Vivekanand Education Society's
College of Arts, Science and Commerce (Autonomous)

Sindhi Society, Chembur, Mumbai, Maharashtra – 400 071.

Accredited by NAAC "A Grade" in 3rd Cycle - 2017
Best College Award – Urban Area, University of Mumbai (2012-13)
Recipient of FIST Grant (DST) and STAR College Grant (DBT)

Affiliated to the

University of Mumbai

Syllabus for

Program: M.Sc. (Applied Biotechnology) -Part I/ Fourth Year B.Sc.(Hons) Biotechnology M.Sc. Sem I/ B.Sc. Sem VII

(Program code: VESPSBT)

As per Choice Based Credit System (CBCS)
with effect from Academic Year 2026 - 2027

The NEP-2020 presents a chance for India's higher education system to change teaching focus from one that is very unilateral to one that is holistic. It offers skill-based education, where the programmes, courses, and supplemental activities are designed backwards in order to achieve the graduation qualities and learning attributes. The learning outcomes-based curriculum framework for a B.Sc. in Biotechnology is designed to give students a thorough grounding in the field and to support them as they successfully pursue further education and research in it while being equipped with the necessary skills at various stages. An effort has been made to incorporate the usage of gradual build up of knowledge and contemporary technologies to aid the teaching-learning process for students.The curriculum framework takes into account the need to uphold knowledge and skill standards that are globally competitive in biotechnology and related courses, as well as the development of scientific orientation, an inquiring spirit, problem-solving abilities, and human and professional values that encourage rational and critical thinking in the students. This degree offers a wide range of prospects in several disciplines, including both traditional and applied parts of biotechnology.

Program Outcomes (PO):

A learner completing B.Sc. (Biotechnology) will be able to:

PO1 Demonstrate analytical skills in applying appropriate science principles and methodologies to solve a wide range of problems.
PO2 Design, carry out experiments and analyze results by accounting uncertainties in different quantities measured using various scientific instruments.
PO3 Acquire the ability to correlate and draw various inferences.
PO4 Be able to apply the learnings in the academic course to an industrial setup

Program Specific Outcomes (PSO's)

On completion of B.Sc. (Biotechnology) the student will be able to:
PSO1 Apply the basics of biotechnology to build a strong foundation that will allow them to comprehend emerging and advanced engineering concepts in life sciences.
PSO2 Acquire expertise in the field of biotechnology so that it may be used in industry and research.
PSO3 By integrating disciplinary and interdisciplinary components of biotechnology, students will be able to gain technological knowledge.
PSO4 Recognize the significance of bioethics, intellectual property rights, entrepreneurship, communication, and managerial skills in the development of the future generation of Indian industrialists.

MSc-Part I/Fourth Year B.Sc. (Hons) APPLIED BIOTECHNOLOGY SEMESTER -I/SEMESTER VII

Course Code	Types of Courses	Subject Name	Credits	Subject Type
PMMBTS1-501	Major	Advanced Molecular Biology and Population Genetics	2	Theory
PMMBTS1-502	Major	Practicals of Advanced Molecular Biology	2	Practical
PMMBTS1-503	Major	Pharmacology and Vaccine Development	2	Theory
PMMBTS1-504	Major	Practicals of Pharmacology and Vaccine Development	2	Practical
PMMBTS1-505	Major	Marine Biotechnology	2	Theory
PMMBTS1-506	Major	Practicals Based on PMMBTS1-505	2	Practical
PMMBTS1-507	Major	Genetic Engineering of Plants and Animals	2	Theory
PMEBTS1-511	Major Elective	Instrumentation	4	Theory
PRMBTS1-581	RM	Research Methodology	4	Theory
		Total Credits	22	

Course Code	Course Title	Credits	No. of Lectures
PMMBTS1-501	**Advanced Molecular Biology and Population Genetics**	**2**	**30**

Course Objectives:

1. To explain the principles and variations of Polymerase Chain Reaction (PCR) and its modifications, including reverse transcriptase PCR, multiplex PCR, nested PCR, and real-time PCR, used in molecular diagnostics and research.
2. To describe and analyse DNA polymorphism techniques such as Restriction Fragment Length Polymorphism (RFLP) and Short Tandem Repeat (STR) typing for genetic identification and analysis.
3. To explain modern DNA sequencing and genomic technologies, including Sanger sequencing, next-generation sequencing, whole genome sequencing, and transcriptome sequencing.
4. To explain the concepts of population genetics, including genotype and allele frequencies, and the Hardy–Weinberg principle.
5. To analyse the factors responsible for changes in gene frequencies, such as mutation, natural selection, migration, genetic drift, and inbreeding, and their significance in conservation biology.

Learning Outcomes:

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

1. Explain the fundamental principles and variations of PCR and their applications in molecular biology and diagnostics.
2. Analyse DNA polymorphisms using RFLP and STR typing methods for genetic identification and population studies.
3. Describe DNA sequencing and genomics technologies such as Sanger sequencing, NGS, whole genome sequencing, RNA-Seq, and SNP detection methods.
4. Calculate genotype and allele frequencies and apply the Hardy–Weinberg law to population genetics problems.
5. Analyse the evolutionary forces influencing gene frequency and explain genetic variation in natural populations and its importance in conservation biology.

Advanced Molecular Biology Tools	**Nucleic Acid Amplification**: **7 lectures** Fundamentals of the PCR, Variations/ Modifications of PCR: Reverse transcriptase PCR, Differential display PCR, Real time Fluorescent PCR, Hot- Start PCR, Multiplex PCR, Nested PCR, Probe amplification, Signal amplification Applications **DNA Polymorphisms: 2 lectures** RFLP typing STR typing **DNA Sequencing and Genomics Tools: 6 lectures** Sanger DNA sequencing Next Generation Sequencing (NGS) technologies Whole genome sequencing Transcriptome sequencing (RNA-Seq)		

	SNP detection and genotyping methods		
Population genetics	Genetic Structure of Populations: Genotypic and allelic frequencies: **2 lectures** Hardy-Weinberg law and its assumptions, and genetic variation in populations: **2 lectures** Problems based on Hardy-Weinberg law: **2 lectures** **Forces responsible for the change in gene frequencies in the population:** mutation, natural selection, genetic drift, migration, speciation, assortative mating, and inbreeding: **4 lectures** Genetic variation in space and time: **1 lecture** Genetic variation in natural populations: **1 lecture** Measuring genetic variation at the protein level: **2 lectures** Role of population genetics in conservation biology: **1 lecture**		
References	1. Russell, P. J. (2013). IGenetics: Pearson New International Edition PDF EBook: A Molecular Approach. United Kingdom: Pearson Education. 2. Molecular Diagnostics: fundamentals, Methods and Clinical Applications By Lela Buckingham & Maribeth Flaws 2007		

Course Code	Course Name	Credits
PMMBTS1-502	**Practicals of Advanced Molecular Biology**	**2**

1. Plasmid Prep and Analysis
   1.1 Preparation of Solutions for purification of plasmid
   1.2 Mini-prep by alkaline lysis method
   1.3 AGE to check the quality of plasmid purified
   1.4 Determination of concentration and purity using UV-Spec
2. SDS-PAGE - Analysis of bacterial proteins
   2.1. Preparation of buffers and solutions
   2.2. Preparation of samples - whole cell lysate of bacterial cultures
   2.3 Set-up and running of SDS PAGE
   2.4 Gel analysis to determine percent similarity in bacterial species
3. Western Blotting
4. PCR

Course Code	Course Title	Credits	No. of Lectures
PMMBTS1-503	**Pharmacology and Vaccine Development**	**2**	**30**
Course Objectives: The course aims at understanding the basics of Pharmacology , understanding drug action from the perspective of Clinical trials. **Learning Outcomes:**By the end of the course the student will be able to: ● Understand basic concepts of pharmacology, basic toxicology ● Understand drug absorption, distribution and regulation. ● Connect basics of immunology to the concept of vaccine development			
Unit I: **General principles of Pharmacology**	General Principles of Pharmacology. Brief History of Pharmacology,Clinical Trials and its Phases-**(1 lecture)** Mechanism of drug action **- (1 Lecture)** Drug receptors and biological response**- (1 Lecture)** Second-messenger systems, The chemistry of drug–receptor binding **(1 Lecture)** Dose–response relationship: therapeutic index **(1 Lecture)** ED, LD - **(1 Lecture)** Potency and Intrinsic Activity - (**1 Lecture)** Drug antagonism - **1 Lecture** Drug Absorption and Distribution Absorption of drugs from the alimentary tract **(1 Lecture)** Factors affecting rate of gastrointestinal absorption - **(1 Lecture)** Absorption of drugs from lungs - **(1 Lecture)** Skin - **(1 Lecture)** Absorption of drugs after parenteral administration factors influencing drug distribution **-(1 Lecture)** Binding of drugs to plasma proteins **- (1 Lecture)** Physiological barriers to drug distribution **(1 lecture)**		
Unit II: **Vaccine Development**	**Introduction and types of Immunization :** Active and passive immunization; live, killed, attenuated, subunit vaccines;**(3 lectures)** **Vaccine technology:** role and properties of adjuvants, recombinant DNA and protein based vaccines,		

	plant-based vaccines, reverse vaccinology; peptide vaccines, conjugate vaccines**(5 lectures)** **Antibody Gene Organization and Engineering Strategies:** Antibody genes and antibody engineering: chimeric,generation of monoclonal antibodies, hybrid monoclonal antibodies; catalytic antibodies and generation of immunoglobulin gene libraries **(4 lectures)** **Modern and Next-Generation Vaccine Strategies** Idiotypic vaccines and marker vaccines, viral-like particles (VLPs), dendritic cell based vaccines, vaccine against cancer, T cell based vaccine, edible vaccine and therapeutic vaccine.**(3 lectures)**		
References	1. Modern Pharmacology with clinical Applications Craig,C.R, Stitzel,R.E 5th edition 2. Textbook of Medical Physiology Guyton, A.C and Hall 11th edition J.E Saunders page 99-131 3. Clinical Pharmacology Bennet,PN,Brown,M.J, Sharma,P 11th edition Elsevier 4. Medical Microbiology, Anantnarayan 5. Immunology essential and fundamental, Second edition S Pathak & U P Parveen Publishing House 6. Immunology, fifth Ed Goldsby, T J. Kindt, Osborne, Janis Kuby Freeman and company.		

Course Code	Course Name	Credits
PMMBTS1-504	**Practicals of Pharmacology and Vaccine Development**	**2**

1. Preparation of TAB vaccine
2. Sterility checking of Vaccine or Injectible
3. LD 50, ED 50 evaluation using suitable models e.g. *Chironomus* larvae
4. Drug Dissolution Test - Effect of pH on drug dissolution
5. Drug Stability Test - Effect of Temperature on drug stability
6. Protein Binding Studies - Interaction of drug with albumin
7. Bioassay of antimicrobials
8. Dose-Response Curve - Simulation studies

Course Code	Course Title	Credits	No. of Lectures
PMMBTS1-505	**Marine Biotechnology**	**2**	**30**

Course Objectives: The course aims at understanding the basics of marine biotechnology and the application of marine bioresources in drug discovery, nutraceuticals, functional foods, and cosmetic industries.

Learning Outcomes: By the end of the course the student will be able to:

- Define nutraceuticals and functional foods with marine examples.
- Identify marine sources of nutraceutical compounds such as omega-3 fatty acids, pigments, and bioactive peptides.
- Explain the role of marine products in health promotion and disease prevention.
- Describe the applications of marine biomolecules in cosmetics and cosmeceuticals.
- Evaluate the potential and challenges of marine biotechnology in food and cosmetic industries

Unit 1 **Introduction to Bioprospecting, Marine Drugs and Enzymes**	**Introduction to Marine Biotechnology** The marine ecosystem and its functioning: intertidal, estuarine, salt marsh, mangrove, coral reef, coastal & deep sea ecosystem. - **4 lectures** **Marine bioprospecting**. - **3 lectures** **Drugs from Marine organisms**- Pharmaceutical compounds from marine flora and fauna -marine toxins, antiviral and antimicrobial agents, ApprovedMarine Drugs as Pharmaceuticals - 5 lectures Marine Natural products and its Challenges, Marine Microbial Enzymes-Marine, Extremozymes and their significance, current use of Marine Microbial Enzymes. 3Lectures	**1**	**15**
Unit 2 **Marine Nutraceuticals, Functional Foods and Cosmetics**	**Marine Functional Foods** Marine Sources as Healthy Foods or Reservoirs of Functional Ingredients, Food Marine-Derived Ingredients with Biological Properties, Functional Foods Incorporating Marine-Derived Ingredients, **5 lectures** **Marine Nutraceuticals** Marine Bioactives as Potential Nutraceuticals, Functional Carbohydrates, Polyunsaturated Fatty Acids Carotenoids, Soluble Calcium, Fish Collagen and Gelatin, Marine Probiotic. **5 lectures**	**1**	**15**

	Scenario of Marine Sources in the Cosmetic Industry, **Cosmetics**: Definition and Regulations, Cosmeceuticals , Target Organs and Cosmetics Delivery Systems ,Major Functions of Some Marine Components in Cosmetics and Cosmeceuticals **3 lectures** Treatments Based on Marine Resources , Products Based on Marine Resources **2 lectures**		
References	1. Marine Biotechnology Himalaya publication, Shubha Agarwal Govil. 2. Nollet, Leo M. L- Marine microorganisms- extraction and analysis of bioactive compounds-CRC Press_Taylor& Francis (2017) 3. Kim, S.K. Springer Handbook of Marine Biotechnology; Springer: Berlin, Germany; Heidelberg, Germany, 2015. 4. R. S. K. Barnes, R. N. Hughes(auth.)-An Introduction to Marine Ecology, Third Edition-Wiley-Blackwell (1999) 5. Fabio Rindi, Anna Soler-Vila, Michael D. Guiry (auth.), Maria Hayes (eds.)-Marine Bioactive Compounds_ Sources, Characterization and Applications-Springer US (2012)		

Course Code	Course Name	Credits
PMMBTS1-506	**Practicals of Marine Biotechnology**	**2**
1.Study of and isolation marine algae 2. DPPH assay for antioxidant extracted from marine algae 3. Extraction of carotenoids from marine algae/Bacteria/Fungi and characterisation using UV spec 4. Extraction and estimation of Gelatin / Collagen from fish scales. 5. Extraction of alkaloids from marine organisms and their separation by TLC.		

Course Code	Course Title	Credits	No. of Lectures
PMMBTS1-507	**Genetic Engineering of Plants and Animals**	**2**	**30**

Course Objectives:

- To explain the principles and applications of plant genetic transformation using the Agrobacterium tumefaciens Ti plasmid vector system for gene transfer in plants.
- To describe and compare physical methods of gene transfer in plants, such as electroporation, microprojectile bombardment, liposome-mediated transfer, and protoplast fusion for producing transgenic plants.
- To explain the design and function of vectors used for gene transfer in plant and animal cells.
- To analyse different methodologies used to generate transgenic mice, including retroviral methods, DNA microinjection, and embryonic stem (ES) cell techniques.
- To evaluate advanced genetic manipulation strategies such as the Cre-lox recombination system, nuclear transfer cloning, and reporter systems like green fluorescent protein in transgenic organisms.

Learning Outcomes: After successful completion of the course, students will be able to:

- Explain the mechanism of plant transformation using Agrobacterium-mediated gene transfer and Ti plasmid–derived vector systems.
- Compare different physical and biological methods used for gene transfer in plants and their applications in crop improvement, such as seed protein quality enhancement.
- Describe the structure and function of vectors used for gene transfer in plant and animal cells.
- Analyse different techniques used to generate transgenic animals, including transgenic mice and transgenic fish.
- Evaluate modern genetic engineering approaches such as Cre-lox recombination, nuclear transfer cloning, and reporter genes like GFP in biotechnology research.

Genetic Engineering of Plants	Plant transformation with the Ti plasmid of A. tumefaciens, Ti plasmid derived vector system - **4 lectures** Transgenic plants: Physical methods of transferring genes to plants: electroporation, microprojectile bombardment, liposome-mediated, protoplast fusion- **5 lectures** Vectors for plant cells - **4 lectures** Improvement of seed quality protein - **2 lectures**		**15**
Transgenic Animals	Transgenic mice- Methodology: retroviral method, DNA microinjection, ES method - **5 lectures** Genetic manipulation with cre-loxP - **2 lectures** Vectors for animal cells - **2 lectures** Transgenic animals recombination system - **2 lectures** Cloning livestock by nuclear transfer - **2 lectures** Green Fluorescent Protein - **1 lectures** Transgenic fish – **1 lectures**		**15**

References	1. iGenetics: A Molecular Approach 3rd Edition Peter J. Russell. 2. Molecular Biotechnology-Principles and Applications of Recombinant DNA Technology 3rd Edition Glick B.R., Pasternak J.J., Patten C.L. 3. Principles of Gene Manipulation 7th Edition Primrose S.B., Twyman R.M.

Course Code	Course Title	Credits	No. of Lectures
PMEBTS1-511	**Instrumentation - III**	**4**	**60**

Course Objectives:

- Apply principles of magnetic resonance, flow cytometry, microscopy, and spectroscopy to analyze biological and chemical systems.
- Interpret experimental data from NMR, MRI, flow cytometry, microscopy, MS, and IR techniques.
- Select appropriate analytical techniques for specific research or diagnostic applications.
- Critically evaluate instrumentation design and experimental methodologies.

Learning Outcomes: At the end of the course, the student will be able to:

- **Explain and apply** the fundamental principles of Nuclear Magnetic Resonance (NMR) and Magnetic Resonance Imaging (MRI), including nuclear spin behavior, relaxation mechanisms, signal detection, and image formation.
- **Interpret and analyze** spectroscopic data from NMR, IR, and FT-IR techniques for structural and functional group identification.
- **Describe and differentiate** advanced analytical instrumentation including mass spectrometers, flow cytometers, and microscopy systems (Fluorescence, Confocal, SEM, TEM, AFM).
- **Analyze and evaluate** biological applications of flow cytometry and cytotoxicity assays for immunological and cellular studies.
- **Select appropriate analytical and imaging techniques** based on principle, instrumentation, resolution, and application requirements for biological and chemical investigations.

NMR and MRI	**Introduction to Magnetic Resonance** (1 lecture) Nuclear Spin and Magnetic Moments (2 lectures) Larmor Precession and Resonance Condition (2 lectures) Relaxation Mechanisms: T_1 and T_2 (2 lectures) NMR Signal Detection and Fourier Transform (2 lectures) Basic NMR Spectroscopy (2 lectures) **Introduction to MRI Physics** (2 lectures) MRI Image Formation and Basic Parameters (2 lectures)		**15**
Flow	**Introduction to Flow Cytometry (1 Lecture)**		**15**

Cytometry and Cytotoxicity	**Types:** Acoustic Focusing Cytometers, Cell Sorters (FACS), Imaging Cytometry and Mass Cytometers. (3 lectures) **Reagents**: Small Organic Molecules (Alexa Fluor), Phycobiliproteins, Metal Conjugates, Nucleic Acid Dyes, Quantum Dots etc. (4 lectures) Applications in Immunophenotyping, apoptosis analysis, Cell Cycle Analysis, RNA Flow Cytometry etc. (3 lectures) **Cytotoxicity**: Functional Assays – Lymphoproliferation, Cell Cytotoxicity (MTT assay), mixed lymphocyte reaction, Apoptosis (Annexin V Assay), Cytokine expression etc. (4 lectures)		
Advanced Microscopy	Principle, Optics, Instrumentation, Sample Preparation, Applications and Advances: A. Fluorescence Microscope (3 lectures) B. Confocal Microscope (3 lectures) C. SEM (3 lectures) D. TEM (3 lectures) E. AFM (3 lectures)		**15**
Spectroscopic and Mass Spectrometric Methods	**Introduction to Mass Spectrometry (1 lecture)** **Basic Principles of Mass Spectrometry (2 lectures)** Atomic/molecular ion formation - Mass-to-charge ratio (m/z) - Isotope patterns **Mass Analyzer Types (2 lectures) -**Quadrupole - Time-of-Flight (TOF) - Magnetic sector - Ion trap **Ionization Methods (2 lectures)** **-** Electron Impact (EI) - Electrospray Ionization (ESI) - MALDI - Chemical Ionization (CI) Sample Preparation & Interpretation of Mass Spectra **(2 lectures)** **Basics of IR Spectroscopy (3 Lectures)** **Functional Group Identification** **Instrumentation Overview** - IR source, monochromator, detector - Sample handling (KBr pellet, liquid cells) **Principles of Fourier Transform (FT) (3 Lectures)**		**15**

	FT-IR Instrumentation **FT-IR Data Analysis & Applications**		
References	1) Magnetic Resonance in Medicine — Peter A. Rinck 2) NMR Spectroscopy: Basic Principles, Concepts and Applications — Harald Günther 3) Wilson, K., & Walker, J. (2010). Principles and Techniques of Biochemistry and Molecular Biology(Seventh edition). 4) Hawley, T. S., & Hawley, R. G. (2018). Flow Cytometry Protocols. In Methods in Molecular Biology (Vol. 1678). 5) Introduction to Mass Spectrometry — J. Throck Watson & O. David Sparkman 6) Infrared Spectroscopy: Fundamentals and Applications — Barbara H. Stuart		

Course Code	**Course Title**	**Credits**	**No. of Lectures**
PRMBTS1-581	**Research Methodology**	**4**	**60**

Course Objectives:

- Understand the fundamental concepts and philosophy of research, including constructs, hypotheses, laws, principles, and the systematic nature of scientific investigation.
- Familiarize students with different types of research and research design, including qualitative and quantitative approaches, formulation of research problems, and literature review.
- Develop knowledge of data collection and sampling techniques, including primary and secondary data sources and appropriate survey and sampling methods.
- Introduce principles of scientific writing, research communication, and ethical practices, including plagiarism awareness, use of open educational resources, and responsible use of AI tools.

Learning Outcomes:

After completing the course, students will be able to:

- Explain the research process and distinguish between different types of research approaches used in scientific investigations.
- Design a basic research study, including formulation of research questions, objectives, sampling strategies, and data collection methods.
- Analyze and interpret collected data and communicate findings effectively through scientific writing such as research papers, abstracts, and proposals.
- Apply ethical practices in research, including identifying and avoiding plagiarism and appropriately using digital tools, open resources, and AI in academic work.

I **Introduction to Research and its types**	Definition and Characteristics of Research: – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Philosophy and validity of research. Objective of		

	research. Various functions that describe characteristics of research such as systematic, valid, verifiable, empirical and critical approach. Research process. Types of Research: Pure and applied research. Descriptive and explanatory research. Qualitative and quantitative approaches. Formulating the Research Problem, Literature Review, Developing the objectives, Preparing the research design including sample Design, Sample size.		
II Data and Methods of Data Collection	Data collection, primary and secondary sources of data, and Selecting a method for data collection. Collection of primary data through questionnaires and schedules. Collection of secondary data, processing, and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling, and multistage sampling. The pilot survey, measurement and scaling techniques.		
III Data Analysis Writing & Communication of Research	Scientific writing (including Language proficiency), scientific literature comprehension, Art and ethics of writing -steps in writing research paper and/or thesis, writing a research proposal, and patents in Science. Abstract writing. SOP writing for laboratory instruments.		
IV Plagiarism	Introduction to plagiarism, reasons for plagiarism, Types of plagiarism, software used for identifying plagiarism, Plagiarism policies and techniques to avoid plagiarism. Use of open educational resources and licenses under creative commons, use of AI tools (any Current references)		
References	1. Research Methodology – Methods and Techniques, C K Kothari, New Age International. 2. Design and Analysis of Experiments, D C Montgomery, Wiley. 3. Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley. 4. Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education. 5. Conducting educational research -Tuckman, B. W. & Harper, B. E. (2012). Conducting educational research (6th ed.). Lanham, MD: Rowman & Littlefield Publishers. (ISBN: 978-1-4422-0964-0)		

	6. CSIR Guidelines for Ethics in Research and in Governance - CSIR (2019) 7. Ethics in Science Education, Research and Governance- Kambadur Muralidhar, Amit Ghosh, Ashok Kumar Singhvi - INSA (2019) 8. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches by John W.Creswell and J. David Creswell 9. The Craft of Research by Wayne C. Booth, Gregory G. Colomb, and Joseph M. Williams 10. Research Methodology: A Step-by-Step Guide for Beginners by Ranjit Kumar. 11. Research Methodology edited Vinayak Bairagi and Mausami Munot. CRC publication

MODALITY OF ASSESSMENT

The performance of the learners for those papers having Semester End Examinations and Internal Assessment shall be evaluated in two parts as per the following ratio:

Semester End Examination: Internal Assessment [60:40]

The learner's performance shall be assessed by conducting the **Semester-end Examination with 60% marks** and **Continuous Internal Assessment (CIA) with 40% mark**s. Practical papers will consist of semester-end examination only.

Students will have to score 40% marks INDIVIDUALLY in Internal assessment as well as Semester-end examination to pass the course.

Internal Assessment: It is defined as the assessment of the learners based on internal evaluation by way of participation of learners in various academic and correlated activities in the given semester of the programme.

Semester End Assessment: It is defined as the assessment of the learners based on performance in the Semester-end Theory/ Practical examination.

Table-1- Mode of Assessment under NEP 2020

Name of the course	Credits	Nature of Evaluation & Mode of Assessment	Duration	Marks
Major/ Minor Subject (Theory)	**2 Credit**	**1. Internal (40%)** (Table 2)		20
		2. Semester-end Theory Examination (60%) (Table 3)	**90 mins**	30
Major (Practical) **(2 subjects)**	**2 Credit**	**Semester-end Practical Examination (Table-4)**	**3 hours**	50

Open Electives(OE) OR Value Education Course (**VEC**) OR Indian Knowledge system (**IKS**)	**2 Credit**	Continuous Internal Evaluation - Assignments/ Presentations/ Group Discussion/ Case Studies etc. **Any two modes of assessment with evaluation at Department level (25 M Each)**	-	50
Vocation Skill Course (**VSC**)(Practical)	**2 Credit**	Practicals (Table-4)	**3 hours**	50
Skill Enhancement Course (**SEC**)(Theory) OR Ability Enhancement Course (**AEC**)	**2 Credit**	**1. Internal (40%)** (Table 2)		20
		2. Semester-end Theory Examination (60%) (Table 3)	**90 mins**	30
On Job training (**OJT**)/NSS/ NCC/ Co-curricular Course (**CC**)/ Field project (**FP**)/ Internship	**2 Credit**	Continuous Internal Evaluation --Tests, Essays, Articles, Group assignments/ Reports/ Journals/ Diaries/ Reviews/ Dissertations/ Observations of Students/Presentation etc (As per the nature of the course)	-	

Note: **CC-Co-curricular Courses** include involvement/participation in various areas such as Cultural Activities, Departmental activities, Fine/Applied/Visual/Performing Arts, Sports, and fitness, NSS/ NCC, DLLE, The Sunday School (TSS), Health & Wellness, Yoga education etc. Record of involvement /Participation by students must be documented with signatures of staff concerned in students' CC Cards.

Table - 2

Theory - Mode of assessment-Continuous Internal Assessment [40%]

Table-3

Paper Pattern for Semester-End Theory Examination
• Each unit should have equal weightage. • Minimum one question per unit • No MCQ/True-False type of questions should be asked, only descriptive questions are allowed. • Each question should have extra sub-questions (max 100% option)

Table-4

Semester End Examination for Practical Assessment -50 marks (2-Credit)-Major

[To be conducted at departmental level]

	For 1 subject		For 2 subjects	
A	Any one/ more experiment/s	35	Min two experiments per subject	40
B	Viva	10	Viva	05
C	Journal	05	Journal	05
	Total	**50 M**	Total	**50 M**