STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA									
TEACHING AND EVALUATION SCHEME FOR 4th Semester (BIOTECHNOLOGY)(wef 2019-20)									
Subject Number	Subject Code	Subject	Periods/week			Evaluation Scheme			
			L	T	P	Internal Assessment/ Sessional	End Sem Exams	Exams (Hours)	Total
		Theory							
Th.1		Organic Chemistry(C)	3	1	-	20	80	3	100
Th.2		Applied Microbiology	3	1	-	20	80	3	100
Th.3		Fluid Mechanics and Heat Transfer	3	1	-	20	80	3	100
Th.4		Immunology	4	-	-	20	80	3	100
		Total	*13*	*3*	-	*80*	*320*	-	*400*
		Practical							
Pr.1		Organic Chemistry Laboratory(c)	-	-	5	50	50	3	75
Pr.2		Applied Microbiology Laboratory	-	-	5	50	50	3	75
Pr.3		Fluid Mechanics and Heat Transfer Laboratory	-	-	5	50	50	3	75
Pr.4		Immunology Laboratory	-	-	5	25	25	3	50
		Student Centered Activities(SCA)	-	-	3	-	-	-	-
		Total	-	-	*23*	*175*	*175*	-	*350*
		Grand Total	**13**	**3**	**23**	**255**	**495**	**-**	**750**
Abbreviations: L-Lecturer, T-Tutorial, P-Practical. Each class is of minimum 55 minutes duration									
Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%									
SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM etc., Seminar and SCA shall be conducted in a section.									
There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester									

Th-1ORGANIC CHEMISTRY

Common to Chemical, Biotechnology & Food Technology

Name of the Course: Diploma in Biotechnology			
Course code:		**Semester**	4th
Total Period:	60	**Examination**	3 hrs
Theory periods:	4P / week	**Class Test:**	20
Tutorial:	1P/ Week	**End Semester Examination:**	80
Maximum marks:	100		

A. RATIONALE:

Study of organic chemistry as a separate subject is more practical and fruitful. The knowledge of structure and function of a large number of compounds built of relatively few elements is important for future bio-technologist, food technologist and chemical engineer.

B. OBJECTIVE:

On completion of study of Organic Chemistry, the student will be able to:

1. Name organic compound in IUPAC system
2. Understand the concept of isomerisation
3. Acquaint themselves with methods preparation, properties and use of common aromatic and aliphatic compounds.
4. Acquire knowledge carbohydrates, proteins and amino acids.

C.	**Topic wise distribution of periods**	
Sl. No.	**Topics**	**Periods**
1	Nomenclature	08
2.	Aliphatic Compounds	20
3.	Aromatic Compounds	09
4.	Carbohydrates, Proteins & fats	23
	Total	**60**

D. COURSE CONTENT

1.0 IUPAC NOMENCLATURE

1.1 Scope of organic chemistry
1.2 Differentiate organic compound and inorganic compounds
1.3 Importance of organic Chemistry in modern life.
1.4 Classification and sources of organic compounds
1.5 IUPAC naming of mono functional and poly functional Organic Compound.
1.6 Concept, type and example of isomerism

2.0 ALIPHATIC COMPOUNDS

2.1 Methods of preparations, properties and uses of CH_4 and C_2H_5.
2.2 Methods of preparations properties of ethylene.
2.3 Methods of preparation, properties and uses of acetylene.
2.4 Methods of preparation properties and uses of methanol and ethanol.
2.5 Absolute alcohol and denatured alcohol.
2.6 Methods of preparation properties and uses of formic acid and acetic acid.

2.7 Methods of preparation properties and uses of formaldehyde and acetone.

3.0 AROMATIC COMPOUNDS

3.1 Methods of preparation, properties and uses of (a) Benzene (b) Toluene

3.2 Methods of preparation, properties and uses of Benzene derivative compound (a) Phenol (b) Benzaldehyde

4.0 CARBOHYDRATES, PROTEINS & FATS

4.1 Classification of carbohydrates

4.2 Synthesis and inter conversions of monosaccharides

4.3 Manufacturing properties and uses of glucose, fructose, sucrose, and starch.

4.4 Preparation, properties and uses of Amino acid

4.5 Classification of proteins,Peptides

4.6 Properties and uses of proteins.

4.7 Sources,Properties and uses of fats.

Syllabus Coverage up to Internal assessment

Chapter 1,2

TEXT BOOKS

E. Books Recommended :			
Sl.No	**Name of Authors**	**Title of the Book**	**Name of Publisher**
1	B.S. Bahl, Arun Bahl	A Text Book of Organic Chemistry	S. Chand Publication

Th-2 APPLIED MICROBIOLOGY

Name of the Course: Diploma in Biotechnology			
Course code:		**Semester**	4th
Total Period:	60	**Examination**	3 hrs.
Theory periods:	4P / week	**Class Test:**	20
Tutorial:	1P/ Week	**End Semester Examination:**	80
Maximum marks:	100		

A. RATIONALE: Study of applied microbiology relating to the application of microbiology, including environmental applications, soil degradation &bioremediation, food safety and degradation and probiotics.

B. OBJECTIVE:

After completion of study of Applied Microbiology the student will be able:
1. Know about the different microbes, their structure and cellularchemistry.
2. Know about microbial growth and itseffect.
3. Know about genetics related to microbialera.
4. Know about the diseases caused bymicro-organisms.

Topic wise distribution of periods

C. Sl. No.	Topics	Periods
1.0	Introduction	10
2.0	Microbial nutrition and growth	08
3.0	Tools and techniques	08
4.0	Microbial genetics	08
5.0	Microbial association and biological nitrogen fixation	08
6.0	Microbial metabolism	10
7.0	Food microbiology and microbial genetics	08
	Total	60

D. COURSE CONTENTS:

1.0INTRODUCTION

1.1 Discovery of microscope &microorganisms.
1.2 Microbes & origin oflife.
1.3 Scope of microbiology.
1.4Classification ofmicroorganism
1.5 Distribution of microorganisms innature.
1.6 Structure & morphology ofbacteria.
1.7 Virus, Fungi,Actinomycetes.

2.0 MICROBIAL NUTRITION &GROWTH

2.1 Nutritional requirements & nutritionalforms.
2.2Growth cycle ofbacteria.
2.3 Batch culture, Continuous culture, Synchronousculture.
2.4 Generation time & Measurement ofgrowth.
2.5 Inherence of environmental factors ongrowth.

3.0 TOOLS &TECHNIQUES
3.1 Microscopy
3.2 Staining
3.3 CultureMedia
3.4 Sterilization
3.5 Isolation of pure culture & maintenance of purecultures.

4.0 MICROBIALGENETICS
4.1 Mutation.
4.2 Isolation of microbial mutant
4.3 Genetic recombination in bacteria: - Conjugation,
4.4 Transformation and Transduction.

5.0MICROBIAL ASSOCIATIONS & BIOLOGICAL N2FIXATION
5.1 Microbial association types.
5.2 Modes of N2fixation.
5.3 Enzymes in N2fixation.
5.4 Mechanism of N2fixation.

6.0 MICROBIALMETABOLISM
6.1 Microbial respiration: Common pathways to both aerobic and aerobicrespiration.
6.2 Aerobicpathways.
6.3 Fermentation
6.4Microbialphotosynthesis.

7.0 FOOD MICROBIOLOGY & MICROBIALDISEASES
7.1 Microbial food contamination.
7.2 Microbial food spoilages
7.3 Food borne diseases by microorganisms.
7.4 Foodpreservation.
7.5Important viraldiseases.
7.6Important t bacterialdiseases

Syllabus Coverage up to I.A
Chapter 1,2,3,4

TEXT BOOKS

E. Books Recommended :			
Sl.No	**Name of Authors**	**Title of the Book**	**Name of Publisher**
1	R.P Singh	A Text Book of microbiology	Kalyani Publishers
2	Presscort	Microbiology	McGraw Hill Education
3	Pelczar	Microbiology	McGraw Hill Education

Th-3FLUID MECHANICS AND HEAT TRANSFER

Name of the Course: Diploma in Biotechnology			
Course code:		**Semester**	4th
Total Period:	60	**Examination**	3 hrs.
Theory periods:	3P / week	**Class Test:**	20
Tutorial:	1P/ Week	**End Semester Examination:**	80
Maximum marks:	100		

A. RATIONALE: This course explores the fundamental concepts of fluid mechanics and heat transfer, and their application in engineering. The course begins by introducing analysis of static fluid bodies and then continues with fluid dynamics, principally the effects of viscous and thermal boundary layers.

B. OBJECTIVE:

On completion of studies of Fluid Mechanics and Heat Transfer the student will be ableto

1. understand and explain between fluid static and fluiddynamics
2. Solve problems on flow measurement, Bernoulli's equationetc.
3. acquaint themselves with various kinds of pumps, blowers &fans
4. Understand various fluid properties like density, viscosity and critical velocity,Reynolds numberetc.
5. Derive dimensional formula of variables in HeatTransfer.
6. Understand and explain various modes of HeatTransfer.
7. Acquaint themselves with various problems on HeatTransfer.
8. Understand the operation of Heat Exchanger of shell and tube, multi pass and single Pass type.
9. Understand the principles of evaporation and operation ofevaporators.

C.	**Topic wise distribution of periods**	
Sl. No.	**Topics**	**Periods**
1.0	Introduction to Fluid static	05
2.0	Fluid flow phenomena and Fluidization	14
3.0	Flow measurement and transportation of Fluid	13
4.0	Conductions	10
5.0	Convections	10
6.0	Heat Exchangers and Evaporators	08
	Total	**60**

D. COURSE CONTENT:

1.0 INTRODUCTION TO FLUIDSTATIC

1.1 Classification of fluid.

1.2Properties offluid.
1.3 Newton's Law ofviscosity.
1.4Differentiate Newtonian and non-Newtonianfluid.

2.0 FLUID FLOW PHENOMENA ANDFLUIDIZATION

2.1 Derive the equation ofcontinuity.
2.2 Types offlow.
2.3 Reynolds'sexperiment.
2.4 Mechanism of fluid flow inpipe.
2.5 Derive Bernoulli'stheorem.
2.6 Solve simple problems related to Bernoulli'stheorem.
2.7 Classification offluidization.
2.8 The fluid flow characteristic in packedbed.
2.9 Derive a pressure drop equation in fluidizedbed.

3.0 FLOW MEASUREMENT AND TRANSPORTATION OFFLUID

3.1 Fluid flow through orificemeter.
3.2 Derive the flow equation on orifice meter and solve simple problems onit..
3.3 Pressure recovery and calibration of an orificemeter.
3.4 Fluid flow through venture meter & derive the flow equation of itandsolve simpleproblems onit.
3.5 Construction and working of rotameter.
3.6 Differentiate pipe andtube.
3.7 Identify and explain standard pipefittings.
3.8 Construction and operation of different types ofvalves.
3.9 Classifypumps.
3.10 Construction and operation of centrifugalpump.

4.0 CONDUCTION

4.1 Heat flow concept inconduction.
4.2 Steady state and unsteady stateconduction.
4.3 Fourier's law ofconduction.
4.4 Derive an equation of heat flow in a composite wall and acylinder.
4.5 Optimum thickness ofinsulation.
4.6 Solve problems onconduction.

5.0 CONVECTION

5.1 classifyconvection
5.2 Flow phenomenon inconvection.
5.3 Derive equation of individual and overall heat transferco-efficient.
5.4 Parallel, Co-current and counter currentflow.
5.5 Derive log mean temperaturedifference.

6.0HEAT EXCHANGERS ANDEVAPORATORS

6.1 Classify heatexchanger.
6.2 Construction and working of single pass, and multipass, shell And tube heat exchangers.
6.3 Derive energy balance for shell and tube heat exchanger and solveproblems.
6.4 Classifyevaporator
6.5 Construction and operation of differenttypesof evaporators.

6.6 Solve simple material balance and energy balanceproblems.

<u>syllabus Coverage up to I.A</u>

Chapter 1,2,3,4

E. Books Recommended :			
Sl.No	Name of Authors	Title of the Book	Name of Publisher
1	Macabe & J.M.Smith	'Unit operations for Chemical Engineers'	(McGraw-Hill)
2	Badgero & Banchero	'Introduction to Chemical Engineering	(McGraw-Hill)
3	Richardson & Coulson	Chemical Engineering Vol. I	Butterworth-Heinemann Ltd

Th-4 IMMUNOLOGY

Name of the Course: Diploma in Biotechnology			
Course code:		**Semester**	4th
Total Period:	60	**Examination**	3 hrs.
Theory periods:	4P / week	**Class Test:**	20
Tutorial:		**End Semester Examination:**	80
Maximum marks:	100		

A. RATIONALE:

Immunology is a branch of biology that covers the study of immune system in all organisms. Immunology charts, measure, and contextualizes the physiological functioning of the immune system in states of the immune system in immunological disorders and the physical, chemical and physiological characteristics of the components of the immune system.

B. OBJECTIVE:

On completion of studies of Immunology & Enzyme Engineering the student will be able to

1. Know about immune system and their role for the existence of life.
2. Know about the different types of immunological systems that occur inside the body and helps to protect the organism from different diseases.
3. Know about the biology, structure and function of enzymes in different biochemical processes about the different application of enzymes in different fields of biology

C.	**Topic wise distribution of periods**	
Sl. No.	**Topics**	**Periods**
1.0	Innate and acquired immunity	15
2.0	Antibody (Structure and Function)	15
3.0	Cell Interaction in Antibody production	15
4.0	Vaccines	15
	Total	**60**

D. COURSE CONTENTS:

1.0INNATE AND ACQUIREDIMMUNITY

1.1 Historic concept of immunity.
1.2 Differentiate between self and non-self-immunity.
1.3 Humoral and cell mediated immunemechanism.
1.4 List major characteristics of acquired immunity.
1.5 Analogy and function of lymphoid tissues.

2.0ANTIBODY (STRUCTURE &FUNCTION)

2.1 Discovery of antibodies
2.2 Structure and function of antibodies
2.3 Antigen-antibody interaction
2.4 List out biological functions of antibodies
2.5 Antibodies as cell membrane antigenreceptor.
2.6 Antibodies as biotechnologicaltools

3.0CELL INTERACTION IN ANTIBODYPRODUCTION

3.1 Different experiments related to cell interactions in humoralresponses.
3.2 Major histocompatibility structure(MHC)
3.3 Deduce the relation between MHC and mousestrains.
3.4 T and B cellinteractions.
3.5 Antigen processing and presentation.

4.0VACCINES

4.1 Active & passive immunization
4.2 Designing vaccines for active immunization.
4.3 Live and attenuated Vaccines
4.4 Inactivated or killed Vaccines.
4.5 Subunit vaccines.
4.6 Conjugate vaccines.
4.7 DNA vaccines.
4.8 Recombinant and DNA vaccines

Syllabus Coverage up to I.A

Chapter 1,2

E.Books Recommended :			
Sl.No	Name of Authors	Title of the Book	Name of Publisher
1	Lydyard	Immunology	Taylor & Francis
2	Roift	Essential Immunology	Wiley-Blackwell
3	Kuby	Immunology	W. H. Freeman

Pr-1 ORGANIC CHEMISTRY LABORATORY

Common to Chemical, Biotechnology & Food Technology

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4th
Total Periods	75	Examination	3 hours
Laboratory Periods:	5P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

A. RATIONALE:

Most of the industrial processes involve reaction involving organic compound. In order to acquaint the students to give practical exposure and hands on training of handling chemical reaction in the laboratory, the practical subject is introduced. The understanding of students on organic synthesis will improve after conducting the experiment in laboratory.

B. OBJECTIVE:

On completion of practical of organic chemistry the students should be able to:

1. Conduct organic synthesis in laboratory with safety measures.
2. Detect the elements present and functional groups in unknown organic compound.
3. Prepare organic compound in laboratory by simple synthesis.

C.	**Experiment wise distribution of Periods**		
Sl. No.	**List of Experiments**		**No. of Periods**
1.	Detect the following elements in the organic compound		30
	i)	Nitrogen	
	ii)	Sulphur	
	iii)	Halogen	
2.	Determine different functional groups of		30
	i)	Carboxylic group	
	ii)	Phenolic group	
	iii)	Alcoholic group	
	iv)	Aldehyde group	
	v)	Ketonic group	
3.	Prepare in Laboratory		15
	(i) Oxalic acid (ii) Benzoic acid (iii) Methyl Orange		

D. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	Dr S K Nayak	Practical Chemistry for +2 students	ABC Publication
2	O.P. Pandey, D.N. Bajpai	Practical Chemistry for B.Sc students	S Chand

Pr-2 MICROBIOLOGY LABORATORY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4th
Total Periods	75	Examination	3 hours
Laboratory Periods:	3P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

A. RATIONALE: Microbiology is one of the largest and most complex of the biological sciences as it deals with many diverse biological disciplines. In addition to studying the nature history of microbes ,it deals with every aspects of microbe-human and environment interaction. These interactions include ecology, genetics, metabolism, infection, disease, immunology and genetic engineering, industry and agriculture.

B.OBJECTIVE:

On completion of the lab course the student will be able to:

1. Become proficient at laboratory skills and safety procedures.
2. Learn to follow experimental procedures.
3. Develop skills to formulate answerable questions/hypotheses, predict expected results.
4. Learn how to make careful observations, collect and analyze data, and draw appropriate conclusions.

C.	**List of experiments**	
Sl. No	**Name Of Experiment**	**No of Periods**
1	Sterilization techniques	10
2	Media preparation	15
3	Isolation, enumeration and purification of microbes	10
4	Gram staining	10
5	Motility test by hanging drop method	10
6	Antibiotics assay	10
7	Bacterial growth kinetics	10

D. Book Recommended			
Sl no	Name of Author	Title of Book	Name of Publisher
1	Maheshwari D.K.	Practical Microbiology	S Chand & Company
2	Mukesh Kumar D.N. Bajpai	Practical Manual for Undergraduates Microbiology	Jain Brothers

Pr-3 FLUID MECHANICS&HEAT TRANSFER LABORATORY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4th
Total Periods	75	Examination	3 hours
Laboratory Periods:	5P/Week	Sessional Marks:	50
Tutorial	-	End Semester Examination Marks	50
Maximum Marks:	100		

A.RATIONALE: This laboratory aims at generating innovative ideas in students by promoting the design of experiments and small scale projects. At present in the fluid mechanics laboratory are conducted experiments on losses in pipes (smooth/rough) and fittings (e.g. valves, bends), comparison between different flow meters, particle image velocimetry technique, Hot-wire anemometer, lab scale sub-sonic wind tunnel for- pressure distribution around a cylinder/air-foil, lift and drag balance, boundary layer development, weather monitoring.

B.OBJECTIVE:

On completion of the lab course the student will be able to:

1. Analyses and evaluation of experimental data.
2. Comparison between theoretical models and experimental data.
3. Design a fluid mechanical and heat transfer system e.g. a piping system considering various technical aspects, heat exchanger, thermal energy storage, receiver, wind catcher, volumetric air receiver.

C.	**List of experiments**	
Sr No	**Name Of Experiment**	**No of Periods**
1	Demonstrate operation of Reynolds's apparatus and find out critical velocity	10
2	Verify Bernoulli's equation	10
3	Demonstrate operation of venturimeter and determine the venturi co-efficient	10
4	Demonstrate operation of Orifice meter and determine the Orifice co-efficient	10
5	Demonstrate operation of a Rota meter and determine rate of flow through Rota meter	05
6	Demonstrate operation of a centrifugal pump and valves	05
7	Demonstrate operation of a fluidized bed column and packed bed column	10
8	Demonstrate heat transfer through composite wall and find the resistance of wall	05
9	Demonstrate operation of multi pass, horizontal heat exchanger and determine h & U	10

D. Book Recommended			
Sl no	Name of Author	Title of Book	Name of Publisher
1	YunusCengel	Heat Transfer: A Practical Approach	McGraw-Hill Education; 2 edition

Pr-4 IMMUNOLOGY LABORATORY

Name of the Course: Diploma in Chemical Engineering			
Course Code		Semester	4th
Total Periods	45	Examination	3 hours
Laboratory Periods:	3P/Week	Sessional Marks:	25
Tutorial	-	End Semester Examination Marks	25
Maximum Marks:	50		

A.RATIONALE: The purpose of this curriculum is to define the process of training and the competencies needed to produce a consultant immunologist capable of independent practice in the United Kingdom. The award of a certificate of completion of training in the specialty will denote that a trainee is equipped with the requisite specialised scientific knowledge, clinical and laboratory skills required to diagnose, treat and where relevant, prevent diseases characterised by immunodeficiency, autoimmunity and allergy coupled with the ability to direct a diagnostic immunology laboratory service.

B.OBJECTIVE:

On completion of the lab course the student will be able to:
1. Participate in effective research to underpin immunology practice .
2. Understanding of the context, meaning and implementation of clinical governance.
3. Develop a management skills required for the running of an Immunology laboratory.
4.Determine the hemagglutinating antibody titer of two different sera.
5.Demonstrate how the ELISA assay is used to diagnose exposure to a disease by testing for the presence of antibodies to the disease in a sample of simulated serum.

C.	**List of experiments**	
Sl. No	**Name of Experiment**	**No of Periods**
1	Agglutination test for peripheral blood.	09
2	Ochterlony's diffusion test.	09
3	Rocket electrophoresis	09
4	Elisa test.	09
5	Precipitation reaction for Ag-Ab interaction	09

D. Book Recommended			
Sr no	Name of Author	Title of Book	Name of Publisher
1	GuptaTalwar	A Handbook of Practical and clinical Immunology	Cbs Publisher