SEMESTER III			
Core IX	**Biochemistry and Biophysics**		
Course Code: 21PBOC31	**Hrs/week: 6**	**Hrs/Semester: 90**	**Credits:4**

Objectives:

- To provide updated knowledge of plant's molecular, macro molecular and supra molecular architecture and how they determine the function of plant life.
- To enhance transferable skills such as conduction of quantitative estimation of biomolecule and give mathematical reasoning to interpret the data of the same.
- Familiarise and applies the concept of other branches of sciences that span plant biology such as chemistry, physics and mathematics.

Course Outcomes:

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	study the polymeric biomolecules and their monomeric building blocks	1,2	Re
CO-2	illustrate that living organisms and biological system interact via molecular connection	1,3	Re
CO-3	able to realise the importance of structural configuration and atomic rearrangement of macromolecule with respect to their functions	1,6	Re
CO-4	detect the source of vitamins and their chemistry and distinguish their symptoms specific to their deficiency	2,4	Re
CO-5	outline enzyme groups and know the nomenclature that be able to explain the specificity of enzyme's role and mode of action	2,3	An
CO-6	set up and operate variety of experiments to analyse data accompanied by problem solving and recording.	3,4	Ap
CO-7	draw electromagnetic spectrum and understand the properties of light to relate biological applications.	2,7	Ap
CO-8	explain that energy is needed by plant and that is transformed in biochemical system as governed by the laws of thermodynamics	3,7	Cr

SEMESTER III			
Core IX	**Biochemistry and Biophysics**		
Course Code: 21PBOC31	**Hrs/week: 6**	**Hrs/Semester: 90**	**Credits:4**

UNIT I: **Biomolecules: Carbohydrates** - Classification, Structure of monosaccharides (glucose, galactose, fructose and mannose), disaccharides (trehalose, sucrose, maltose and cellobiose), polysaccharides (starch, cellulose, glycogen, chitin). Properties of carbohydrates. **Amino acids:** Structure and classification based on R - group. **Protein:** Structural organisation of protein (primary, secondary (keratin), tertiary (myoglobin) and quaternary structure (hemoglobin)), bonds involved in protein structure. Properties of protein.

UNIT II: **Metabolism**: Introduction to metabolism. **Metabolism of carbohydrate**: Gluconeogenesis, metabolism of glycogen, galactose and fructose. **Metabolism of aromatic amino acids**: Biosynthesis and degradation of phenylalanine, tyrosine and tryptophan. Intermediatory metabolism. Commercial polypeptides – ACTH, Thymosin.

UNIT III: **Lipids:** Classification, structure and properties of simple lipids (triglyceride and wax), compound lipids (phospholipids andglycolipids) and derived lipids (steroids - cholesterol, terpines). **Metabolism of lipids:** Biosynthesis and degradation of fatty acid and cholesterol. **Vitamins:** Biochemical functions of vitamin A, B_{12}, C, D.

UNIT IV: **Enzymes** –nomenclature IUPAC 1974. Isozymes, Allozymes. Principles of catalysis, enzyme action, active site,activation energy, enzyme kinetics (invertase). Cofactors and inhibitors. Coenzymes NADP, FAD, FMN and coenzyme A. Factors affecting enzyme activity.

UNIT V: **Biophysics**: Dual nature of light, electromagnetic spectrum, phosphorescence, fluorescence and bioluminescence. Laws of thermodynamics, concept of enthalpy, entropy and free energy. Redox couple, redox potential, coupled reactions, oxidative phosphorylation. High energy compound - ATP.

Books for Reference:

1. Bhutani S.P. *Chemistry of Biomolecules*. New Delhi: Ane Books Pvt. Ltd., 2009.
2. Conn E. E. and Stumpf P. K. *Outlines of Biochemistry*. New York: John Wiley and Sons, Inc., 1987.
3. Cox M.M. and Nelson D. L. *Principles of Biochemistry*. India: Replika Press Pvt. Ltd., 5th edition, 2008.
4. David Rawn. *Biochemistry*. New Delhi: Panima Publications, 2004.
5. Ferrier D. R. *Biochemistry*. New Delhi: Wolters Kluwer (India) Pvt. Ltd., 6th edition, 2014.
6. Gupta S.N. *Biochemistry*. Meerut, India: Rastogi Publications, 2011.
7. Lehninger A. L. *Principles of Biochemistry*. Delhi: CBS publishers and Distributors, 1987.
8. Nagini, S. *Text Book of Biochemistry*. Chennai, India: Scitech Publications Pvt. Ltd., 2nd edition, 2007.
9. Salil Bose. *Elements of Biophysics*. Madurai: Jothi Books, 1982.
10. Sathyanarayana, U and Chakrapani U. *Biochemistry*. Kolkata: Arunabha Sen, Books and Allied (P) Ltd. 3rd edition, 2006.

Practical

Hrs/Week: 2

- Estimation of total carbohydrates.
- Titration of amino acid (glycine)
- Estimation of free amino acid from plant tissues (Ninhydrin method)
- Estimation of total soluble protein from plant tissues (Barfoed's test)
- Separation of amino acids (ascending paper chromatography).
- Separation of photosynthetic pigments (column chromatography).
- Absorption spectrum of chlorophyll
- Study of enzyme kinetics and determination of Km value.
- Saponification value of two vegetable oils.
- Enzyme assay- Protease
- Chem sketch/morvin sketch for compound structure prediction
- Pass online analysis
- Submission - Record Note Book

Laboratory Manual for Reference:

1. Jayaraman. J. *Laboratory manual in Biochemistry*. New Delhi: New Age International Publishers, 2011.

SEMESTER - III			
Core XI	**Molecular Biology and Genetic Engineering**		
Course Code: 21PBOC33	**Hrs/week: 5**	**Hrs/Semester: 75**	**Credits: 4**

Objectives:

- To furnish broad insight on chemical nature of hereditary material (DNA), organization of chromosome at different phases of cell cycle, basic rules, governing its replication and to examine genes have the code to life.
- To apply the understanding of DNA and adopt molecular techniques to manipulate gene to get the desired output.
- To educate the students in strategizing research methodologies employing genetic engineering techniques.

Course Outcomes:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know the chemistry of genetic material and details of its replication at molecular level	1	Un
CO-2	pronounce how errors during replication are repaired	6	An
CO-3	infer complexity of gene expression in eukaryotes over prokaryotes	2	Un
CO-4	explain gene regulation mechanisms at various levels by which they can learn how it controls growth and development of an organism	4	Cr
CO-5	Understand the principles of genetic engineering and basic steps of gene cloning	2	Un
CO-6	advocate the role of enzymes and vectors responsible for gene manipulation, transformation and genetic engineering	1	Un
CO-7	grasp different types of gene transfer methods employed in gene cloning process	2	Cr
CO-8	practice the advanced techniques in genetic engineering, investigate the different strategies of recombinant DNA technology and resolve the problems encountered	3	Ap

SEMESTER - III			
Core XI	**Molecular Biology and Genetic Engineering**		
Course Code: 21PBOC33	**Hrs/week: 5**	**Hrs/Semester: 75**	**Credits: 4**

UNIT I: **Replication of DNA:** Molecular mechanism of DNA replication in prokaryotes (activation, initiation synthesis of new strands of DNA, termination and helix formation) and eukaryotes (replication of the ends of eukaryotic chromosomes, telomerase enzyme), Enzymology of DNA replication (DNA polymerase enzymes in prokaryotes and eukaryotes and DNA ligase enzymes), replication models (theta replication of DNA, rolling circle model and D-loop model). **DNA repair:** necessity of DNA repair, mistakes in DNA (types), Biochemical mechanism of DNA repair (mismatch repair and repair of thymidine dimers).

UNIT II: **Gene expression:** Definition of gene, types of genes, functions of genes, transcription and processing of RNA in prokaryotes and eukaryotes, genetic code, translation in prokaryotes (initiation, elongation, termination) and eukaryotes (initiation, elongation, termination and polypeptide folding), post translational processing of protein (protein folding).

UNIT III: **Regulation of gene expression:** Gene regulation in prokaryotes: Coordinated gene regulation, strategies of gene regulation, mechanism of gene regulation at transcriptional level induction (*lac* operon – structure, functioning) and repression (*trp* operon – structure). **Gene regulation in eukaryotes:** genome level (presence of multigene families, gene alteration, gene arrangement), transcription level (acetylation of histones, euchromatin remodeling complexes, methylation of nucleotides, control elements, transcription factors, mediators, insulator, regulatory proteins, hormones and chromosome level), post-transcriptional level (post-transcriptional control by choice of splice site, polyproteins, regulation of gene expression by RNA, control on transport of RNA, control at translation of RNA, mRNA degradation control, protein folding level and protein degradation control).

UNIT IV: **Genetic Engineering:** Discovery, denaturation and renaturation of DNA, artificial synthesis of gene, restriction enzymes – types, target sites, DNA cleavage styles (sticky and blunt end style). Biologicaltools for recombinant DNA technology (enzymes, linkers, foreign DNA and cloning vectors). Vectors – cloning and expression vector, plasmid vectors – types, characteristics (pBR322 and pUC8), bacteriophage vectors (lambda phage and M13 vectors), cosmid vectors (pJB8), phagemid vectors (pBluescript), artificial chromosome vectors (BAC and YAC), shuttle vectors, fosmid vectors.

UNIT V: **Techniques used in Genetic Engineering:** Generation of DNA fragments (DNA cleavage by restriction enzymes, Southern blotting technique, Northern blotting and Western blotting). Artificial synthesis

of gene (Chemical assembly of oligonucleotides, enzymatic assembly of oligonucleotides and complementary DNA synthesis). Joining of foreign DNA fragment to a cloning vector (sticky, blunt end ligation and homopolymer tailing method). Introduction of recombinant DNA into host cell (transformation, transduction, electroporation, liposomes, microinjection and microprojectile). Selection and screening of transformed cells (reporter genes, elimination of non-transformed cells, identification of clones having rDNA, selection, formation and expression of cloned genes). Genetic engineering and human welfare.

Books for Reference:

1. Veer Bala Rastogi. *Principles of Molecular Biology*. India: MEDTECH.2016.
2. Brown T.A. *Gene cloning and DNA analysis, An Introduction.* Manchester: John Wiley & Sons. 2010.
3. Primrose S.B and Twyman R. *Principles of gene manipulation and genomics*.Wiley. 7th edition 2006.
4. Verma P.S. and Agarwal V.K. Genetic Engineering. New Delhi: S. Chand & Company. 2010.
5. Benjamin Lewin. *Genes VII.* Burlington: Pearson Prentice Hall. 2004.
6. Channarayappa. *Molecular Biology. Principles and Principles and Practices.* India: Universities Press Pvt. Ltd., 2006.
7. Nicholl D.S.T. *An Introduction of genetic engineering*. UK: Cambridge University press. 2001.
8. Robert H. Tamarin. *Principles of Genetics*. New Delhi: Tata Mc. Graw-Hill publishing company Ltd., 2006.
9. Sathyanarayana U. *Biotechnology.* Kolkatha: Book sand Allied (P). Ltd., 2006.
10. Glick B.R, Pasternak J.J and Patten C.L. *Molecular Biotechnology: principles and applications of recombinant DNA.* Washington: ASM Press. 4th edition 2010.

Practicals

Hrs/ week - 2

- Estimation of DNA by diphenylamine method.
- Estimation of RNA by Orcinol method.
- Isolation of bacterial genomic DNA.
- Isolation of genomic DNA from plant tissue.
- Separation of DNA fragments using AGE.

- Digestion of DNA with restriction enzymes.
- Vecscreen software to detect foreign DNA.
- Protein translation using p BLAST.

Laboratory Manual for Reference:

1. William D. Stansfield, Jame S. Colome and Raul J. Cano. *Theory and Problems Molecular and cell biology*. Schaum's outline series, 1st edition McGraw-Hill. 2019.

SEMESTER - III			
Core XII Ecology and Conservation Biology			
Course Code: 21PBOC34	**Hrs / Week:5**	**Hrs / Semester: 75**	**Credits:4**

Objectives:

- To explore the natural capital asset, ecosystem services provided by the biodiversity and their biogeochemical intersection that shape the environment.
- To realize the current ecological threat associated with biodiversity and learn about global / national level action taken to address the issues of biodiversity.
- To understand the characteristics of community, community dynamics and development of community forest.

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	reveal the range of plant diversity in terms of structure, function and their environmental relationships.	5	Un
CO-2	describe the climatic and edaphic factors and ecological succession	5	Un
CO-3	categorize the plants based on adaptation	3	An
CO-4	address the global environment crisis and the strategies applicable for environmental problem mitigation	7	Ev
CO-5	learn the global level environmental summit organized that focused for sustainable future	7	Cr
CO-6	know the importance of remote sensing in finding the current status of global health	7	Cr
CO-7	recognize the causes of environmental problems	7	Un
CO-8	manage and conserve the biological resources	7	Cr

SEMESTER - III			
Core XII	**Ecology and Conservation Biology**		
Course Code: 21PBOC34	**Hrs / Week:5**	**Hrs / Semester: 75**	**Credits:4**

UNIT I: Plant and the environment: climatic factors - air, water and temperature; Edaphic factors - types based on texture and colour. Components of soil- soil air, soil water, pH, mineral matter, organic matter, soil profile - soil organisms - reclamation of soil erosions and conservation. Biotic Factors, positive and negative interactions. Structure and function of major ecosystems - terrestrial (Grassland, forest and desert) aquatic (pond).

UNIT II: Population structure and dynamics: Basic concepts - characteristics of population, size and density, dispersion, age structure, natality, mortality, biotic potential and life table. Population dynamics - theory of population growth, Plant population dynamics, Regulation of population growth, Evolution among population and population interaction. Ecological succession - Causes of succession, Kinds ofsuccession and process of succession. Climax concept – mono climax and poly climax theories. Adaptation of plants- hydrophytes and xerophytes

UNIT III: Environmental Management Plan (EMP), ecological indicators. Bioremediation – *in situ* and *ex situ* bioremediation: Bioremediation of - hydrocarbon, dyes, heavy metals and xenobiotics. Bio- augmentation – principles and use of enzymes. Bio-filtration – biofilters, microorganisms used and mechanism. Bioleaching - microorganisms used, leaching process, examples of bioleaching. Ecology in national affairs- carbon trading, carbon sequestration, blue carbon, climate conference, convention and summit.

UNIT IV: Conservation of biodiversity *In situ* conservation – National park, wild life sanctuaries and Biosphere reserve, afforestation, social forestry, agro forestry. *Ex situ* conservation - field gene bank, seed bank, pollen bank, tissue culture, DNA bank and cryopreservation methods. Species based approaches, Social approaches- sacred groves and sthalaviriksha. Green movements – Chipko movement and Silent valley movement.

UNIT V: Organizations associated with biodiversity management, IUCN, WWF, UNEP, NBPGR, ICAR, WHF. Biodiversity legislations – GATT, TRIPS, CITES, Wild life preservation Act (1972), Rio Summit – Agenda- 21, Convention on biological Diversity, Biodiversity**,** Act (2002). Role of indigenous people in conservation. Biopiracy, sustainable development and management of biodiversity.

Text Books:

1. Sharma, P.D. *Elements of ecology*. Meerut: Rastogi Publications. 1999.
2. Shukla, R.S. and Chandal, S.S. *Plant Ecology*. New Delhi: S. Chandal and Co.1991.

Books for Reference:

1. Asthana and Meera Asthana. *Environmental problems and solutions.* New Delhi: S.Chand and Co. Ltd., 2001.
2. Balasubramania, D., Bryee C.F.,Dharmalingam, K., Green J. and Jeyaraman K. *Concepts in Biotechnology*. Universities Press.2005.
3. Dash M. C. *Fundamentals of ecology*. New Delhi: Tata McGraw Hill publishing Co. Ltd.2001.
4. Murugesan, A.G. and Rajakumari *Environmental Science and Biotechnology, theory and Techniques.* Chennai: M.J.P. Publishers, 2005.
5. Sharma, P.D. *Elements of ecology*. Meerut: Rastogi Publications. 1999.
6. Trivedi P.R, Sharma, P.L. and Sundarshan, K. N..*Natural environment and Constitution of India.* New Delhi: Efficient offset printers. 1994.
7. Tyller Miller G. *Environment Science.* Singapore: Thompson Brooks / Cole. 2004.
8. Varshney C. K. *Water pollution and management*. Noida: S.P. Printers.1989.

Practical Hrs/week: 2

- Determination of soil pH (at least 3 types of soil)
- Determination of soil texture.
- Determination of soil moisture.
- Determination of soil bulk density.
- Determination of soil porosity.
- Determination of soil organic matter content.

- Estimation of calcium.
- Estimation of magnesium.
- Estimation of sodium.
- Estimation of potassium.
- Estimation of nitrogen.
- Adaptation of plants- hydrophytes, xerophytes and halophytes,
- India map showing grass land, forest and desert.
- India map showing hotspots
- India map showing Biosphere reserves.
- Endangered / Endemic plants lists and photos (any2).

Scientific visits: Visit to any nearby place to observe the ecosystem their communities and their succession.

Submission - Record note book.

Book for Reference:

1. Murugesan A.G. and Rajakumari *Environmental Science and Biotechnology Theory and Techniques.* Chennai: MJP Publishers.2005.

SEMESTER IV			
Core XIV	**Horticulture and Seed Technology**		
Course Code: 21PBOC42	**Hrs/week:4**	**Hrs/Semester: 60**	**Credits: 4**

Objectives:

- To promote, develop, disseminate horticultural and strengthen in the field of seed science & technology.
- To understand the techniques and make significant contribution to an efficient and sustainable production of crops.
- To understand the importance of seed certification and seed testing.

Course Outcomes:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the scope and potential of horticulture product in India and Tamil Nadu	4	Un
CO-2	classify the horticulture plants based on soil and climate	4	Ap
CO-3	Illustrate different systems of planting in orchard and suggest plant choices	4	Ap
CO-4	demonstrate the methods and types of pruning and explain the basics of soil science and justify the role of soil as a medium for plant growth	4, 7	Un
CO-5	explain about integrated nutrient management and demonstrate the skills of soil testing	7	An
CO-6	identify the diseases and pest of crops and their management	6	Ap
CO-7	acquire skills & handling operations of different equipment's inseed science laboratory	2	Ap
CO-8	learn the techniques of seed processing for quality up gradation and of storage for maintenance of seed quality.	1	Un

SEMESTER IV			
Core XIV	**Horticulture and Seed Technology**		
Course Code: 21PBOC42	**Hrs/week:4**	**Hrs/Semester : 60**	**Credits : 4**

UNIT I: Introduction to Horticulture – definition, special features of horticulture, divisions of horticulture, importance of horticulture. Plant growing structure – Hot beds, cold frames, green houses. Nutrition of horticulture plants, irrigation of horticulture plants.

UNIT II: Pomology: Definition, establishment of orchard: location and site, preliminary operation, planning of an orchard, laying out of the orchard, planting distance, planting season, planting method and transplantation. Training, pruning, cropping, harvesting, handling, storage and preservation of fruits.

UNIT III: Olericulture: Definition, Climate and soil requirement, spacing, water and weed management, nutrient requirement and management, training system for vegetables, harvest and yield of important vegetablecrops – tomato, brinjal, chilly, Bhendi, cluster beans, dolichous bean, onion, cucumber, bitter guard. Storage and preservation of vegetable.

UNIT IV: Seed technology: definition, importance, principles of seed production. Foundation and certified seed production of varieties and hybrids. Principles of GM crop and organic seed production. Seed storage – principles- factors affecting seed longevity during storage – Seed treatments and packaging materials - measures for pest and disease control during storage and godown sanitation. Post-harvest handling of seeds - threshing methods - drying - methods of seed drying - Seed processing - seed cleaning and grading - Processing equipment -cleaner cum grader -Upgrading equipment - specific gravity separator, colour sorter, indented cylinder separator, spiral separator, magnetic separator, needle separator - working principles - Seed quality enhancement techniques - importance - seed fortification, seed priming, seed coating, seed pelleting.

UNIT V: Seed Quality and seed testing: Seed certification - phases of certification, procedure for seed certification, field inspection, field counts, field and seed standards. Post-harvest inspection - processing,

bagging and tagging. Seed testing: seed viability and longevity, pre and post-harvest factors affecting seed viability. Seed ageing – physiology of seed deterioration liquid peroxidation seed viability. Seed vigourand its concept, vigour test method. Factors affecting seed vigour.Physiological and basis of seed vigour in relation to crop performance and yield.

Books for Reference:

1. Allard John, R.W. *Principles of plant breeding New York:* Wiley & Sons, Inc. 1960.
2. Chopra, V.L *Plant Breeding Theory and Practice*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd., 2000
3. Choudhri D and Amal Metha *Flower crops cultivation and management.* Jaipur: Oxford Book Company, 2010.
4. Edmund Senn - Andrew – Halfacre. *Fundamentals of Horticulture*. Tata Mc. Graw Hill, 1977.
5. Hartmann & Kester, – *Plant propagation*. New Delhi: Prentice – Hall of India Pvt. Ltd., 1989.
6. Mallikarjuna Reddy and Aparna Rao *Plant propagation in horticulture*.New Delhi: Pacific book international. 2010
7. Randahawa *Floriculture in India*. Allied publishers, 1985.
8. Utpal Banerji *Horticulture.* Jaipur: Mangal Deep Publication, 2008.
9. Agarwal, R.C. Seed Technology. New Delhi: Oxford and IBH Publishing Co., 1996.

Practicals:
Hrs / Week: 2

- Knowledge of garden implements and tools - Spade, Sprayer, Water can, Pruning scissor, Tiller, Digging fork, Pickaxe, Budding and Grafting Knife,
- Preparation of nursery and seed bed.
- Propagation - stem, leaf and root cutting.
- Propagation - air layering, budding and grafting technique.
- Designing kitchen garden, Rockery, Hanging basket, terrarium
- Seed sampling and testing: Physical purity, germination, viability, etc.
- Seed and seedling vigour test.

Laboratory Manual for Reference:

1. Horticulture Science lab manual. Dr. Chiwan W. Lee. Department of Plant Science, North Dakota State University
2. A Practical Manual of Seed Science and Technology Volume-1. Dr.Satya Prakash Gupta.

SEMESTER - IV			
Core Elective	**Entrepreneurship Botany**		
Course Code: 21PBOE41	**Hrs / Week: 4**	**Hrs /Semester: 60**	**Credits: 4**

Objectives:

- To able to understand the available natural resources and explore the greatest opportunity to increase and achieve sustainable competitive business advantage.
- To introduce organizations and agencies that can backup entrepreneurial initiatives.
- To expose students to various business opportunities emerging from the plant resources.

Course Outcomes:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	C L
CO-1	adapt the methods of preservation of vegetables and fruits and identify the industrial scope of these resources	6	Un
CO-2	determine the quality of oil and prepare aesthetic product to find out good marketing capacity	6	Ap
CO-3	understand contemporary opportunities in business situations of value added products and develop skills needed to successfully convert them into entrepreneurial ventures	6	Un
CO-4	explore how the value added products can enhance the profitability of local farmers	6	Un
CO-5	acquire knowledge on primary forest product, wood products and secondary wood products and infer wood industries are major sector in many economy	2,6	Un
CO-6	able to differentiate natural and synthetic wood able to dictate the their pros and cons	3	Un
CO-7	develop ideas that will lead them to start their own business and enable them to be professionally competent	6	Ap
CO-8	able to start entrepreneurship (small scale/medium scale industries) , extract the financial support available and manage the targeted customers to enhance profitability	6	Re

SEMESTER - IV			
Core Elective	**Entrepreneurship Botany**		
Course Code: 21PBOE41	**Hrs / Week: 4**	**Hrs / Semester: 60**	**Credits: 4**

UNIT I: **Fruits and Vegetables preservation:** Fruits and vegetables preservation methods: Dehydrating, canning, salting, pickling and freezing. Fruits and Vegetables Products: tutti frutti, health drink, mango pulp, pickle, jam, jelly, amla candy and raisin. Factors influencing the growth of microorganisms in food. Sources of contamination of fruits. Types of spoilage.

UNIT II: **Bioventure:** Industry, overview of *Spirulina*, *Pleurotus* sajor-caju, *Ganoderma*, *Lentinus edodes*, drumstick and coconut. Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO): methods and marketing. Fresh and dry flowers for aesthetics.,

UNIT III: **Value added plant based products:** Mushroom recipes (soup, omelette, pakoda and briyani). Preparation of - Coco peat, Banana products, Palm products, fiber products; Packing techniques – low, trans wrap, deep drawing, doy, sachet, top seal, vacuum: Cost management and estimation.

UNIT IV: **Commercial Wood products:** Natural durability of wood. Wood preservation: Nonpressure processes, Pressure process, Chemical processing of wood. Commercial wood species and identification, Synthetic woods, Marine plywood, Fuel wood, pulp and paper making woods, matchstickwood. Economic importance of pulp and wood

UNIT V: **Marketing and trade :** Steps for starting a small scale industry. Registration as SSI. Role of SIDBI. Advantages and problems of SSI. Government Schemes for SSI: NABARD, NCDC, MSME, NSIC. Marketing and entrepreneurship: different types of marketing, identification of types of consumer and their needs, building consumer relationship. FSSAI, FAO, ICDS, import and export businessdevelopment and strategies.

Text Books:

1. Bahi N. *Hand Book on Mushrooms*. New Delhi: Oxford and IBH Publishing Co. Pvt. Ltd. Print, Fourth edition, 2015.
2. Desrosier N.W. and Desrosier J.N. *The Technology of Food Preservation*. New Delhi: CBS Publishers & Distributors. Fourth edition, 1987.
3. Narayanaswami R.V. and Rao K.N. *Outlines of Botany*, Chennai: India: Esvee Press, 1976.

Books for Reference

1. Taneja S. and Gupta S.L. *Entrepreneurship development*, New Delhi: New venture creation, Galgeha Publication Company, 2015.

2. Desai V. *Entrepreneurship development*, Mumbai: Himalaya publication house, First edition, 2015.

3. Khanna S.S. *Entrepreneurial development*. New Delhi: S. Chand Company Ltd., 2016.

4. Manohar D. *Entrepreneurship of small scale industries*, New Delhi: Deep and deep publication, 1989.

5. Lal G., Siddhapa G.S. and Tandon G.L. *Preservation of fruits and vegetables*. New Delhi: Indian council of Agricultural Research (ICAR), 2009.

6. Ranganna S. *Hand book of analysis and quality control of fruits and vegetable products*. New Delhi: Tata mcgraw hill, Second edition, 2001.

7. Cruses W.V. and Fellows P.J. *Commercial fruits and vegetable processing*. United States: CRC press, 2000.

8. Franz F.P. Kollmann. *Wood Science and Technology*. New York: Springer Verlag, 1988.

9. Pearson and Brown. *Commercial Timbers of India*. New Delhi: Government of India Publication, 1984.

10. Tieuran H.D. *Wood Technology*. New York: Pituran Publishing Company, 1951.

SEMESTER – IV			
Core Elective	**Nanobiotechnology**		
Course Code: 21PBOE42	**Hrs/Week: 4**	**Hrs/Semester: 60**	**Credits: 4**

Objectives:

- To provide a broad overview of fundamental principles and current research directions and future scope in nanoscience and nanotechnology.
- To familiarise in synthesis, detection and characterization of nano particle using modern tools.
- To apply nanotechnology for developing new products for various industries (good/ agriculture/ health/ cosmetics)

Course Outcomes:

CO.No.	Upon completion of this course, students will be able to	PSO's Addressed	CL.
CO-1	understand the fundamental principles of nanotechnology and types of nano particle	1	Un
CO-2	apply engineering and physics concepts to the nano-scale and non-continuum domain.	2	Cr
CO-3	understand the wide range of applications of nanotechnology and its interdisciplinary aspect	1	Re
CO-4	apply and transfer interdisciplinary systems ngineering approaches to the field of bio- and nanotechnology projects	3	Re
CO-5	practice and explain state-of-the-art characterization methods for nanomaterials, understanding and critiquing nanomaterial safety and handling methods required during characterization	4	An
CO-6	correlate the impact of nanotechnology and nanoscience in a global, economic, environmental, and societal context.	6	En
CO-7	gain a knowledge in nanotechnology techniques (synthesis, fabrication, characterization) and its applications in the various field like engineering, biomedicine and agricultural/environmental issues	4	An
CO-8	identify career paths at the interface of nanotechnology, biology, environmental and agricultural engineering and medicine	6, 7	An

SEMESTER – IV			
Core Elective	**Nanobiotechnology**		
Course Code: 21PBOE42	**Hrs/Week:4**	**Hrs/Semester: 60**	**Credits: 4**

UNIT I: Nanoparticles – definition and historical background of nanotechnology. Principles: quantization effects - inverse relationship between size and reactive surface area. Properties: surface effects, the effects of size, shape, surface and bulk composition, and solubility and persistence. Types of nanoparticles: liposomes, albumin-bound, polymeric iron oxide, quantum dot and gold.

UNIT II: Physical, chemical and biogenic synthesis of nanomaterials – biomimetics, green plants, and microorganisms. Role of biomolecules - reducing and/or capping agents: proteins, viruses and carbohydrates.

UNIT III: Detection and measurement of nanoparticles – physicalcharacterization by UV, FTIR, SEM, FESEM, DLS, X-ray diffraction and Zeta potential.

UNIT IV: Targeted nanoparticles: active & passive targeting. Application: medicine, manufacturing & materials, delivery vehicles, cancer therapy, tissue engineering, fluorescent biological labels, biological assays, imaging agents and biosensors.

UNIT V: Interactions between nanoparticles and living systems, interaction with cells, exposure of living systems to nanomaterials - toxicityeffects. Factors influencing the interaction of nanomaterials over mammalian cells: uptake, transport and biodistribution of nanoparticles in living system, toxicity on cellular processes.

Books for Reference:

1. Pradeep Kumar Srivastava, *Nanotechnology, The Hidden potential of science*. New Delhi: MPS Publisher & Distributors, 2008.
2. Shanmugam S. *Nanotechnolgy,* www.MJP publishers.com, 2010.
3. Barbara Panessa-Warren. *Understanding cell-nanoparticle interactions - making Nanoparticles more biocompatible.* Upton: Brookhaven National Laboratory, 2006.
4. Bhushan Bharat (Ed.) *Encyclopedia of Nanotechnology*, Springer, 2012.
5. Chand A., Mirkin, Christof Niemeyer. *Nanobiotechnology II: more concept and applications.* New Jersey: Wiley-VCH Publisher, First edition, 2007.

6. Jain K.K. *Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience).* United Kingdom: Taylor & Francis, First edition, 2006.
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8. Jain, K. K. *Handbook of Nanomedicine*, New York: Springer, 2012.
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