for cell culture and maintenance.
- Analyze the process of mitosis and meiosis through microscopic observation.
- Interpret experimental data and maintain accurate laboratory records.

. **LIST OF EXPERIMENTS:**

Sl No.	Name of Experiments
1	Laboratory Safety and Basics
2	Slide identification of different cells
3	Isolation of Plasmids
4	Isolation of Genomic DNA from blood, plant cell and bacteria
5	Microtomy: Fixation, block making, section cutting, double staining of animal tissues like liver, oesophagus, stomach, pancreas, intestine, kidney, ovary, testes.
6	Study of different stages of mitosis
7	Microscopic study of cell and cell organelles
8	Identify constituents of blood.
9	Study the effect of temperature and organic solvents on semi permeable membrane.
10	Study of structure of any Prokaryotic and Eukaryotic cell.
11	Nuclear staining

REFERENCES:

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

SUMMER INTERNSHIP - I

L	T	P		Course Code: SI 201	
0	0	0			
Total Contact Hours					
Practical		: 0Hrs	**Total Marks: 50**	End Term Exam	15
				Progressive Assessment	35
Pre-Requisite		**: Nil**			
Credit		**2**		Category of Course	: SI

Duration: 3-4 weeks during summer vacation after 2nd Semester.

RATIONALE: Summer Internship - I is to offer a structured and practical learning experience that prepares individuals for their future careers, helps them make informed career choices, and equips them with the skills and knowledge necessary to succeed in their chosen field. This course provides opportunities to students for hands-on industry experience.

LEARNING OUTCOMES:

After completion of the course the students will be able to:

- Apply theoretical knowledge gained in their academic work to real world
- situations.
- Develop and refine specific skills relevant to the field.
- Gains hands-on experience in a professional network by interacting with mentors
- and industry professionals.
- Learn to manage their time effectively.
- Clarify career goals.

DETAILED COURSE CONTENTS:

Unit No.	Topic/Sub-Topic
I	**Orientation:** • Introduction to the organization's mission, values, and culture. • Familiarization with workplace policies, procedures, and safety guidelines. • Orientation to the team and organizational structure.
II	**Project-Based Learning:** • Description of the main project or tasks the intern will be working on during the internship. • Detailed project goals and objectives. • Training and guidance on project-specific tools, technologies, or • methodologies.
III	**Technical and Skill Development:**

	• Training sessions or workshops to enhance technical skills relevant to the internship role (e.g., programming languages, software tools, laboratory techniques). • Soft skills development, including communication, teamwork, problem solving, and time management
IV	**Mentorship and Supervision:** • Regular meetings with a designated mentor or supervisor for guidance, feedback, and support. • Mentorship objectives and expectations.
V	**Professional Development:** • Sessions on professional etiquette, networking, and building a personal brand • Resume writing and interview preparation workshops.
VI	**Industry and Field-Specific Knowledge:** • Lectures, seminars, or presentations on industry trends, best practices, and emerging technologies. • Guest speakers from the field to share insights and experiences.
VII	**Reporting and Documentation:** • Training on how to document project progress, results, and findings. • Practice in creating reports, presentations, or other deliverables.
VIII	**Ethics and Professionalism:** • Discussions on ethical considerations within the field. • Scenarios and case studies related to ethical decision-making
IX	**Feedback and Evaluation:** • Regular performance evaluations and feedback sessions. • Self-assessment and goal-setting exercises.
X	**Networking and Industry Exposure:** • Opportunities to attend industry conferences, webinars, or networking events. • Encouragement to connect with professionals in the field.

NOTE

As per AICTE guidelines, in Summer Internship-I, students are required to be involved in Inter/ Intra Institutional Activities viz;

- Training with higher Institutions;
- Soft skill training organized by Training and Placement Cell of the respective institutions;
- contribution at incubation/ innovation /entrepreneurship cell of the institute;

- participation in conferences/ workshops/ competitions etc.;
- Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop;
- Working for consultancy/ research project within the institutes and
- Participation in all the activities of Institute's Innovation Council for eg: IPR workshop/Leadership Talks/ Idea/ Design/ Innovation/ Business Completion/ Technical Expos etc.