Course:M.Sc. Geology		Course Outcomes
Course Code	Paper/Title	
Semester - I		
15041	I: Geomorphology & Atmospheric Science	Students will get the knowledge of Earth Interior, activities occurring in earth's interior. Activities of Geological agents like wind, rivers, glaciers, oceans etc. Atmospheric Science deals with clouds, precipitation, cyclones-their causes, weather forecasting, economic importance of atmosphere.
15042	II:Crystallography, Mineralogy & Optical Mineralogy	Students get acquire the broad knowledge about - Crystallography ,Mineralogy and Optical mineralogy. Crystallography is the study of atomic and molecular structure. students want to know how the atoms in a material are arranged in order to understand the relationship between atomic structure and properties of these materials and also learn crystal classes ,Braggs law and Twinning in crystal and Mineralogy concerned to learn mainly Physical Characteristics of Minerals, Classifying Minerals,: Identifying Minerals and also occurrence , distribution ,origin and uses of minerals and also know the optical properties of minerals
15043	III: Palaeontology & Stratigraphy	To obtain the comprehensive snapshot of the Paleontology and its implications for the Geological applications. Basics of world Stratigraphy and Geological Time Scale will be taught
15044	IV: Indian Geology & Field Geology	The Paper deals of stratigraphy of India covering all the rock formation of India through the Geological Time Scale. This study is useful for mineral and groundwater exploration. Students are benefited with the knowledge of mineral occurrences of different locations corresponding to different geological ages. Field Geology will help student to get the practical knowledge of understanding the theory in the class room by its application in the field.
Semester - II		
25041	I: Statistics & Computer Applications	Students should gain knowledge about Geostatistics, mainly used to analyze and predict the values associated with spatial or spatiotemporal phenomena. Geostatistical analysis has also evolved from uni- to multivariate and offers mechanisms to incorporate secondary data sets that complement a (possibly sparse) primary variable of interest, thus allowing the construction of more accurate interpolation and uncertainty models. And also gain knowledge about computers mainly on Fundamentals of Computers MS Office – MS Word, MS Excell, MS Power Point and Basic concepts of data and Database Management System (DBMS)

25042	II: Structural Geology & Geotectonics	The Subject deals with types of structure, their controlling factors, classification of folds, faults and unconformities. Geotechtonics is a branch dealing tectonic aspects of plutonic igneous rocks, structures in metamorphic rocks.
25043	III: Igneous & Metamorphic Petrology	The paper deals with the kinds of rocks existing in nature, their genesis, occurrence and distribution. Students will get a detailed knowledge on Classification of rocks, identification features of rocks their significance in mineral exploration
25044	IV : Sedimentalogy & Marine Geology	Students get knowledge of Sedimentary rocks, their genesis, occurrence, classification etc, and their implications in mineral, groundwater exploration.
Semester – III		
35041	I: Economic Geology, Mineral Economics & Gemmology	The papers deal with the types of economic minerals exists in nature, their classification, genesis, mode and provenance of occurrence, and distribution. Further, after extraction how they will be commercialized and its limitations. Gemmology is a branch of Geology dealing with origin, occurrence, distribution and classification of Precious stones.
35042	II: Energy Resources	To be familiar with the several Energy Resources and its pros and cons
35043	III: Remote Sensing & GIS	Students learn latest knowledge about Remote sensing and GIS is highly helpful for students as well as for researchers because they should learn the EMR, Electromagnetic Spectrum ,EMR interaction with earth and atmosphere, and also studied Sensors ,platforms, resolutions ,multispectral scanners, RS in the microwave region and also RS in thermal infra red region Students get knowledge about .GIS is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface. GIS can help individuals and organizations better understand spatial patterns and relationships.
35044	Geochemistry	Study of Geochemistry provide knowledge about the cosmic abundance of elements, meteorites, distribution of elements in the Earth, Geochemical classification of elements, isotopes. Finally the applications in Geochemical Prospecting.
Semester – IV		
45041	Mineral Exploration, Mining & Ore beneficiation	The paper deals with the processes of formation of economic minerals and techniques of mineral exploration like geochemical, geophysical and Remote Sensing etc. Methods of extraction of various minerals like open cast mining, underground mining etc. Finally, it deals with the beneficiation techniques for low grade ore minerals
45042	Hydrogelogy & Watershed management	Students have familiarized Hydrogeology is **the study of groundwater** – it is sometimes referred to as geohydrology or groundwater hydrology. Students to learn how water gets into

		the ground (recharge), how it flows in the subsurface (through aquifers) and how groundwater interacts with the surrounding soil and rock (the geology).and also learn the quality of groundwater ,geophysical exploration and artificial recharge structures and also learn watershed management
45043	Engineering Geology & Natural Hazards	Students will get knowledge on Engineering properties of rocks and their applications in Civil Engineering. Constructions huge structures like dams, tunnels, airports and their about the limitations while undertaking these constructions. The subject Natural hazards deals with disasters like floods, earth quakes, cyclones, tsunamis, landslides their prediction, mitigation and disaster management.
45044	Environmental Geology	The subject enlightens on renewable and non-renewable energy resources, degradation to irrigation, effects of over use of pesticides, fertilizers, problems associated with urbanization, global warming, waste disposal, water contamination and their management.

2.6.1-Programme outcome details of Departmentment of Zoology

Course	Outcomes
Semester I	
Paper: ZTH 101	It gives scope to learn, understand and appreciate diversity of anatomical features of invertebrates and vertebrates with respect to various physiological functions.
Paper: ZTH 102	Students will learn about Mendelian and non-Mendelian inheritance. Understand the concepts multiples alleles, genetic disorders and karyotyping etc.
Paper: ZTH 103	Students learn and gain knowledge on cellular structure and functional organization of prokaryotes and eukaryotes Gain knowledge on cell division, cell cycle regulation cell signalling mechanisms and their functions. Students gain knowledge on the basics of microbiology, microbial diseases, growth and their control. Gain knowledge on applications of microbes in industry and learn the methods of production of some industrially important products.
Paper: ZTH 104	Students gain knowledge about various tools and techniques used in biological systems and gives them insights about their usage research and various diagnostics

Course	Outcomes
Semester II	
Paper: ZTH 201	It enables to understand primary aspects of carbohydrate, protein, lipid and nucleotide metabolism. It also highlights their interplay and biological significance in energy metabolism and cell function
Paper: ZTH 202	Students learn about germ cell determination,primordial germ cell migration,determination of germ cells in insects,nematodes,amphibians. They also learn about oogenesis,fertilization and post fertilization events.
Paper: ZTH 203	Students will have scope to learn various concepts of metabolic activities of the body such as digestion, respiration, excretion and the functions of nerves and muscles.
Paper: ZTH 204	Students gain knowledge on scope and importance of biostatistics. Students learn and practice various statistical methods used in zoological studies and research. Learn basic applications of computers that are useful in biological applications.

Noncore :ZTH 205	Students would learn about animal diversity from primitive to advanced fauna. They would also gain knowledge about economic importance of useful organisms. Students will understand the potential of disease causing organisms
Course	**Outcomes**
Semester III	
Paper: ZTH 301	Students learn about different types of biomes , ecosystem and energy flow patterns of different ecosystems .They also learn about biogeochemical cycles,natural calamities,disaster management in India. They gain knowledge about epidemiological studies,Environmental health hazards.
Paper: ZTH 302	Students gain knowledge on basic concepts and principles of DNA, genes, organisation of chromosomes. Students learn and gain knowledge on DNA replication, translation, transcription and its regulation, DNA repairs. Learn basic principles of molecular biology techniques like PCR, DNA sequencing, DNA finger Printing etc.,
Paper: ZTH 303	Students gain basic knowledge about various hormones from endocrine glands. Students will learn the concepts of mechanisms of hormone action and their biosynthesis. They also gain the knowledge about homeostasis and various hormones involved in metabolism and further they understand the role of hormones as drugs
Paper: ZTH 304	Students learn about Enzymes ,its isolation, purification and distribution. They also learn its mechanism and regulation. They gain knowledge about the process enzyme engineering ,immobilization and their applications.
Noncore: ZTH 305	students learn about Biodiversity and types of biodiversity students gain knowledge about importance of biodiversity students learn about Biodiversity resources in India students gain knowledge about documentation of biodiversity and Nomenclature students gain knowledge about biodiversity laws and acts in India students learn about biodiversity hotspots in India and on globe students learn about importance of wild life management and wildlife sanctuaries in India students learn about conservation aspects of rare and endangered species students learn about deforestation and its effects on ecosystem students learn about management programmes of wild animals in India students gain knowledge about wildlife trade and preventive measures

Course	**Outcomes**
Semester IV	

Paper: ZTH 401	Gives knowledge to culture of animal cells and its culture medium. Learn basic concepts and principles of recombinant DNA technology, Gene manipulation for transgenic animal production and therapeutics/vaccine production. Provides knowledge on Livestock, improvement aquaculture, generation of Chimeras. Provides knowledge on Intellectual property rights and genetically modified organisms.
Paper: ZTH 402	Students get benefitted with the knowledge on various toxic substances and their effects on living organisms. Students get benefitted with the skill development in environment and occupational toxicology. They will gain practical experience in toxicity evaluation experiments.
Paper: ZTH 403	As neurobiology segment covers basic aspects of types and structure of neurons, mechanism of signal transmission along nerves, it helps students to comprehend nervous system function. Further it also explains in detail about types of neurotransmitters, their production, storage ,release and inactivation to understand their precise role in neuronal function
Paper: ZTH 404	Imparts in depth knowledge of tissues, cells and molecules involved in host defense mechanisms Students gain knowledge and understanding of types of immunity Lean fundamentals of antigens, antibodies, complements and other immune components and its interactions. Understanding of immune mechanisms of tolerance, autoimmunity, Transplantation, vaccination

M.Sc. DEGREE IN PHYSICS

CHOICE BASED CREDIT SYSTEM

(Effective from the Academic Year 2018-2019)

DEPARTMENT OF PHYSICS
YOGI VEMANA UNIVERSITY
KADAPA - 516003
April 2018

Important notes:

The basic criteria of UGC have been followed in preparing the course structure of this programme.

Department Vision

To become an internationally recognized centre of excellence in academics and research in the area of Physics and related inter-disciplinary fields.

Department Mission

- The Department of Physics since its inception in 2007 has played a pivotal role in the University. This course aims to train the young students with the following objectives:
- To impart high quality Science education in a vibrant academic ambience.
- To prepare students to take up challenges as a researcher in diverse areas of theoretical and experimental physics.
- Excellent laboratory and internet facilities.
- Students to take admission to pursue Ph.D. programs in various advanced research areas like Atmospheric Science and Advanced Materials.
- During 3rd and 4th semesters, students may opt special papers for the following areas: Condensed Matter Physics and Electronics.

Program Educational Objectives of M.Sc.(Physics):

1. To impart high quality education in Physical Sciences.
2. To prepare students to take up challenges as globally competitive physicists/researchers in diverse areas of theoretical and experimental physics.
3. To make the students technically and analytically skilled.
4. To give exposure to a vibrant academic ambience.
5. To create a sense of academic and social ethics among the students.
6. To prepare them to take up higher studies of interdisciplinary nature.

Program Outcomes of M.Sc.(Physics):

1. The students will obtain good knowledge in Physical Sciences. They will be trained to compete national level tests like UGC-CSIR NET, JEST, GATE, APSET etc., successfully.
2. They will be prepared to take up challenges as globally competitive physicists/researchers in diverse areas of theoretical and experimental physics.
3. They will be technically and analytically skilled enough to pursue their further studies.
4. They will have a sense of academic and social ethics.
5. They will be capable of taking up higher studies of interdisciplinary nature.
6. They will be able to recognize the need for continuous learning and develop throughout for the professional career.

COURSE STRUCTURE AND EXAMINATION SCHEME for M.Sc. (Physics)

Semester	Course code	Title of the Course	No. of credits	No. of hours per week	Max. Marks 100		Total
					Internal Assess-ment	End Exams	
SEMESTER I	PHY 15101	Classical Mechanics and Theory of Relativity	04	04	25	75	100
	PHY 15102	Atomic and Molecular Physics	04	04	25	75	100
	PHY 15103	Solid State Physics	04	04	25	75	100
	PHY 15104	Analog and Digital Electronics	04	04	25	75	100
	PHY 15105	Practical - I (General)	04	12		100	100
	PHY 15106	Practical-II (Electronics)	04	12		100	100
SEMESTER II	PHY 15201	Statistical Mechanics	04	04	25	75	100
	PHY 15202	Electromagnetic Theory, Lasers and Modern Optics	04	04	25	75	100
	PHY 15203	Mathematical Physics	04	04	25	75	100
	PHY15204	Computational Methods and Programming	04	04	25	75	100
	PHY 15205	Practical - I (General)	04	12		100	100
	PHY 15206	Practical-II (Computer Lab.)	04	12		100	100
	PHY 15207	***Non-Core: Frontiers of Physics***	04	04	25	75	100
SEMESTER III	PHY15301	Quantum Mechanics – I	04	04	25	75	100
	PHY15 302	Nuclear and Particle Physics	04	04	25	75	100
	PHY 15303	Physics of Semiconductor Devices	04	04	25	75	100
	PHY 15304 **Special Paper 1**	(A) Condensed Matter Physics (CMP)-I: Physics of Crystalline Materials (B) Electronics-I : Advanced Electronics	04	04	25	75	100
	PHY 15305	Practical - I (General)	04	12		100	100
	PHY 15306	Practical-II (CMP/Electronics)	04	12		100	100
	PHY 15307	***Non-Core: Advanced analytical Instruments***	04	04	25	75	100
SEMESTER IV	PHY15401	Quantum Mechanics – II	04	04	25	75	100
	PHY15 402	Analytical Techniques	04	04	25	75	100
	PHY 15403 **Elective***	(A) AtmosphericPhysics (B) Applied Spectroscopy (C) Vacuum and Thin Film Physics (D) Photonics	04	04	25	75	100
	PHY 15404 **Special Paper 2**	(A) Condensed Matter Physics (CMP)-II: (B) Electronics II: Communication Systems	04	04	25	75	100
	PHY 15405	Practical - I (Elective)	04	12		100	100
	PHY 15406	Practical-II (CMP/Electronics)	04	12		100	100
Total for CorePapers			**96**	**160**	**400**	**2000**	**2400**
Total for Non-CorePapers			**08**	**08**	**50**	**150**	**200**

NON-CORE COURSES
(FOR THE STUDENTS OF OTHER DEPARTMENTS)

COURSE CODE	TITLE
PHY 15207	Analytical Methods
PHY 15307	Remote Sensing and Applications

Note: The Department will offer both External Elective Courses depending on the student's strength opted for that course, which will be intimated at the beginning of the semester.

Semester-I

Course Code: PHY 15101
Course Title: CLASSICAL MECHANICS AND THEORY OF RELATIVITY

Course Objectives

This course enables the students:

A. To define the concepts of Langrangian Mechanics.
B. To interpret the concepts of Hamiltonian Mechanics.
C. To explain generating function, canonical transformation & Poisson brackets.
D. To illustrate the dynamics of a rigid body and non-inertial frames of reference.
E. To formulate the concepts of coupled oscillators.
F. To learn the Special theory of Relativity and concepts of Relativistic Mechanics.

Course Outcomes

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

1. Formulate the Lagrangian mechanics concepts and solve the problems with the help of Lagrangian mechanics.
2. Compare the formulation of Hamiltonianand Lagrangian mechanics and solve the problems of classical and relativistic mechanics
3. Solve the problems of generating function, canonical transformation & Poisson brackets.
4. Formulate the equations of rigid body dynamics and demonstrate the examples of noninertial frames of reference.
5. Solve the equations of coupled oscillator and to examine the two coupled pendulums, and double pendulum related problems.

UNIT – I: Lagrangian Mechanics and Hamiltonian Mechanics

Newtonian mechanics of one and many particle systems: Conservation laws, Constraints and their classification, Degrees of freedom: Generalized coordinates: Principle of virtual work, D'Alemberts principle, Lagrange's equations of motion. Applications: Inclined plane, Linear harmonic oscillator and simple pendulum.

Hamiltonian principle, Lagrange's equation from Hamilton's principle, Hamilton's equation of motion. Applications: Simple pendulum, Compound pendulum. (1-4)

UNIT – II: Canonical Transformations and Hamilton - Jacobi Theory

Canonical Transformations, Generating function and their properties, Condition for transformation to be canonical, Illustration of canonical transformation, Poisson – Brackets, Canonical equations in terms of Poisson, Bracket notation. Lagrange - Brackets and their properties.

Hamiltonian - Jacobi equation, one dimensional harmonic oscillator, Small oscillations and normal modes, Action Angle variables, Kepler problem in action angle variables. (4,5)

UNIT –III: Motion in a Central Force Field

Reduction to the equivalent one body problem; Motion in a central force field: Conditions for closed orbits: Inverse square law of forces: Kepler’s laws of planetary motion; Rutherford scattering.

Rotations – Space and body fixed axes: Angular momentum and Torque; Eulerian angles – Euler's equations of a rigid body: Motion of symmetrical top ; Expression for slow and fast precessions; Larmour precision; Gyroscope. (1-3,6)

UNIT –IV: Special Theory of Relativity

Introduction – Postulates of Special Theory of Relativity – The principle of constancy of light – The Lorentz transformations. Relativistic Kinematics: The velocity transformations – The transformations for the acceleration of a particle, The Doppler effect.

Relativistic Mechanics: The mass of a moving particle – The relativistic dynamics of a single particle – Applications of relativistic dynamics of a single particle : Motion in electric field – Motion in a magnetic field – Experimental verification of the variation of mass with velocity – Bucherer's experiment - Transformation of momentum and force. (7-9)

Books for Reference

1. Classical Mechanics by N.C. Rana and P.S. Joag (Tata Mc-graw Hill) 1991
2. Classical Mechanics by H. Goldstein (Addi Wesely) 1980
3. Classical Mechanics by J.C.Upadyaya
4. Classical Mechanics by Gupta, Kumar and Sharma
5. Classical dynamics of particles by J.B.Narion Academic press
6. Introduction to Classical Mechanics by R.G. Takwale and P.S. Puranic
7. Theory of Relativity by W.Pauli
8. Introduction to the theory of relativity by P.G.Bergmann
9. Introductory Relativity by W.G.V.Rossner

Semester-I

Course Code: PHY 15102
Course Title: ATOMIC AND MOLECULAR PHYSICS

Course Objectives

This course enables the students:

A. To learn about the intricacies of spectra of Hydrogen-like atoms
B. To understand the concepts of Zeeman and Startk effects and their applications.
C. To study the details of rotational and vibrational spectra of molecules.
D. To learn about the FTIR and vibrational spectroscopy and the corresponding instrumentations.
E. To understand the concepts of Frank-Condon principle and application.

Course Outcomes

After the completion of this course, students will be:

1. Able to deal with problems related to Hydrogen-like atomic spectra
2. Having knowledge about the Zeeman and Startk effects and their applications
3. Through with the knowledge of rotational and vibrational spectra of molecules
4. Able to comprehend the instrumentation techniques that are used in different regions of spectra
5. Understanding principle and working of IR and FTIR spectrometers.
6. Learning the Frank-Condon principle and intensity distribution in absorption and emission spectra.

UNIT I: Atomic Spectra
Hydrogen atom (one electron atom) - quantum numbers- Spectra of hydrogen atom- Spectra of alkali elements- Fine structure- Elements with more than one valence electron- Forbidden transitions and selection rules- Vector atom model – Spin-orbit interaction energy- Space quantization- Stern-Gerlach (S-G) experiment-Coupling schemes- Spectral terms and term symbols, Ground states based on electron configuration - LS coupling - JJ coupling- Interaction energies in LS and JJ couplings - Hund's rule of multiplicity - Pauli's exclusion principle - Equivalent and non-equivalent electronic systems – Applications of atomic spectra.

UNIT II: Zeeman and Stark Effects
Zeeman effect, Normal and anomalous Zeeman effects, Experimental details, Zeeman effect of hyperfine structure, Magnetic moment of the atom and Lande's 'g'-factor, Zeeman effect in sodium atom, Lande g-formula for LS and JJ couplings - Paschen-Back effect- Splitting of sodium lines and selection rules, Stark effect, Experimental details, Weak and strong field effects- linear and quadratic Stark effects-Width of spectral lines.

UNIT III: Diatomic Molecular Spectroscopy – Rotational Energies
Rotational, vibrational, electronic spectra of diatomic molecules, Types of molecules: Linear, symmetric top, asymmetric top and spherical top molecules, Rotational spectra of a diatomic molecule as rigid rotator – Energy levels and spectra of non-rigid rotor – Intensity of rotational lines - Rotational spectra of polyatomic molecule (OCS, CO_2) -Evaluation of

rotational constants -Effect of isotopic substitution on rotational levels- Stark modulated microwave spectrometer- Applications of rotational spectroscopy - Determination of molecular structure, dipole moment, atomic mass- Microwave oven.

UNIT IV:Diatomic Molecular Spectroscopy – Vibrational Spectra

Vibrational spectra of diatomic molecule – Diatomic molecule as simple harmonic oscillator – Anharmonic oscillator – Energy levels and spectrum – Molecule as vibrating rotator – PQR branches – progressions and sequences – Vibrational analysis of electronic spectra - Deslander's table – Evaluation of vibrational constants – Morse potential energy curve – Frank-Condon principle – Intensity distribution in absorption and emission spectra - Effect of isotopic substitution on vibrational bands – IR spectrometer – FTIR spectroscopy – Principle – Interferometer arrangement – advantages - Applications of vibrational spectroscopy: Identification of molecular constituents – Elucidation of molecular structure.

Books for study

1. Introduction to Atomic Spectra, H.E. White, McGraw-Hill Kogakusha. Ltd., New Delhi.
2. Fundamentals of Molecular Spectroscopy, C.N. Banwell and E.M.Mc Cash, Tata McGraw-Hill Pub. Co. Ltd., New Delhi,1994.
3. Spectroscopy, Vol. I & III, B.P. Straughan& S. Walker, John Wiley & Sons, Inc., NY,1976.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw - Hill Book Co, 1962.
5. Spectra of Diatomic Molecules, G. Herzberg, D.VanNostrand Company Inc, New York 1950.
6. Molecular Spectroscopy, J.M. Brown, Oxford Science Pub. Oxford, 1998.
7. Molecular Structure and Spectroscopy, G. Aruldhas, Prentice- Hall of India, Pvt., 2005.
8. Elements of Diatomic Molecular Spectra by H. Dunford – Addison-Wisely, 1957.

Semester-I

Course Code: PHY 15103
Course Title: SOLID STATE PHYSICS

Course Objectives

This course enables the students:

A. To understand the bonding in solids and study crystal structures and properties.
B. Acquire knowledge of the behaviour of electrons in solids and on expression for thermal and electrical conductiveties in metals.
C. To become familiar with the Band theory and difference between metals, semiconductors and insulators.
D. To develop an understanding on the properties of Semiconductor materials.
E. To get familiarized with the different parameters associated with superconductivity and the theory of superconductivity.

Course Outcomes

After the completion of this course, students will be:

1. Able to differentiate types of crastals based on their structure.
2. Able to explain how the predicted electronic properties of solids differ in the classical free electron theory, quantum free electron theory and the nearly free electron model.
3. Able to explain Band theory and difference between metals, semiconductors and insulators.
4. Able to understand the properties and applications of different types of semiconductor meterials.
5. Able to differentiate between type-I and type-II superconductors and their theories.

UNIT – I: Lattice Energies and Lattice Vibrations
Bonding in Solids - Ionic and van der Waals crystals – Elastic properties – Stress and strain – Elastic moduli - Lattice energy calculations for ionic and van der Waals crystals – Lattice vibrations: Mono and diatomic one dimensional infinitely long lattices – Vibrational spectra – Infrared absorption in ionic crystals – Vibrational spectra of finite lattice – Quantization of lattice vibrations – Phonons – Properties – Experimental measurement of dispersion relation.

UNIT – II: Transport Phenomena and Band Theory
Concept of electrical and thermal resistivity – Expression for thermal and electrical conductivities for metals – Lorenz number - Different scattering mechanisms – Matthissen's rule- Formulation of Boltzmann transport equation – Relaxation time approximation

Free electron theory - Band theory of Solids - Motion of electron in periodic potential – Bloch function - Kroning-Penny model – Formation of energy bands in solids — Brillouin zones – Concept of effective mass – Distinction between metals, insulators and semiconductors.

UNIT – III: Semiconductor Physics

Intrinsic and extrinsic semiconductors – Expression for position of Fermi levels and carrier concentrations – Variation of Fermi level with temperature – np product – Degenerate and non-degenerate semiconductors – Charge neutrality equation - Carrier mobility, conductivity and their variation with temperature – Direct and indirect band gap semiconductors – Differences and examples – Hall effect – Drift and Diffusion – Diffusion equation - Einstein relation – Generation, Recombination and life time of non-equilibrium carriers – Hayness-Shockley experiment.

UNIT – IV: Superconductivity

Concept of zero resistance – Magnetic behavior –Meissner effect – Type I and Type II superconductors - Isotope effect – Specific heat behavior –Expression for entropy difference between normal and superconducting states – Two-fluid model – London's equations – Penetration depth – BCS theory –Josephson junctions – SQUIDS - Applications of superconductors – High T_C superconductors (Conceptual)

Books for Study

1. Solid State Physics, C. Kittel, John Wiley & Sons.
2.Solid State Physics, Neil W. Ashcroft & N David Mermin
3. Solid State Physics, A.J. Dekkar, Macmillan India Ltd.
4. Elementary Solid State Physics, M. Ali Omar, Addison-Wesley.
5. Solid State Physics, M.A.Wahab, Narosa Publishing House.
6. Solid State Electronic Devices, B.G. Streetman.
7.High T_C Superconductivity, C.N.R. Rao and S.V. Subramanyam.
7. Solid State Physics, S.O. Pillai.
8. Electrons in Solids, Richard H. Bube.
9. Semiconductor Device fundamentals, Robert F. Pierret, Addison and Wesley Longmann

Semester-I

Course Code: PHY 15104
Course Title: ANALOG AND DIGITAL ELECTRONICS

Course Objectives:

A. To impart knowledge about a variety of special, power and microwave solid state electronic devices, their structure and the underlying physical principles.
B. To expose the students to the Operational Amplifiers and to add to the knowledge on the variety of circuits encompassing all major class of applications.
C. Combinational logic and Sequential logic circuits would be dealt with in all its expanse and rigor to give a good feel of the different types of Flip-Flops and their useses.
D. Microcompueter concept is introduced and intended to impart knowledge on 8085 Microprocessor.

Course Outcomes:

1. Understanding the physics of the devices their characteristics and applications, to be able to use them in electronic circuits
2. Students would develop an insight into the Operational Amplifier device and applications during and after the course
3. In depth understanding would enable the students to appreciate the beauty of the subject and design logic circuits that are technically sound.
4. Students would develop a comprehensive understanding of Microprocessor.
5. Students would be aware of writing assembly language programs for 8085 Microprocessor to understand their use in larger and complex systems.
6. Students would enjoy the new and stimulating ideas behind the future novel devices and would also appreciate the link between electronics and the quantum effects that come into play.

UNIT – I: Introduction to Electronic Devices:
P-N junction and its characteristics, BJT, characteristics, BJT as amplifier, Field Effect Transistor (FET): Structure and working of JFET, Characteristics, and parameters of JFET. Advantages of FET over BJT. FET as switch and Amplifier Application of FET as voltage variable resistor. Structure of MOSFET, depletion type and enhancement type, MOSFET Characteristics, MOSFET as variable resistor, Concept of CMOS. Structure, working and Characteristics of UJT. Application of UJT as a Relaxation oscillator.

UNIT – II:
Operational Amplifiers:
Block diagram of a typical Op-Amp, differential Amplifier, Comparator open loop configuration, inverting and non-inverting amplifiers. Op-amp with negative feedback, CMRR, frequency response, slew rate. Instrumentation Amplifier, Integrator and differentiator. Waveform generators (Square and triangle). Converters: R-2R Ladder D/A Converter, Successive Approximation A/D Converter.

UNIT – III : Digital Electronics
Combinational Logic: Multiplexers, Decoder, Demultiplexer, Data selector, Multiplexer, Encoder. Sequential Logic: Flip–Flops, 1-bit memory, The RS Flip-Flop, JK Flip – Flop, JK Master Slave Flip–

Flops, T Flip-Flop, D Flip-Flop, Shift Registers, Serial in Serial out, Serial in Parallel out, parallel in Serial out, Parallel in Parallel out Registers. Counters: Asynchronous and Synchronous Counters, MOD-3 Counter, MOD-5 Counter.

UNIT – IV: 8085 Microprocessor

Introduction to microcomputers, memory, input/output, interfacing devices, 8085 CPU-Architecture-BUS timings Demultiplexing the address bus generating control signals, instruction set, addressing modes, illustrative programs – writing assembly language programs, looping, counting and indexing counters and timing delays, stack and subroutine.

Text Books

1. Micro Electronics by Milliman and Halkias. TMH Publications
2. OP-Amps & Linear Integrated Circuits, by Ramakanth A.Gayakwad, PHI, 2nd Edition, 1991.
3. Digital Systems by Ronald J. Tocci, 6th Edition, PHI, 1999.
4. Digital Principles and Applications by A.P. Malvino and Donald P.Leach, Tata McGraw- Hill, New Delhi, 1993.
5. Microprocessor Architecture, Programming & Appplications with 8085/8086 by Ramesh S.Gaonkar, Wiley – Eastern Ltd, 1987 (UNIT – V)

Reference Books

1. Electronic Devices and Circuit Theory by Robert Boylested and Louis Nashdsky, PHI, New Delhi, 1991
2. Micro Electronics by Sedra and Smith
3. Electronic Principles by Malvino, 6th Ed. TMH
4. Linear Integrated circuits by Roy Choudhry
5. Operational amplifiers by Collins

Semester-II

Course Code: PHY 15201

Course Title: STATISTICAL MECHANICS

Course Objectives

A. To understand the dependence of equilibrium properties of various systems on their microscopic constituents and compute thermodynamic parameters by using classical statistics.

B. To learn to use methods of quantum statistics to obtain properties of systems made of microscopic particles which either obey Fermi-Dirac statistics or Bose-Einstein statistics.

C. To grasp the concepts of first order and second order phase transitions and critical phenomena.

D. To understand phase transition arising in Ising model.

E. To learn to obtain the properties of out-of-equilibrium systems using concepts from equilibrium physics.

Course Outcomes:

Students should be able to

1. Use various ensemble theories to calculate the thermodynamic properties of different systems.
2. Compute properties of systems behaving as ideal Fermi gas or ideal Bose gas.
3. Classify transitions as first order or second order.
4. The student should be able to reproduce the exact solution of Ising model in one dimension and solve it using mean field theory.
5. Understand the approach required to predict the evolution of non-equilibrium systems.

UNIT- I: Ensembles

Phase space – Macro and micro states - Contact between Statistics and Thermodynamics - Concept of ensembles – Types of ensembles - Ensemble average - Liouville's Theorem – Micro canonical ensemble: ideal gas – Gibb's paradox and its resolution – Entropy and probability – Canonical ensemble – Ideal gas in canonical ensemble – Grand canonical ensemble – Ideal gas in grand canonical ensemble – Comparison of various ensembles.

UNIT – II: Partition Functions

Canonical partition function – Free energy and relation with thermodynamic quantities - Molecular partition function – Translational partition function – Rotational partition function – Vibrational partition

function – Electronic and Nuclear partition functions – Applications of Rotational partition function – Applications of vibrational partition function to solids.

UNIT – III: Maxwell – Boltzmann and Bose – Einstein Statistics

Classical and Quantum Statistics - Maxwell - Boltzmann distribution –Density of States - Velocity and Energy distribution - Calculation of mean values – Equipartition theorem - Bose – Einstein distribution, Bose – Einstein condensation - Black body radiation and the Planck's radiation law - Dulong and Petit's law - Einstein and Debye's theories of heat capacities - Liquid helium – Two fluid model of liquid helium II.

UNIT – IV: Fermi – Dirac Statistics & Fluctuations

Fermi - Dirac distribution – Electrons in metals – Thermionic emission – Magnetic susceptibility of free electrons – White dwarfs – Fluctuations in ensembles, Onsagar's one dimensional and reciprocal relations - Ising Model - Random walk and Brownian motion, First and second order phase transitions.

Books for study

1. Statistical Mechanics ,B.K. Agarwal, Melvin Eisner,2nd Edition, New Age International (P)Ltd.
2. Statistical Mechanics and properties of Matter by ESR Gopal — Student Edition (EllisHorwood)
3. Statistical and Thermal Physics ,F. Reif—4thEdition,McGraw Hill
4. Statistical Mechanics, R.K. Pathria and Paul D. Beale, Elsevier
5. Fundamentals of Statistical Mechanics, B.B. Laud, New Age International Publishers
6. Elementary Statistical Mechanics, S.L. Guptha and V. Kumar, PragathiPrakashan Publications

Books for reference:

1. Statistical Physics,Bhattacharjee
2. Introduction to Modern Statistical Mechanics, David Chandler, Oxford University Press

Semester-II

Course Code: PHY 15202
Course Title: ELECTROMAGNETIC THEORY, LASERS AND MODERN OPTICS

Course Objectives

This course enables the students:

A. To understand the electromagnetic theory and propagation of light in different types of medium.

B. To identify conditions for lasing phenomenon and properties of the laser.

C. To compare continuous and pulsed lasers.

D. To classify different types of lasers with respect to design and working principles

E. To illustrate various applications of laser e.g. holographic non-destructive testing and Fourier optics.

F. To understand the construction of optical fiber and its applications.

Course Outcomes

After the completion of this course, students will be:

1. Having knowledge about the electromagnetic theory and propagation of light in different types of medium.
2. To evaluate conditions for lasing phenomenon and properties of the laser.
3. To calculate cavity modes of a given cavity and identify the given resonator is stable or unstable one.
4. To evaluate Q-switching and the mode-locked lasing phenomenon.
5. To appraise different type of lasers with respect to design and working principles.
6. To assess applications of a laser for holography and Fourier optics.
7. Familier about Optical Fiber and its applications.

UNIT – I: Electromagnetic Theory
Maxwell's equations in differential and integral forms, Scalar and Vector potentials- Gauge invariance, The general wave equation, Propagation of light in isotropic dielectric medium – Dispersion, Propagation of light in conducting medium-skin depth, Reflection and refraction at the boundary of a dielectric interface – Fresnel's equations- Propagation of light in crystals- Double refraction. Electromagnetic radiation ; Retarded potentials, Radiation from moving point

charge, Radiation from oscillating dipole (electric and magnetic dipoles), Radiation from linear antenna – Radiation resistance, electric quardrupole radiation, Lienard – Wiechert potentials.

UNIT – II: Lasers and Non-Linear Optics

Basic principles of lasers – Spontaneous and stimulated emission – Laser beam properties - Einstein coefficients - Population inversion – Pumping schemes – Threshold condition for laser oscillation –Types of lasers- Ruby laser-Nd:YAG laser - GaAs laser, -Dye laser - Argon ion laser-CO_2 laser - rate equations for three level and four level lasers-Laser applications.

Basic Principles – Origin of optical nonlinearity - Harmonic generation – Second harmonic generation – Phase matching condition – Third harmonic generation – Optical mixing – Parametric generation of light – Parametric light oscillator – Frequency upconversion – Self focusing of light - Guided wave optics - Pulse compression - Optical solutions.

UNIT – III: Holography and Fourier Optics

Introduction to Holography – Basic theory of Holography – Recording and reconstruction of Hologram – Diffuse object illumination – Speckle pattern – Fourier transform Holography – Applications of Holography.

Introduction to Fourier optics– Two dimensional Fourier transforms – Transforms of Dirac-Delta function – The convolution integral – convolution theorem- Spectra and correlation – Parsevel's formula – Auto correlation and cross-correlation – Apodization – Array theorem – Fourier methods in diffraction - Fraunhouffer diffraction of single slit, double slit and transmission grating using Fourier method.

UNIT – IV: Fiber Optics

Total internal reflection - Optical fiber modes - TE and TM modes– Single mode fibers – Graded index fibers – Fiber materials and fabrication – Mechanical properties of fibers – Fiber optic cables – Attenuation – Signal distortion on optical wave guides- Erbium doped fiber amplifiers – Solitons in optical fibers - Block diagram of fiber optic communication system - Applications of optical fibers in communication and medicine.

Text and Reference Books

1. Introduction to Electrodynamics, D.J. Griffiths, 4 th Edition, Prentice-Hall of India, ND,2513.
2. Electromagnetics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, ND, 2511.
3. Fundamentals of Electromagnetic theory, 2nd Edition, S.K. Dash and S.R. Khuntia, ND,2511.
4. Modern Optics by G.R. Fowels, 1989.
5. Laser and their Applications, M.J. Beesly, Taylor and Francis, 1976
6. Lasers and Non-Linear Optics, B.B. Laud, 3rd Edition, New Age International Publishers Ltd, New Delhi, 2511.
7. Optics, E. Hecht, Addison Wiley,1974.
8. Optical Fiber Communications, Gerel Keiser, McGraw Hill Book, 2500.

Semester-II

Course Code: PHY 15203
Course Title: MATHEMATICAL PHYSICS

Course Objectives

This course enables the students:

A. To learn about Special Functions
B. To understand the concepts of Laplace Transform and Fourier Transform and their applications.
C. To know about Partial Differentiations and Tensors
D. To gain knowledge on complex variables
E. To gain familiarity with the Cauchy's theorem and integral formula.

Course Outcomes

After the completion of this course, students will be:

1. Able to use Special functions for evaluating integrals, Legendre, Bessel and Hermite differential eauations.
2. Able to apply Laplace Transform and Fourier Transform to solve LCR circuits, Operational Amplifiers, resonance of simple pendulum etc.
3. Numerically able to solve partial differential equations
4. Solving eigenvalue problems numerically
5. Comfortable in dealing with integral equations

UNIT - I: Special Functions
Beta and Gamma Functions – Definitions and properties – Evaluation of integrals, Legendre, Bessel and Hermite differential equations – Solutions – Generating functions – Orthogonal properties of Legendre, Bessel and Hermite Functions (Proof not necessary) – Recurrence relations – (Proof for Legendre polynomials only)

UNIT - II: Integral Transforms
Laplace Transform: Properties of Laplace transforms **–**Derivative of Laplace transform– Laplace transform of a derivative –Laplace transform of periodic functions- Inverse Laplace transform and its properties –Inverse Laplace theorem –Convolution theorem-Evaluation of inverse Laplace Transforms by Convolution theorem. Solution of linear differential equations with constant coefficients - Applications to LCR circuits, Operational amplifiers and resonance of simple pendulum.
Fourier Transform: Infinite Fourier Sine and Cosine transforms–Properties of Fourier transforms - Derivative of Fourier transform –Fourier transform of a derivative- Fourier Sine and Cosine transform of derivatives-Finite Fourier transforms – Applications of Fourier Transforms.

UNIT - III: Partial Differentiations and Tensors
Partial Differentiations: Laplace equation – Method of separation of variables – Application of Laplace equation to two dimensional steady state of heat flow in a thin rectangular plate and a

long cylinder. Wave equation in two dimensions – Application to the vibration of a rectangular membrane and circular membrane.

Tensors: Definition – Contravariant, Covariant and Mixed tensors – Dummy suffix notation- Addition, subtraction, contraction, inner product, outer product, symmetric and anti-symmetric tensors - Application of Tensor theory to strain, thermal expansion and piezoelectricity.

UNIT – IV: Complex Variables

Functions – Complex differentiation - Analytic function - Cauchy – Reimann equations – Derivatives of elementary functions – Singular points and classification. Complex integration - Cauchy's theorem – Integrals of special functions – Cauchy's integral formula – Taylor's and Lorentz theorem (statements only) – Residues, calculations of residues - Residue theorem – evaluation of definite integrals.

Reference Books

1. Functions for Scientists and Engineers, W.W. Bell, Van Nostrand Co., London (1968).
2. Fourier Analysis, Hsu P.Jewi, Unitech Division.
3. Laplace Transforms, Murray Spiegle, Schaum's outline series, McGraw Hill,New York.
4. Applied Mathematics for Engineers, Pipes and Harval, III Edition, McGrawHill Books Co.
5. Vector Analysis & Introduction to Tensor Analysis, M. R. Spiegel, Schaum's Series 1959.
6. Physical Properties of Crystals, J.F. Nye, Schaum'sSeries, Oxford Univ. Press, 1957.
7. Theory and Properties of Complex Variables, S. Lipschutz, Schaum'sSeries, McGraw Hill.
8. Mathematical Physics, H.K. Das and Ramaverma, S. Chand & Co. Ltd., New Delhi (2011).
9. Mathematical Physics, B. Bhattacharyya, New Central Book Agency Pvt. Ltd., (2010).
10. Applied Mathematics for Engineers and Physicists –Lious A Pipes and Lawrance R. Rarvill.
11. Mathematical Physics –AK Ghatak, IC Goyal and SL Chua-Macmillan India Ltd
12.. Vector and Tensor Analysis –Scham Series.
13.. Mathematical Physics –SatyaPrakash

Semester-II

Course Code: PHY 15204
Course Title: COMPUTATIONAL METHODS AND PROGRAMMING

Course Objectives

This course enables the students:

A. To learn the fundamentals of C-programming language and also expressions and I/O statements, control statements, arrays, user define functions and pointers.
B. To learn the fundamentals of MATLAB and applications.
C. To obtain training on linear, non-linear and curve fitting methods, which are useful for solving Algebraic, transcendental and simultaneous equations.
D. Instruct them to calculate integrals and differentials using different numerical methods.
E. Train them to solve partial differential equations numerically.

Course Outcomes

After the completion of this course, students will be:

1. Able to write and execute C-programs for solving problems.
2. Able to work with MATLAB and handle large data set.
3. Develop a good knowledge in solving Algebraic, transcendental and simultaneous equations.
4. Able to to solve partial differential equations numerically.

UNIT – I: C programming language
(a) Fundamentals of C
C character set – Identifiers and keywords – Constants – Variables – Data types – Declarations of variables – Declaration of storage class – Defining symbolic constants – Assignment statement. Operators : Arithmetic operators – Relational operators – Logic operators – Assignment operators – Increment and decrement operators – Conditional operators.

(b) Expressions and I/O statements: Arithmetic expressions – Precedence of arithmetic operators – Type converters in expressions – Mathematical (library) functions – Data input and output - Getchar and putchar functions – Scanf – Printf – Simple programs.
(c) Control statements: If-Else statement – Switch statement – The ?Operator – GO TO – While , Do-while, FOR statements – BREAK and CONTINUE statements.

(c) Arrays
One dimensional and two dimensional arrays – Initialization – Type declaration – Inputting and outputting of data for arrays – Programs of matrices addition, subtraction and multiplication.
(d) User Define function: The form of C functions – Return values and their types – Calling a function – Category of functions. Nesting of functions.Recursion.ANSI C functions – Function declaration. Scope and lifetime of variables in functions.

(e) Pointers: Accessing the address of a variable. Declaration and Initialization of pointer variables. Accessing the value of a variable through its pointer. Pointer Expressions- Pointers and arrays – Pointers and structures.

UNIT II – Fundamentals of MATLAB and Applications

Basics of Matlab – Matlab windows- On-line help- Input-Output-File types-Platform Dependence - Creating and working with Arrays of Numbers – Creating, saving, plots, printing Matrices and Vectors – Input – Indexing –Matrix Manipulation-Creating Vectors Matrix and Array Operations Arithmetic operations- Relational operations – Logical Operations – Elementary math functions , Matrix functions – Character strings Applications- Linear Algebra,- solving a linear system, Gaussian elimination, Finding Eigen values and eigenvectors, Matrix factorizations

Application-Curve Fitting and Interpolation-Polynomial curve fitting on the fly , Least squares curve fitting, General nonlinear fits, Interpolations

UNIT – III: Linear, non-linear equations and curve fitting

(a) Solution of Algebraic and transcendental equations – Bisection, Falsi position and Newton- Rhapson methods – Basic principles – Formulae – Algorithms.

(b) Simultaneous equations: Solutions of simultaneous linear equations – Gauss elimination and Gauss-Seidel iterative methods - Basic principles – Formulae – Algorithms

(c) Curve fitting – Least squares fitting – Linear and quadratic equations.

UNIT – IV: (a) Interpolations: Concept of linear interpolation – Finite differences – Newton's and Lagrange's interpolation formulae –Principles and Algorithms

(b) Numerical differentiation and integration: Numerical differentiation – algorithm for evaluation of first order derivatives using formulae based on Taylor's series – Numerical integration – Trapezoidal and Simpson's 1/3 rule – Formulae – Algorithms.

(c) Numerical solution of ordinary differential equations: Euler, method, fourth order Runga-Kutta Method.

Books for reference

1. Programming with 'C', Byron Gottfried, Tata McGraw Hill.
2. Numerical Methods, E. Balaguruswamy, Tata McGraw Hill.
3. Let Us C, Yeswanth Kanetkar.
4. Rudra Pratap, Getting started with Matlab 7, Oxford, Indian University Edition, 2006
5. Y.Kirani Singh and B.B.Chaudhuri, MATLAB Programming, Prentice-Hall India, 2007
6. Computer oriented numerical methods, Rajaraman.

Semester-II

Course Code: PHY 15207

Course Title: Non-Core Elective Paper - FRONTIERS OF PHYSICS

Course Objectives

This course enables the students belong to other subjects:

A. To know the life sketchs of great Indian Physisists and their concributions.

B. To learn about the different conventional energy sources available on Earth and their characteristics.

C. To obtain knowledge on Non-Conventional Energy sourses.

D. To know the concepts of Nuclear Physics and advantages and disadvantages of Nuclear power.

Course Outcomes

After the completion of this course, students of non-physics stream will be:

1. Able to get knowledge on great Indian Physisists and their research contributions.
2. Exposed to the knowledge on various energy sourses available and their advantages and future treats.
3. Develop a good understanding about the Nuclear power and Nuclear power stations of India.

Unit I: Contribution of Indian Scientists:

J.C.Bose, Dr.C.V.Raman, S.N.Bose, M.N.Saha, Prof. SatishDhawan, Dr.B.D.NagChaudhary, H.J.Bhabha, Dr.A.P.J.AbdulKalaam, Vikram Sarabhai, Prof.S.Bhagavantham, Prof. C.N.R.Rao

Unit II: Conventional Energy

Role of new and renewable energy source; solar energy-solar heating/cooling technique, solar distillation and drying, photovoltaic energy conversion
Wind energy-Sources and potentials, horizontal and vertical axis windmills, performance characteristics
Tidal and wave energy: Potential and conversion techniques

Unit-III Non-conventional Energy

Non-renewable sources such as petroleum, natural gas, coal (Rayalaseema Thermal Power Project and Ramagundam Thermal Power Project)andHydel power plants – Srisailam Hydroelectric power plant and NagarjunaSagar Hydroelectric power plant

Unit IV: Nuclear Energy

Introduction Nuclear Physics concepts; Nuclear power plants – Advantages and disadvantages

1. Kalpakkam Atomic power station
2. Tarapur Atomic power station

Source: The relevant material of the above units must be down loaded from authenticated web location from https://www.google.com

Semester-III

Course Code: PHY 15301

Course Title: QUANTUM MECHANICS – I

Course Objectives

This course enables the students to:

A. to learn the important postulates of quantum mechanics.
B. To know the concepts of wave function, operator and quantum mechanical tunnelling.
C. To learn particle motion and its equation. Three different pictures like Schrodinger picture, Heisenberg picture and Interaction picture.
D. To know how to evaluate Eigen values and Eigen fuctions of a particle in different problems.
E. Formulate various approximate methods to solve real problems which can not be solved analytically.
F. To learn classical theory of scattering and quantum theory of scattering and method of evaluation of scattering parameters.

Course Outcomes

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

1. differentiate classical theory and quantum theory and also understand the concept of wave particle duality.
2. Learn Bra and Ket notation of the function and also matrix representation of the operator.
3. Understand the method of evaluating eigen fuctions and eigen values of particle in different situations.
4. apply the WKB Approximation to solve the real problems.
5. Understand classical theory of scattering and quantum theory of scattering and method of evaluation of scattering parameters.

UNIT - I: Formulation and Simple Problems

Wave particle duality – Wave functions in coordinate and momentum representation- Postulates of quantum mechanics -Linear vector space: Hilbert space - Dirac's Bra and Ket notations- Hermitian operators and their properties- Matrix representation of an operator- Unitary operators- Unitary transformation - The Kronicker Delta and Dirac delta functions

Eigen values and Eigen functions for finite potential well and step barrier – Quantum mechanical tunneling

UNIT - II: Quantum Dynamics and Simple Problems

Equations of motion - Schrodinger Picture- Heisenberg Picture- Interaction Picture- Equivalence of various Pictures- . Poisson and Commutation brackets- Their Properties

Eigen values and Eigen functions for Simple harmonic oscillator- Polynomial method and abstract operator method in one dimension- Eigen values and Eigen functions for a free particle and particle in a box in three dimensions.

UNIT - III: Approximate Methods

Time independent perturbation theory for non-degenerate levels: Perturbed harmonic oscillator, Normal Helium atom, Stark effect of the plane rotator. First order perturbation theory for degenerate levels: First order Stark effecting in hydrogen atom; Time dependent perturbation theory: Transition to continuum (Fermi Golden rule).

WKB approximation – Turning points and connecting formulae: Application to potential barrier. Variational methods.

UNIT - IV: Scattering Theory

Introduction: classical theory of scattering - Quantum theory of scattering - Method of partial wave analysis - Scattering by a perfectly rigid sphere - Greens function in scattering theory - Born approximation - Validity of Born approximation - optical theorem.

Reference Books

1.QuantumMechanics: S.L.Kakani and H.M.Chandalia.SultanChandandSonsFirst Edition
2. Advanced Quantum Mechanics : B.S. Rajput, Pragatiprakasan.
3. Quantum Mechanics: V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan, Tata McGrawHill Publishing Company.
5. Quantum Mechanics: S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma Jai PrakashNath and Company.
6. An introduction to QuantumMechanics, P.T. Mathews c Graw Hill Publishing Company.

Semester-III
Course Code: PHY 15302
Course Title: NUCLEAR AND PARTICLE PHYSICS

Course Objective:

A. To impart the knowledge regarding the fundamental and basics of Nucleus and its models.
B. To provide the knowledge of the Two-nucleus problem, concept of nuclear force.
C. To acquire knowledge about the nuclear accelerators and their classification
D. To learn the concepts of nuclear fission and nuclear fusion reactions and reactors basic technology.
E. To have a good understanding of interaction of charged particles with matter.
F. To have an elementary idea of particles and their classification.

Course Outcome:

1. Student will have an idea developed about the nucleus.
2. Student will have a concept and nature of nuclear force.
3. Student will learn about the the nuclear accelerators and their classification.
4. Student will develop good knowledge about nuclear reactions and nuclear reactor technology.
5. Student will have an idea about the interaction of particles with matter.
6. Student will understand te nature, interaction etc.. of the elementary particles.

UNIT – I:Nuclear Forces and Reactions

General properties of nuclei: Parity, isospin, Magnetic dipole moment, electric quadrupole moment and nuclear shape.

Nuclear Forces and Models: Characteristics of nuclear forces – Ground state of Deuteron – Proton – Proton scattering – Neutron – Proton scattering – Meson theory of nuclear forces – Bethe-Weizacker semi-empirical binding energy equation and its applications, Nuclear shell model - energy levels and calculation of angular momentum- its validity and limitations.

Nuclear Reactions: Types of nuclear reactions –Compound nuclear reactions – Bhor's theory- Nuclear cross section – Direct reactions- stripping and pick up reactions - Resonance theory – Briet Wigner one level formula.

UNIT – II: Nuclear Accelerators

Introduction – Ions sources – Classification of accelerators - Electrostatic accelerators – Cockcroft-Walton accelerator, Van de Graff accelerator and Tandem accelerators - Linear accelerators – Drift tube and Wave guide accelerators – Low energy circular accelerators – Cyclotron and Betatron – High energy circular accelerators – Proton and electron Synchrotrons and Microtron.

UNIT – III: Nuclear Reactors

Nuclear fission reactions – Types of fission - Distribution of fission products – Neutron emission on fission – Spontaneous fission – Nuclear fission and thermonuclear reactions – Hydrogen bomb.

Nuclear fusion reactions - Nuclear chain reactions – Four factor formula – The critical size of a reactor – General aspects of reactor design – Classification of reactors – Research reactors and Power reactors.

UNIT – IV:Elementary particles

Discovery and classification of elementary particles – Types of interactions – Conservation laws – Iso-spin, parity, charge conjugation – Time reversal – CPT theorem – Properties of leptons, mesons and baryons – Elementary particle symmetries (SU_2 and SU_3 symmetries) – Quark model – Higg's particle – Elementary ideas.

Reference Books

1. Nuclear Physics, Irving Kaplan, Narosa Pub. (1998).
2. Nuclear Physics, Theory and experiment – P.R. Roy and B.P. Nigam, New Age Int.1997.
3. Atomic and Nuclear Physics (Vol.2), S.N.Ghoshal, S.Chand&Co. (1994).
4. Nuclear Physics, D.C.Tayal, Himalaya Pub. (1997).
5. Atomic and Nuclear Physics, R.C.Sharma, K. Nath& Co., Meerut.
6. Nuclei and Particles, E.Segre.
7. Introduction to Nuclear Physics, H.A. Enge, Addison Wesley (1975).
8. Introduction to Nuclear Physics, K.S. Krane.

Semester-III

Course Code: PHY 15303
Course Title: PHYSICS OF SEMICONDUCTOR DEVICES

Course Objectives

This course enables the students:

A. Introducing the concept of junctions and interfaces between semiconductors
B. To understand V-I characteristics of p-n junction diode and concepts of Zener and Avalanche breakdown in p-n junctions.
C. To learn the characteristics of majority carrier diodes, microwave devices and transferred electronic devices and their applications.
D. To learn principle of operation and V-I charateristics of various junction transistors like BJT, FET, MOSFET, Charged Coupled Devices etc.
E. To acquint with the semiconductor technology and Optoelectronic devices.

Course Outcomes

After the completion of this course, students will be:

1. Able to know about the junctions and interfaces of semiconductors.
2. Understand V-I characteristics of various diodes.
3. Aquire knowledge on characteristics of various semiconductor devices and their useses.
4. Learn about the junction transistors and their various applications.
5. Obtaining commond on the semiconductor technology and Optoelectronic devices.

UNIT - I: Junctions and Interfaces
P-N Junctions, Description of P-N Junction action – Junction in equilibrium- application of bias – energy band diagrams – Types of junctions - Abrupt junction – calculation of the built-in voltage - electric field and potential distributions – Expression for Depletion layer capacitance, Static I-V characteristics of p-n junction diodes: Ideal diode model- Derivation of ideal diode equation. Real diodes – Carrier generation – recombination in the junction depletion region, I-V characteristics of Real Diodes.
Zener and Avalanche breakdown in P-N junctions, Applications of breakdown diodes. Metal-Semiconductor interfaces, Ohmic and Schottky contacts.

UNIT- II: Junction Diodes
Majority carrier diodes: Tunnel diode- I-V characteristics, Equivalent circuits as an oscillator and amplifier, Backwarddiode, Schottky barrier diode - operation and applications.
Microwave devices: Varactordiode-basic principle, equivalent circuit, figure of merit and applications, p-i-n diode operation and its applications.
Transferred electronic devices- Gunn diode, IMPATT diode, TRAPATT diode, BARITT diode - basic principle, operation and its applications.

UNIT - III: Junction Transistors

Bipolar junction transistors: Principle of operation, Carrier recombination in the Emitter-Base junction depletion region – Effect of collector bias variation, avalanche multiplication in the collector – base junction and base resistance.

Junction field-effect transistors: JFET Principle of operation, Static I-V Characteristics of the idealized model.

MOS transistors and charge-coupled devices: MOS capacitor – Surface field effect – Energy band diagrams of an MOS capacitor for different bias conditions - C-V characteristics of the MOS capacitors - Basic Structures and the operating principle of MOSFET, I-V characteristics of an ideal MOSFET, Charge Coupled Devices (CCD)- principle of operation.

UNIT – IV: Semiconductor Technology and Optoelectronic Devices

Technology of Semiconductor Devices: Crystal growth and Wafer preparation, Methods of p-n junction formation, Growth and deposition of dielectric layers, Planar technology, Masking and lithography, Pattern definition, Metal deposition techniques.

Optoelectronic devices: Solar cell- principle of operation- p-n homo-junction Si solar cell – device configuration – electrical characteristics- Photodetectors- Junction –photodiode- Principle of operation, Light Emitting Diode (LED).

Books for Study

1. Introduction to Semiconductor Materials and Devices, M.S. Tyagi, John Wiley & Sons (Asia) Pvt. Ltd., Singapore, 2500.
2. Microwave Devices and Circuits, Samuel and Y. Lao, Prentice-Hall of India, 1999.
3. Microwave and Radar Engineering, M. Kulkarni, UMESH Publications, New Delhi, 1999.

Reference Books

1. Physics of Semiconductor Devices , S.M. Sze, 3rd Edition , Oct.2506, John Wiley.
2. Solid State Electronic Devices, B.G. Streetman, PHI, New Delhi.
3. Semiconductor device fundamentals, Robert F. Pierret, Tata Mcgraw Hills

Semester-III

Course Code: PHY 15304 (A)
Course Title: Specialization Paper - CONDENSED MATTER PHYSICS – I: Physics of Crystalline Materials

Course Objectives :

This course enables the students

A. To become familiar with crystal growth techniques and identify imperfection in crystals.
B. To become familiar with the electrical behaviour of dielectric materials and understand the field charge induced by dielectrics.
C. To learn the properties and applications of ferroelectrics
D. To become familiar with the theory behind the ferromagnetic and anti-ferromagnetic materials.
E. To understand the photoconductivity and luminescence properties of solids.

Course Outcomes :

1. After the completion of this course, students will be
2. Able to learn various crystal growth techniques and understand the imperfection if any in the crystals.
3. Able to acquire knowledge about the properties of dielectrics and ferroelectrics.
4. Able to describe the ferromagnetic and anti-ferromagnetic materials and their applications.
5. Able to measure photoconductivity of the given material by using appropriate equipment.
6. Able to acquire knowledge on thermoluminescence, electroluminescence, photoluminescence, cathodoluminescence and chemiluminescence properties of solids.

UNIT - I: Crystal Growth and Imperfections in Crystals

Crystal growth: Nucleation and growth – Homogeneous and heterogeneous nucleation – Classification of crystal growth techniques – Melt growth: Bridgman,Czochralski techniques.

Imperfections: Classification of imperfections – Point defects – Schottky and Frenkel defects - Expressions for equilibrium defect concentrations – Colour Centres –Production of colourcentres – Line defects – Dislocations – Edge and Screw dislocations – Burger vector – Estimation of dislocation densities – Mechanism of creep – Experimental determination of creep activation energy.

UNIT- II: Dielectrics and Ferroelectrics

Dielectrics: Introduction – Dipole moment – various types of polarization – Electronic, ionic and orientational polarization **–**Measurement of dielectric constant – Applications of dielectrics.

Ferroelectrics: Piezo-, Pyro- and ferroelectric crystals– Spontaneous polarization – Classification and properties of ferroelectrics - Ferroelectric domains – Oxygen ion displacement theory – Applications of ferroelectrics.

UNIT- III: Ferromagnetism and Anti-ferromagnetism

Ferromagnetism:Introduction – Weiss molecular field theory – Temperature dependence of spontaneous magnetization – Heisenberg model – Exchange interaction – Ferromagnetic domains – Magnetic bubbles – Bloch wall – Thickness and energy – Ferromagnetic spin waves – Magnons – Dispersion relations.

Anti-ferromagnetism: Introduction – Two sub lattice model of anti-ferromagnetism – Ferri magnetism - Ferrites – Structure – Applications – Multiferroics.

UNIT-IV: Photoconductivity and Luminescence

Excitons: Weakly bound and tightly bound – Photoconductivity – Simple model – Influence of traps – Space charge effects – Determination of photoconductivity. Luminescence – Various types– Thermoluminescence, Electroluminescence, Photoluminescence, Cathodoluminescence and Chemiluminescence - Excitation and emission – Decay mechanisms – Applications.

Reference Books

1.Introduction to Solid State Physics, Charles Kittel VII edition, John Wiley & Sons.
2. Solid State Physics, A.J.Dekker, McMillan Publications.
3.Material Science and Engineering, V.Raghavan, PHI, New Delhi.
4.Crystal Growth, B.R.Pamplin, Pergmon Press.
5.Crystal Growth from High Temperature Solutions, D.Elwell and H.J.Scheel,Academic Press.
6.Solid State Physics, M.A.Wahab, Narosa Publishing House.
7. Fundamentals of Solid State Physics, Saxena, Gupta, Saxena, Pragathi Publications, Meerut.
8. Solid State Physics, R.L.Singhal, KedarNath Ram Nath& Co. Pub.

Semester-III

Course Code: PHY 15304 (B)

Course Title: Specialization Paper - ELECTRONICS-I: Advanced Electronics

Course Objectives

This course enables the students:

A. Course on advance electronics intends to impart knowledge on microprocessors and microcontrollers architecture.
B. Unit I of the course addresses the architecture of the 8086 Microprocessor and their addressing modes and instruction set.
C. Unit II addresses the architecture of the advanced microprocessors like 80386, 80486 and 80586 and also basics of Pentium and Pentium pro.
D. Unit III addresses assembler and assembler programs.
E. Unit IV addresses the architechture of 8051 Microcontroller and its addressing modes and instruction sets. In the same unit it is planned to teach the students about PIC 16F873A and its interface with LED displays, LCDs, Sensors and Actuators.

Course Outcomes

After the completion of this course, students will be:

1. Learning architecture of different microprocessors and microcontrollers.
2. Able to learn addressing modes and instruction sets of 8086, 80386, 80486 and 80586 microprocessors.
3. Able to write assembly languge to instruct microprocessors.
4. Able to acquire knowledge on architechture of 8051 Microcontroller and its addressing modes and instruction sets.
5. Able to learn about PIC 16F873A and its interface with LED displays, LCDs, Sensors and Actuators.

UNIT I – 8086 Microprocessors and its Architecture

8086 Microprocessor Architecture, memory paging. **Addressing modes**: Data addressing modes, program-memory addressing modes, and Stack- memory addressing modes.

Instruction Set: Data movement instructions, Arithmetic and Logic instructions, Program control instructions, Assembler details, Data conversions

UNIT II – Advanced Microprocessors

80386 Architecture – Addressing modes – Instruction sets - 80486 Architecture – Addressing modes – Instruction sets - 80586 Architecture – Addressing modes – Instruction sets – Pentium and Pentium pro basics

Unit - III: Assembler and Assembler Programs

Basic idea – PIC 16 series instruction set and ALU – Assemblers and Assembler format – creating simple programs – Adopting a development environment – Building structured programs – Flow control : Branching and Subroutines – Generating time delays and intervals – Logical instruction – Arithmetic instructions.

Unit - IV: 8051 Microcontroller and PIC 16F873A

Introduction of microcontroller 8051, Internal Architecture, Instruction set, addressing modes, PIC 16F87XA Timer 0 and Timer 1 – 16F87XA Timer 2, Comparator and PR2 register – capture/Compare/PWM (CCP) Module – Pulse width modulation – ADC module.
Interface: LED displays – Liquid crystal displays –Sensors –Actuators.

Books for Study

1. The Intel Microprocessors 8086/80-88,80186/80188.80286,80386, Pentium and Pentium pro processor architecture, programming and interfacing by B. B. Brey 4/e, PHI,1999
2. Microprocessors and interfacing, Programming and hardware by Douglas V. Hall, 2/e McGraw Hill International Edition, 1992.
3. The 80x86 IBM PC and Compatible computer (Volumes I &II) by Muhammad Ali Mazidi and Janice Gillespie Mazidi, 2/e, Prentice-Hall Inc.,1998.
4. Soft ware, Hard ware and applications by Walter A. Tribel and Avatar Singh, PHI, 1995.
5. Microcomputer systems: The 8086/8088 Family Architecture Programming and Design by Yu Cheng Lin and Glenn A. Gibson, PHI 1992.
6. Designing Embedded Systems with PIC Microcontrollers: Principles and Applications by Tim Wilmshurst, First Edition, 2007, Newnes – Elsevier – Publishers.

Reference Books:

1. Microcontrollers: Theory and Applications by Ajay V. Deshmukh, , Tata Mc Graw-Hill, New Delhi, 2005.
2. Designing with PIC Microcontrollers by John B. Peatman, Pearson Education,Inc.,1998.
3. The 8051 Microcontroller and Embedded systems, by Mahammad Ali Mazidi and Janice Gillispie Mazidi, Pearson Education Asia, Pvt. Ltd., 2000.

Semester-III

Course Code: PHY 15307

Course Title: Non-Core Elective Paper - ADVANCED ANALYTICAL INSTRUMENTS

Course Objectives

This course enables the students belong to other subjects:

A. To learn principle and working of various spectroscopic measurement instruments.

B. To learn principle and working of various Bio-physical measurement instruments.

C. To learn principle and working of various weather monitoring instruments.

D. To learn principle and working of various ambient air pollutants monitoring instruments.

Course Outcomes

After the completion of this course, students of non-physics stream will be:

1. Able to understand working of various spectroscopic instruments in particular Single beam and Double beam Spectrophotometerget knowledge on great Indian Physisists and their research contributions.

2. Exposed to the knowledge on various energy sourses available and their advantages and future treats.

3. Develop a good understanding about the Nuclear power and Nuclear power stations of India.

Unit I: Spectroscopic Measurement Techniques
Introductionto Spectroscopy – Propertiesof Electromagnet Radiation – EM Spectrum –Beer's law – Absorptivity – UV and visible absorption- Essential parts of Spectrophotometer- Gratings and prisms – Radiant energy sources – filters –detectors- Photomultiplier tubes -Instrumentation –-Single Beam, Double BeamSpectrophotometer-Applications.

Unit II: Bio-physical Measurement Techniques
Principles of blood pressure equipment, glucometer, Ultrasonography, cardiovascular measurement circulatory systems of heart- ECG anatomy and function of heart. Generation of X-rays -X-ray diffractograph- CT- Scan -Applications - Introduction to nuclear magnetic resonance, NMR – Chemical shift – spin – spin coupling _Instrumentation- Magnetic resonance Imaging (MRI)

Unit III: Weather Measurement Techniques

Introduction to TropicalWeather, Climate, Lighting, Cyclones and Monsoons.

Climatic Station, Rain gagues, Automatic Weather Station, Global Positioning System, Radisonde, Radar and weather Satellites

Unit IV : Air pollutions Measurement Techniques:

Introduction to Greenhouse Effect -Enhancement of the Greenhouse Effect;

Primary gaseous pollutants (CO_2, CH_4, CO AND NOx)- sources and their effects on climate/human health. Secondary gaseous pollutants (Ozone and PAN)- Formation and their effects on human health.

Gaseous pollutants measurement techniques – principles, block diagrams and working.Effects of aerosols on climate and human health. Measurement techniques- direct measurements by sampling and remote sensing measurement by Multi wave solar radiometer and LIDAR.

Source: The relevant material of the above units must be down loaded from authenticated web location from https://www.google.com

Semester-IV

Course Code: PHY 15401

Course Title: QUANTUM MECHANICS-II

Course Objective:

A. To learn about the identical particles and Pauli Exclusion Principle.

B. To learn how to include angular momentum and spin of the particle in operator and evaluate eigen function and eigen values of such system.

C. To learn the basics of relativistic quantum Mechanics.

D. To acquint with the concenpt of wave fields.

E. To learn how to do the quantization of wave fields.

Course Outcome:

1. Will be able to understand about the identical particles system.
2. Will be able to know the importance of angular momentum, general angular momentum and sin angular momentum of the particle in solving eigen value and eigen function of the system.
3. Will be able to understand the central concept and principles of relativistic Quantum Mechanics.
4. Will be able to understand the concept of negative energy states in the system.
5. Will be able to learn method of Canonical quantization along with Lagrangian formulation of field and Hamilton formulation of field.
6. Able to to know the system of Fermiouns and Bosons.

UNIT- I: Identical Particles and Molecules

Identical particles- Indistinguishability of Identical particles- Construction of Symmetric and Anti-symmetric wave functions for two and three particle systems - Pauli's Exclusion Principle- Hydrogen molecule- Spin-orbit interaction- Ortho and Para hydrogen- Spin statistics connection.

UNIT - II: Angular Momentum

Introduction: Definition of angular momentum operator - Commutation rules for angular momentum - Eigen values and Eigen functions of L_z and L^2 - Angular momentum in general - Allowed values of angular momentum J - Eigen values of J_+ and J_- angular momentum matrices - Addition of angular mometa and Clebsh -- Gorden co-efficients: Clebsh – Gorden co-efficient for $J_1=J_2=1/2$ and $J_1=1$, $J_2=1/2$ - spin angular momentum and Pauli's spin matrices.

UNIT - III: Relativistic Quantum Theory

Klein – Gorden Equation – Probability Current Density – Inadequacies of K.G. Equation – Dirac's Relativistic Equation for a Free Particle - Dirac`s Matrices – Dirac`s Equation in Co-variant form – Plane wave solution – Negative Energy States – Spin Angular Momentum - Existence.

UNIT - IV: Quantization of Wave Fields

Concept of Field - Method of Canonical Quantization: Lagrangian Formulation of Field, Hamilton Formulation of Field - Second Quantization – Field equation - Quantization of Non-relativistic Schroedinger equation – Commutation and Anti-commutation Relations, The N-representation - System of Fermions and Bosons – Creation and Annihilation.

Reference Books

1.QuantumMechanics:S.L.Kakaniand H.M. ChandaliaSultanChandandSonsFirst Edition
2. Advanced Quantum Mechanics : B.S. Rajput, Pragatiprakasan
3. Quantum Mechanics : V.K. Thankappan, Wiley Eastern Limited
4. A Textbook of Quantum Mechanics : P.M. Mathews and K. Venkatesan, Tata McGraw Hill Publishing Company
5. Quantum Mechanics : S.L. Gupta, V. Kumar, H.V. Sharma and R.C. Sharma, Jai PrakashNath and Company
6. An Introduction to Quantum Mechanics, P.T. Mathews McGraw Hill Publishing Company

Semester-IV

Course Code: PHY 15402

Course Title: ANALYTICAL TECHNIQUES

Course Objectives :

This course enables the students

A. To learn about the different crystal systems.
B. To learn the concepts of X-ray diffraction especially principles of Bragg's, Laue and Powder diffraction. To know the the method of determination of lattice constants of various structures.
C. To learn principle and working of Electron Spin Resonance and Mossbauer Spectrometrs.
D. To learn principles and working of Nuclear Magnetic Resonance Spectrometer and NQR Spectrometer.
E. To learn basic principles, instrumentation and applications of advanced spectroscopic amd Microscopic techniques.

Course Outcomes :

After the completion of this course, students will be

1. Able to learn the method of determination of lattice constants of various crystal structures using X-ray Diffraction techniques.
2. Able to acquire knowledge on principle and working of Electron Spin Resonance and Mossbauer Spectrometrs.
3. Able to learn principles and working of Nuclear Magnetic Resonance Spectrometer and NQR Spectrometer.
4. Able to familier with basic principles, instrumentation and applications of advanced spectroscopic amd Microscopic techniques.

UNIT- I: Diffraction Methods for Structure Analysis

Crystal systems: Symmetry elements, Concept of point groups and space groups. Reciprocal Lattice: Geometrical construction, Relation between direct – Reciprocal Lattice X- ray diffraction, Bragg's law, Laue methods, Powder X-ray Diffractometer– Focusing circle geometry-Determination of lattice constant of a cubic and tetragonal structures using d-spacings, Single crystal X-ray Diffractometer- Electron diffraction and Neutron diffraction: Basic principles and applications.

UNIT - II: Electron Spin Resonance and Mossbauer Spectroscopy

Electron spin resonance spectroscopy: Magnetic moment of an electron, two states of an electron in a magnetic field, ESR theory- Spin-spin interaction, Spin-lattice interaction - Hyperfine interaction-g factor, Line widths and Intensities, Relaxation effects, Experimental methods and applications.

Mossbauer spectroscopy: Introduction-Mossbauer effect, Recoilless emission and absorption, Mossbauer spectrum, Mossbauer nuclides-Experimental methods - Isomer shift - Hyperfine interactions and applications.

UNIT – III: NMR and NQR Techniques

Introduction to NMR: Nuclear spin and magnetic moment, Quantum description of NMR, theory of NMR, chemical shift, Spin-lattice (T_1), spin-spin (T_2) couplings, Bloch equations, Theory of relaxation mechanisms for spin ½ nuclei, Proton NMR, Carbon-13 NMR and NMR applications.

Basic concepts of NQR spectra: Half integral and integral spins, Instrumentation, Super regenerative oscillator, CW oscillator, Pulse RF detection and applications.

UNIT – IV: Advanced Spectroscopic and Microscopic Techniques

Basic principles, Instrumentation and applications of X ray fluorescence spectroscopy, Photoelectron spectroscopy, Photo Acoustic spectroscopy. Basic principles, Instrumentation and applications of Scanning electron microscopy, Transmission electron microscopy, Atomic force microscopy, Energy dispersive spectroscopy, Differential scanning calorimetry and Thermo gravimetric analysis.

Text Books and Reference Books

1. Elements of X-ray Diffraction, B.D. Cullity.
2. Methods of Surface Analysis, Techniques and Applications, J.M. Walls Cambridge University Press, 1990.
3. Neutron Diffraction, G.E. Bacon, Oxford University Press, London, 1962.
4. Electron Diffraction, T.B. Rymer, Methnen, London, 1970.
5. X-ray Structure Determination, H. Stout and LH. Jenson, Macmillan, London, 1968.
6. An Introduction to Electron Paramagnetic Resonance, M. Bersohn, J.C. Baird, Benjamin Inc., London, 1966.
7. Instrumental Methods of Analysis, Willard Merritt, Dean Settle, CBS publishers, New Delhi, 1986
8. Spectroscopy, B.P. Straughan and S. Walker, John Wiley & Sons Inc., New York,1976.
9. Spectroscopy, G. Chatwal and S. Anand, Himalaya Pub., 2502.
10. Spectroscopy, B.K. Sharma, Goel Publishers House, Meerut, 1975.
11. NMR Spectroscopy, R.K. Harris, Longman Sci. Tech, 1983.

Semester-IV

Course Code: PHY 15403 (A)

Course Title: Elective Paper: ANALYTICAL TECHNIQUES

Course Objectives :

This course enables the students

A. To learn about the Earth's atmosphere and radiation laws.
B. To acquire the knowledge on Weather parameters and their measurement techniques.
C. To get knowledge about the ambient air composition and different techniques available for the measurement of air pollutants.
D. To learn basic principle and technology of RADAR and its application in measurement of meteorology.

Course Outcomes :

After the completion of this course, students will be

1. Able to learn about the different layers of the Earth's atmosphere and their characteristics.
2. Able to learn concept of Black body radiation and related radiation laws.
3. Get the knowledge about the weather parameter and their measurement techniques.
4. Acquire the knowledge on ambient air composition, primary pollutants and secondary pollutants and their measurement techniques.
5. Know the effects of various air pollutants and their mitigation techniques.
6. Able to familier with basic principles, instrumentation and applications of RADAR used for the measurement of meteorology.

UNIT I- Earth's atmosphere

Layers of the atmosphere, variation of temperature with height in the atmosphere; Atmospheric pressure; Composition of the atmosphere-expressing the amount of a substance in the atmosphere; Energy balance of earth and atmosphere, Green house effect, Solar and terrestrial radiation; Block body radiation, laws of black body radiation -Plank's Law, Stefan – Boltzmann Law, and Wien's Displacement Law.

UNIT II - Meteorological Instrumentation

Ground based climatic station and automatic weather station for the measurement of air temperature, humidity, atmospheric pressure, wind speed, velocity and Rainfall.
Upper air observations- Rawinsonde, Radiosonde, GPS sonde-estimation of convective boundary layer height, thermo dynamical parameters and construction of T-Phigram.

UNIT III – Air pollution and its measurement techniques

Primary gaseous pollutants (CO_2, CH_4, CO AND NOx)- sources and their effects on climate/human health. Secondary gaseous pollutants (Ozone and PAN)- Formation and their effects on human health. Gaseous pollutants measurement techniques – principles, block diagrams and working. Description of aerosols, sources of aerosols, aerosol production mechanisms, effects of aerosols on climate and human health. Measurement techniques- direct measurements by sampling and remote sensing measurement by Multi Wavelength solar Radiometer and LIDAR.

UNIT IV – Radar Principles and Meteorology

Introduction to RADAR, Types of Radars- Mono-static, Pulsed radar, FM-CW radar; Basic principles of Pulsed (Wind Profiler) radar- Antenna Basics- radar signal processing ; Types of Radar Scattering theory- Wind Vector calculations; Wind Profiler Applications- Aviation, Tropical Cyclone, Thunderstorm, meteorological (Synoptic and Mesoscale) and Environmental.

Prescribed Books:

1. Battan, L.J. Radar Observation of the Atmosphere, University of Chicago Press, 1973, USA
2. Doviak, R.J., and D.S. Znic, Doppler Radar and Weather Observations. Academic Press, San Diego, Calif., 1993, USA
3. B.R. Bean and E. J. Dutton, radio meteorology, U.S. Govt, print. Off (Washingtion), 435p.1996.
4. Handbook of the Atmospheric Science- Principles and Applications by C. N. Hewitt and Andrea V. Jackson Black well publishing company, USA, 2003.
5. Atmospheric Chemistry and Physics by John H. Seinfeld and Spyros N. Pandias
6. Air Pollution by JermyColls, Spon Press, New York, 2002.
7. Atmospheric Pollution by Aerosols by V.K. Sharma, Scientifi Publishers, Jodhpur, 1994.

Semester-IV

Course Code: PHY 15403 (B)

Course Title: Elective Paper: APPLIED SPECTROSCOPY

Course Objectives :

This course enables the students

A. To become familiar with Beer's law and working of Spectrophotometer.
B. To learn about the IR spectrophotometry and Fourier Transform Infrared Spectrometer used for the study of molecular structure.
C. To familier with the principles of Fluorescence and Phosphorescence spectroscopy and their applications.
D. To learn the theory of Raman scattering and application of Raman Spectroscopy.
E. To learn the technique of structure determination using IR and Raman spectroscopy.
F. To learn non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

Course Outcomes :

After the completion of this course, students will be

1. Able to learn absortion principle and spectrophotometrs working in different spectral regions.
2. Able to undertake molecular structure elucidation.
3. Able to use effectively the Fluorescence and Phosphorescence spectroscopic techniques for various analytical purposes.
4. Able to determine the structure of molecules using IR and Raman spectroscopy.
5. Able to acquire knowledge about the non-linear Raman phenomenon and photo-acoustic Raman scattering and multi photon spectroscopy.

UNIT I – Spectrophotometry

Introduction- Beer's law – Absorptivity – UV and visible absorption- Instrumentation- Essential parts of spectrophotometer- Gratings and prisms – Radiant energy sources – filters – Photosensitive detectors- Barrier layer cells – Photo emissive cells – Photomultiplier tubes – Relationship between absorption in the visible and UV region and molecular structure – IR spectrophotometry - Fourier Transform Infrared (FTIR) Spectrometer – Molecular structure.

UNIT II - Fluorescence and Phosphorescence Spectroscopy

Introduction – Flourescence- Resonance Flouorescence- Normal Fluorescence-Intensities of Transitions – Non-radiative decay of fluorescent molecules – Phosphorescence and the nature of the rriplet state- Population of the triplet state – Delayed fluorescence- Excitation spectra -

Experimental methods – Emission lifetime measurements – Time resolved emission spectroscopy – Applications of Fluorescence and Phosphorescence

UNIT III - Raman Spectroscopy

Introduction- Theory of Raman Scattering – Rotational Raman Spectra- Vibrational Raman Spectra – Mutual Exclusion principle – Raman Spectroscopy/ Sample Handling Techniques-polarization of Raman Scattered Light – Single Crystal Raman Spectra – Raman Investigation of Phase Transitions – Resonance Raman Scattering – Structure Determination using IR and Raman Spectroscopy.Difference between Raman spectra and Infrared spectra.

UNIT IV - Non-linear spectroscopic phenomena

Non-linear Raman phenomenon - Hyper Raman spectroscopy – Stimulated Raman spectroscopy – Inverse Raman effect – Coherent Anti-stokes Raman scattering – Photo-acoustic Raman scattering – Multi Photon Spectroscopy

Prescribed Books:

1. Molecular spectra and Molecular structure Volume I, **G. Herzberg** (2nd Edition, Van. Nostrand London)
2. Fundamentals of Molecular Spectroscopy,**C.N. Banwell**(Tata Mcgraw- Hill Publishing Company Ltd, 1983)
3. Spectroscopy,**Straughan and Walker** (volume 2 and volume3, John wiley and Sons, 1976)
4. Molecular Structure and Spectroscopy,**G. Aruldhas**(Printice- Hall of India, Pvt. Ltd. 2001)
5. Instrumental Methods of Analysis,**Willard, Merritt, Dean and Settle** (CBS Publishers and Distributor, New Delhi, 200)

Semester-IV

Course Code: PHY 15403 (C)

Course Title: Elective Paper: VACUUM AND THIN FILM PHYSICS

Course Objectives

This course enables the students to:

A. Definevacuum and compare various vacuum pumps and gauges.
B. Outline the thermodynamics of thin films.
C. Illustrate the mechanism of thin film formation.
D. Explain various techniques of thin film formation.
E. Summarize various properties of thin films.

Course Outcomes

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

1. Demonstrate various types of pumps and gauges, inspect leak in vacuum and can design a vacuum system.
2. Define the thermodynamical parameters of thin films and can outline interdiffusion in thin films.
3. Demonstrate the stages of thin film formation and can outline the conditions for the formation of amorphous, crystalline and epitaxial films.
4 Illustrate and compare physical vapour deposition (PVD) and chemical vapour deposition (CVD) techniques.
5. Define various thin film properties and outline the techniques of their determination.

UNIT I – Production and Measurement of Vacuum
Fundamentals of kinetic theory of gases – Vacuum fundamentals
Production of Vacuum: Mechanical oil sealed Rotary pumps - Roots pump – Turbo molecular pump - Vapor pumps – Diffusion pump - Sorption pump
McLeod gauge- Thermal conductivity gauges-Pirani gauge – Cold cathode Ionization gauges-Penning gauge – Hot cathode ionization gauge - Bayard- Alpert gauge- Quadruple mass spectrometer
Vacuum application – Tungsten filament and discharge lamps – Electron tubes- Vacuum metallurgy- Space simulators and freeze drying

UNIT II - Methods of Thin film Preparation
Physical methods: Vacuum evaporation, Types of evaporation sources - Resistive heating electron beam evaporation – Co-evaporation - Two source evaporation and three source evaporation - Flash evaporation- Laser ablation - Reactive evaporation - Epitaxial deposition-Hot wall epitaxy and Molecular beam epitaxy
Sputtering: Glow discharge, DC sputtering, RF sputtering, Magnetron sputtering, Reactive sputtering
Chemical Methods: Electroplating – Spray Pyrolysis – Chemical vapor deposition (CVD)

UNIT III - Growth and Thickness measurement of Thin Films

Condensation – Nucleation – and growth of thin films – Langmuir Frenkel theory of condensation – Theories of thin film nucleation – Capillarity theory – Statistical or Atomistic theory – Comparison of nucleation theories – The four stages of film growth – Incorporation of defects during growth

Thickness Measurement: Multiple beam Interferometer (MBI) – Quartz Crystal Thickness Monitor

UNIT IV – Properties of Thin Films

Sources of electrical resistivity in metallic conductors – Sheet resistance – Temperature coefficient of resistance – Influence of thickness on the resistivity – Fuchs-Sondheimier theory – Hall Effect

Reflection and Transmission at an Interface - Reflection and Transmission by a single film – Reflection from an absorbing film – Multilayer films – Determination of optical constants by ellipsometry

Applications of thin films

Thin film resistors – Capacitors – Beam splitters – reflection and anti reflection coatings – Optical filters

Prescribed Books:

1. "Vacuum Technology" A.Roth, North Holland, 1986.
2. "Vacuum Science and Technology" V.V. Rao, T.B. Ghosh and K.L. Chopra, Allied Publications, 1998.
3. "Fundamentals of Vacuum", Ward & Bann
4. "Hand book of Thin Film Technology" L.I. Maissel and R.L. Glang, McGraw Hill Bool Co., 1970.
5. "Thin Film Phenomenon" K.L. Chopra, McGraw Hill Bool Co., New York1969.
6. " Hand Book of Technologies for Films and Coatings" R.F. Bunshah, Noyes Publication, 1996.
7. "The Material Science of Thin Films", M. Ohring, Acddemic Press, New York, 1992.
8. "Preparation of Thin Films", JoyGeorge

Semester-IV

Course Code: PHY 15403 (D)

Course Title: Elective Paper: PHOTONICS

Course Objectives

This course enables the students:

A. To understand the light propagation phenomenon through fiber optic cable
B. To understand various loss mechanism of signal while travelling through an optical fiber.
C. To understand the basic working principle of waveguides and its design parameters.
D. To identify waveguides for applications in fiber optics communication systems
E. To understand the principle of working of fiber based sensors for various application purposes.

Course Outcomes

After the completion of this course, students will be:

1. Able to illustrate the principle of fiber optics communications.
2. Able to distinguish between various loss mechanism in fiber optics communication system.
3. Able to utilize the idea of waveguide for different application purpose.
4. Able to categorise different waveguides for the utilization in optics communication system
5. Able to interpret different fiber sensors and their respective application and can recommend this technique for other new application.

UNIT - I: Fibre Optic Components and Sensors

Connector principles, Fibre end preparation, Splices, Connectors, Source coupling, Distribution networks, Directional couplers, Star couplers, Switches, Fiber optical isolator, Wavelength division multiplexing, Time division multiplexing, Fiber Bragg gratings. Advantage of fiber optic sensors, Intensity modulated sensors,

Mach-Zehnder interferometer sensors, Current sensors, Chemical sensors –Fiber optic rotation sensors. Optical biosensors: Fluorescence and energy transfer sensing, molecular beacons and optical geometries of bio-sensing, Bio-imaging, Biosensing.

UNIT - II: Integrated Optics

Introduction – Planar wave guide – Channel wave guide – Y-junction beam splitters and couplers - FTIR beam splitters – Prism and grating couplers – Lens wave guide – Fabrication of integrated optical devices - Integrated photodiodes – Edge and surface emitting laser – Distributed Bragg reflection and Distributed feed back lasers - Wave guide array laser.

UNIT - III: Optical Signal Processing

Introduction, Effect of lens on a wavefront, Fourier transform properties of a single lens, Optical transfer function, Vanderlugt filter, Image spatial filtering, Phase-contrast microscopy, Pattern recognition, Image de-blurring, Photonic switches, Optical transistor, Optical Gates- Bistable systems, Principle of optical Bistability, Bistable optical devices, Self electro-optic effect device.

UNIT - IV: Photonic Crystals

Basics concepts, Theoretical modeling of photonic crystals, Features of photonic crystals, Methods of fabrication, Photonic crystal optical circuitry, Nonlinear photonic crystals, Photonic crystal fibers, Photonic crystals and optical communications, Photonic crystal sensors.

Text and Reference Books

1. Fibre Optic Communication, Joseph C. Palais, Pearson Education Asia, India, 2001
2. Introduction To Fibre Optics, A.Ghatak And K.Thyagarajan, Cambridge University Press, New Delhi, 1999
3. Optical Guided Wave Signal Devices, R.SymsAndJ.Cozens. Mcgraw Hill, 1993.
4. Optical Electronics, A Ghatak and K. Thyagarajan, Cambridge University Press, New Delhi, 1991
5. Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, John Willy and Sons,1991
6. Introduction to Fourier Optics, Joseph W. Goodman, McGraw-Hill, 1996.
7. Nanophotonics, P.N.Prasad, Wiley Interscience, 2003.
8. Biophotonics, P.N.Prasad, Wiley Publications, 2004.

Semester-IV

Course Code: PHY 15404 (A)

Course Title: Specialization Paper - CONDENSED MATTER PHYSICS – II

Course Objectives :

This course enables the students

A. To become familiar with elastic properties of solids.

B. To learn about thermal properties of solids.

C. To understand the energy band theory and Fermi surfaces.

D. To learn the concept of Brillouin zones of simple cubic, bcc fcc lattices.

E. To learn about the nano-structured materials and their methods of preparation.

F. To learn the techniques like XRD/SPM/STM/AFM used for the determination of particle size.

Course Outcomes :

After the completion of this course, students will be

1. Able to learn various elastic and thermal properties of solids.
2. Able to understand the applications of energy band theory and fermi surfaces.
3. Able to estimate Brillouin zones various crystal lattices.
4. Able to prepare nano-materials using CVD and Sol-Gel processes.
5. Able to use techniques like XRD/SPM/STM/AFM for the determination of particle size.

UNIT - I: Elastic Properties of Solids

Lattice as a homogeneous and continuous medium - Analysis of stress and strain tensors – Hooke's law - Elastic compliances and stiffness constants – Elastic energy density – Reduction in the number independent elastic constants in cubic crystals – Cauchy's relations – Bulk modulus and compressibility – Elastic waves in cubic crystals – Formulation and solution of wave equations along [100], [110] and [111] directions – Experimental determination of elastic constants – Pulse-echo technique.

UNIT - II: Thermal Properties of Solids

Quantum theory of lattice vibrations – Properties of phonons – Lattice specific heat at low temperatures – Einstein and Debye models – Born cut-off procedure – Inelastic scattering of neutrons by phonons – Experimental study of dispersion curves – Inadequacy of harmonic model – Anharmonicity – Thermal expansion – Gruneisen parameter- Lattice thermal conductivity – Elementary kinetic theory – Role of U and N processes.

UNIT - III: Energy band theory and Fermi Surfaces

Energy band theory: – Periodic potentials – Bloch's theorem and functions – Electron motion in periodic potentials – Origin of energy gap – Brillouin zones – Reduced zone and periodic zone schemes – Brillouin zones for simple cubic, bcc and fcc lattices, Tight binding model.

Importance of Fermi surface – Characteristics of Fermi surface – Construction of Fermi surface - Quantization of electron orbits - Experimental study of Fermi surface: Anomalousskin effect – Cyclotron resonance – de Haas van Alphen effect.

UNIT - IV: Nano - structured Materials

Definitions _ Nano- crystalline – XRD patterns –General Methods of preparation of Nano structured materialss by Physical and Chemical routes. Inert Gas condensation Chemical Vapor Deposition, and sol – zel process, Growth of nanocrystals in Glasses through thermal treatment (Glass ceramics). Particle size estimation by XRD/SPM,/STM/AFM Techniques. Size quantization effects, Band gap expansion (Blue shift) in semiconductors, quantum wells, wires and Dots- density of states. Applications of nano materials with specific examples.

Reference Books

1.Introduction to Solid State Physics, Charles Kittel7th Edition, John Wiley & Sons.
2.Solid State Physics, A.J.Dekker, MacMillan.
3.Solid State Physics, H.C. Gupta, Vikas Publishing House.
4.Elementary Solid State Physics, M.Ali Omar, Addison Wesley.
5.Solid State Physics, M.A.Wahab, Narosa Publishing House.
6.Science of Engineering Materials, C.M.Srivastsava and C.Srinivasan, New Age Inter. Pub.

Semester-IV
Course Code: PHY 15404 (B)
Course Title: Specialization Paper - ELECTRONICS-II: COMMUNICATION SYSTEMS

Course Objectives

This course enables the students:

A. To learn details of Computer Communications systems like ISDN, LAN, TDMA, FDMA, ALOHA and CSMA.

B. To know the concept of CDMA.

C. To acquaint with optical Fiber systems and Coherent optical fiber systems used for the communication.

D. To learn wireless communication systems like GSM, cellular, 1G, 2G, 3G etc.

E. To get basic knowledge on Satellite and optical communications.

Course Outcomes

After the completion of this course, students will be:

1. Able to learn technology behind computer communication systems.
2. Able to acquire knowledge on optical Fiber systems and Coherent optical fiber systems used for the communication.
3. Able to understand and work on wireless communication systems like GSM, cellular, 1G, 2G, 3G etc.
4. Able to understand Satellite and optical communications and technology involved.

UNIT I - Computer Communications Systems
Types of networks, Design features of computer communication networks – ISDN, LAN Time Division Multiple Access (TDMA), Frequency division multiple Access (FDMA), ALOHA, slotted ALOHA and carrier sense multiple Access (CSMA), Introduction to CDMA.

UNIT II - Fiber Optics Communication
Optical Fiber System : Intensity modulation/direct detection, optical transmitter circuit, Optical receiver circuit, system design considerations, Digital Systems & planning considerations, Analog systems, distribution systems, Advanced multiplexing strategies.
Coherent Optical Fiber Systems: Basic Systems, Detection principles, Practical Constraints, Modulation formats, Demodulation schemes, Receiver sensitive, Signal and Multi carrier systems.

Unit – III: Introduction to wireless communication systems

Global system for mobile (GSM): cellular concept, system design. Transmission system, Receiving system; frequency re-use; Spread spectrum modulation; Multiple access techniques as applied to wireless communications; 1G, 2G, 3G wireless networks.

Unit – IV: Satellite and Optical communications

Introduction Satellite systems: Orbiting satellites, satellite frequency bands, communication satellite system-modulation and multiple access format-satellite systems in India, Satellite receiving systems, G/T ratio, satellite uplink and down link analysis. Applications to communications and remote sensing. Introduction to Optical communications systems: Optical fibers, sources and detectors, analog and digital systems.

Text Book

1. Modern Digital and Analog communication system, B.P. Lathi: Oxford 3 rdEdition.
2. Digital Communications Fundamentals and Applications, Bernard Sklar, Sklar Pearson Education.
3. Taub and Schilling, "Principles of Communication Systems", Second edition, Tata McGraw Hill edition, 1991
4. Simon Haykin, "Communication Systems, Third Edition", John Willey & Sons, Inc.1994.
5. Wayne Tomasi, "Advanced Electronics Communications Systems",IV Edi, P. Hall,Inc,1998
6. John M. Senior, "Optical Fiber Communications", Second Edition, PHI, 1999
7. Gerd Kesier "Optical Fiber Communications" Second Editaion, McGrw- Hill International Editions,1991.
8. Principles of Communication, R.E. Ziemer, WH Tranter 5th Edition John Wiley (Fifth module).

Reference Books

1. Morden Electronic Communication Systems, Wayne Tomoasi, Person Education/PHI.
2. Digital Communication, John G Proakis, MGH.
3. Digital Communication Techniques Simon, Hindey Lindsey PHI.
4. Communication Systems, Simon Haykin, John Wiley & Sons. Pvt. Ltd.
5. Principles of Communication Systems, Taub and Schilling, Tata McGraw-Hill.
6. Digital and Analog Communication System, K. Sam Shanmugam. John Wiley.
7. Communication Systems Engineering, Proakis, Pearson Education.
8. Digital and Analog Communication System, Leon W Couch, Pearson Education/PHI.
9. Introduction to Statistical Signal Processing with Applications, M.D. Srinath, P.K.
10. Rajasekaran, R.E. Viswnathan PHI.
11. Analog and Digital Communication, M.S. Roden PHI.
12. Digital Modulation and Coding. Wilson, Pearson Education.
13. Applied Coding and Information Theory for Engineers, Wells, Pearson Education.

M.Sc. DEGREE EXAMINATIONS,

I, II, III & IV SEMESTERS

PHYSICS

PHYS 15101 to 15104, 15201 to 15204, 15301 to 15304 &15401 to 15404: <u>TITLE OF THE PAPER</u>

(Revised Syllabus with effect from 2018 - 2019**)**
(No additional sheet will be supplied)

Time: 3 hours **Max. Marks: 75**

PART – A (Marks: **5x3 = 15**)

Answer any **FIVE**questions. Each answer should not exceed ONE (1) Page
All questions carry equal marks

1. From **UNIT - I**
2. From **UNIT - I**
3. From**UNIT - II**
4. From**UNIT - II**
5. From**UNIT - III**
6. From**UNIT - III**
7. From**UNIT - IV**
8. From**UNIT - IV**

PART B (Marks: **4 x 15 = 60**)
Answer **ALL** questions.
Each answer should not exceed SIX (6) Pages

9. **OR** 10. **UNIT – I (With internal Choice)**

11. **OR** 12. **UNIT – II (With internal Choice)**

13. **OR** 14. **UNIT – III (With internal Choice)**

15. **OR** 16. **UNIT – IV (With internal Choice)**

YOGI VEMANA UNIVERSITY, KADAPA

M.Sc MICRO BIOLOGY COURSE STRUCTURE CBSE PATTERN (w.e.f. 2021-22)

Semester-I

Paper	**Title of the Paper**	**Instruction hrs/week**	**Internal assessment marks**	**Semester end marks**	**Total marks**	**Credits**
MBT-101	General Microbiology	4	25	75	100	4
MBT-102	Bacteriology and Virology	4	25	75	100	4
MBT-103	Biological Chemistry	4	25	75	100	4
MBT-104	Biophysical and Analytical Techniques	4	25	75	100	4
MBP-101	General Microbiology, Bacteriology and Virology	8	-	100	100	4
MBP-102	Biological Chemistry, Biophysical and Analytical Techniques	8	-	100	100	4

Semester-II

Paper	Title of the Paper	Instruction hrs/week	Internal assessment marks	Semester end marks	Total marks	Credits
MBT-201	Microbial Physiology and Metabolism	4	25	75	100	4
MBT-202	Molecular Biology	4	25	75	100	4
MBT-203	Microbial Genetics	4	25	75	100	4
MBT-204	Biostatistics, Research Methodology and Bioinformatics	4	25	75	100	4
MBP-201	Microbial Physiology and Metabolism, Molecular Biology	8	-	100	100	4
MBP-202	Microbial Genetics, Biostatistics, Research Methodology and Bioinformatics	8	-	100	100	4
Non core-1	Fundamentals of Microbiology	4	25	75	100	-

Semester-III

Paper	Title of the Paper	Instruction hrs/week	Internal assessment marks	Semester end marks	Total marks	Credits
MBT-301	Recombinant DNA Technology	4	25	75	100	4
MBT-302	Bio-processing Technology	4	25	75	100	4
MBT-303	Immunology	4	25	75	100	4
MBT-304	Medical and Diagnostic Microbiology	4	25	75	100	4
MBP-301	Recombinant DNA Technology, Bio-processing Technology	8	-	100	100	4
MBP-302	Immunology, Medical and Diagnostic Microbiology	8	-	100	100	4
Non core-II	Microbial Technology and Entrepreneurship	4	25	75	100	-

Semester-IV

Paper	Title of the Paper	Instruction hrs/week	Internal assessment marks	Semester end marks	Total marks	Credits
MBT-401	Agriculture Microbiology	4	25	75	100	4
MBT-402	Environmental Microbiology	4	25	75	100	4
MBT-403	Food Microbiology	4	25	75	100	4
MBT-404	Industrial Microbiology	4	25	75	100	4
MBP-401	Agriculture Microbiology, Environmental Microbiology	8	-	100	100	4
MBP-402	Food Microbiology, Industrial Microbiology	8	-	100	100	4
	Total for core papers	128	400	2000	2400	96
	Total for Non-core papers	8	50	150	200	-
	Grand Total	136	450	2150	2600	96

SEMESTER – I

MBT 101: GENERAL MICROBIOLOGY

OBJECTIVES:

- To import information on the historical developments in molecular biology
- An in-depth study on structure and organization of chromosomes, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various molecular techniques used in the biological research.

LEARNING OUT COME:

On the completion of the course, students should be able to:

UNIT-I: Students are able to understand in depth knowledge on molecular biology.

UNIT-II: Must be able to know types of mutagens and their study for further biological innovations.

UNIT-III: Understand the detailed mechanism of Replication in both pro & Eukaryotes.

UNIT-IV: Understand the overall concepts of Transcription and translation for further translational research (Systems biology)

UNIT - I (16 hrs)

History and scope of Microbiology: Theory of spontaneous generation, germ theory of diseases; Major contributions in the field of microbiology, importance of microbes in human welfare.
Study of microorganisms: Microscopy – principles and applications of light, scanning and transmission electron microscopes. Confocal microscopy. Preparation of microbiological samples for microscopy.

Systematic position of the microorganisms- taxonomy, nomenclature and classification (Five kingdom classification and Carl Woes classification), taxonomic ranks, major characteristics used for identification: morphological, physiological, ecological, genetic and molecular.

UNIT - II **(**14 hrs)

Structure and function of prokaryotic and eukaryotic cells. Physical and chemical approaches for sterilization and disinfection -control of microorganisms by heat, radiation, pH, pressure, filters, chemical agents and safety precautions. Concepts of containment facility.

Microbiological media: Types of media – natural and synthetic media (basal, defined, complex, enrichment, selective, deferential and transport media).

UNIT - III (18 hrs)

Isolation, cultivation and enumeration of microorganism: pure culture techniques (enrichment, dilution plate, streak plate, spread plate and micromanipulator), cultivation of aerobic and anaerobic microorganisms - continuous, batch, synchronous and stock cultures, enumeration and measurement of growth of microorganisms.

Identification and characterization of microorganisms - staining techniques (simple, negative differential, capsular, spore, flagellar staining. Giemsa staining and AFB (Acid Fast Bacilli), lactophenol mounts for fungi. Preparation of tissue for thin sectioning (fixation, dehydration, infiltration, embedding and sectioning).

Preservation of microbial cultures: (sub culturing technique, sterile soil or sand preservation, glycerol, deep freezing, liquid paraffin oil, drying and freeze drying).

UNIT – IV (16 hrs)

Introduction to Mycology: systematic position and classification of fungi. General characters, structure, reproduction, life cycles and economic importance: Myxomycotina (*Physarium*, and *Plasmodiophora)*Mastigomycotina (*Synchytrium*, *Phytophthora* and *Albugo)* Zygomycotina (Mucor, Rhizopus and Pilobolus). Ascomycotina (Yeast, *Aspergillus*, *Penicillium* and *Neurospora)*Basidiomycotina (*Punccinia*, *Ustilago*and *Agaricus)*.

Deoteromycotina (*Alternaria*, *Fusarium*, *Colletotrichum* and *Trichoderma)*. General account, classification, structure, reproduction and economic importance of algae (*Chlorella,Senedesmus*, *Gracellaria*, Nostoc and Anabena).

References:

1. Alexopoulus CJ and C W. Mims.(1993).Introductory Mycology(3rd edition).Wiley Eastern Ltd, NewDelhi.

2. Jefreery C Pommerville, 2011, Findamentals of Microbiology, Barlett Series

3. Bergys Manual of Determinative Bacteriology(9^{th} Edition), Williams and Wilkins, Baltimore

4. Black, J.G. (2005). Microbiology: Principles and Explorations, John Wiley, USA

5. Dube R C and Maheswari D. K (2000) General Microbiology. S. Chand, New Delhi Mc Graw-Hill Publishing company Ltd, New Delhi.

6. Elizabeth Moore-Landecker. (1996). Fundamentals of the fungi. (4th edition).Prentice Hall International, Inc, London.

7. K. Talaro and A. Talaro (1996) Foundations in Microbiology 2^{nd} ed. Wm. C. Brown Publ.

8. Madigan MT Martinkl. J.M and Parker J (2008). Brock Biology of Microorganisms. (9th edition). MacMillan Press, England.

9. Pelczar Jr, M.J. Chan, E.C.S. and Kreig, N.R. (1993). Microbiology, Mc. Graw Hill. Inc, New York

10. Prescott LM Harley JP and Klein DA (2007). Microbiology (7th edition) McGraw Hill, New York.

11. S.B. Sullia, Oxford (1999) General Microbiology, IBH Publishers

12. R.M. Atlas Wm. C. Brown (1997). Principles of Microbiology. 2^{nd} ed. Publ.

13. Sullia, S.B. and Leaderberg J (1998). General Microbiology, Oxford & IBH Publishing Pvt. Ltd., New Delhi.

14. Schaechter M and Leaderberg J (2004). The Desk encyclopedia of Microbiology. Elseiver Academic press, California

15. Salle, A.J. (1996). Fundamental principles of Bacteriology.(7th edition).Tata McGraw-Hill publishing company Ltd, New Delhi.

16. Stanier, R.Y., Adelberg, E.A. and Ingram, J.L. (1991). General Microbiology, 5th Ed., Prentice Hall of India Pvt. Ltd., New Delhi.

17. Rami Reddy and SM Reddy (2005). A text book of Microbiology. Vol I and II.

MBT 102: BACTERIOLOGY AND VIROLOGY

OBJECTIVES:

- To import information on the historical developments in Bacteriology and Virology
- An in-depth study on structure and organization of chromosomes, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various molecular techniques used in the biological research.

LEARNING OUT COME:

On the completion of the course, students should be able to:

UNIT-I: Students are able tounderstand in depth knowledge on molecular biology.

UNIT-II: Must be able to know types of mutagens and their study for further biological innovations.

UNIT-III: Understand the detailed mechanism of Replication in both pro & Eukaryotes.

UNIT-IV: Understand the overall concepts of Transcription and translation for further translational research (Systems biology)

UNIT – I (16 hrs)

Morphological types- cell walls of archaebacteria, Gram positive, Gram negative bacteria and L-forms, capsule types, composition and function, Cell membrane- structure, composition and functions.

Structure and function of flagella, cilia, pili, gas vesicles, chromosomes, carboxysomes, magnetosomes, phycobilisomes, nucleoids, spores and cell division. Reserve food materials- poly-β-hydroxybuterate, polyphosphate granules, cyanophycin granules and sulfur inclusions.

UNIT - II (12 hrs)

Salient features and classification of bacteria as per the second edition of Bergey's Manual of Systematic Bacteriology.

Characteristics, classification and economic importance of major bacterial groups: *Enterobacteriae*, *Rickettsiae*, *Mycoplasma*, *Mycobacteria*, actinomycetes and oxygenic and anoxygenicphotosynthetic bacteria.

UNIT- III (18 hrs)

History and general characteristics of viruses, chemical composition, morphology, symmetry and architecture with reference to T4, TMV, Adeno, Polio and Influenza. Sub viral particles- satellite viruses, viroids, DI particles and prions.

Taxonomy of viruses: classification and nomenclature of viruses as per ICTV. General methods of detection, isolation, cultivation, characterization and assay / quantification of plant, animal and bacterial viruses.

UNIT - IV (18 hrs)

Life cycles of bacterial viruses; one step growth curve, lytic and lysogenic cycles with reference to T4, λ and ϕ X 174. Biological significance of Phages.

Multiplication strategies of plant viruses (TMV, CaMV) and animal viruses (Adeno, Influenza, Herpes, SV 40, and Retro viruses). Transmission and management of plant and animal viral diseases, interferon, antiviral drugs and vaccines.

References:

1. Alan J. Cann (1997). Principles of Molecular virology. (2nd edition).Academic press, California.

2. Bergey's Manual 2nd Ed. "Systemic Bacteriology" 2001-2005

3. Dimmock NJ, Primrose SB. (1994) Introduction to Modern Virology IV edition. Blackwell Scientific Publications, Oxford.

4. Flint, S.J., Enquist, L.W., Krung, R. Racaniello, VR. and Skalka, A.M. (2000). Principles of Virology ASM Press.

5. Roger Hull (2002). Mathews' Plant Virology. (4thEdition). Academic press- Harcourt Science and technology company, New York.

6. Ram Reddy S and Reddy SM (2007) essentials of Virology Scientific Publishers (India) Jodhpur.

7. W.D. Frost and E.F. Mc Camp Bell (2010). Text book of general Bacteriology, Bibliobazaars Publications.

8. J.K. Struthers and R.P. Westram 2000. Clinical Bacteriology. Mansion Publication Ltd.

9. William Henarl 2000. Bergey's Manual of Determinative Bacteriology. 9th Edition Lippincott Publications.

10. S.H. Gillespie and P.M. Hawkey 2006. Principles and practice of Clinical Bacteriology. John Wiley.

11. A Text - Book of Bacteriology 4th Edition**Authors:** R. W. Fairbrother **ISBN:** 9781483225340 (2018)

12. A Text-Book of General Bacteriology Paperback– Import, 15 Feb 2018 by William Dodge Frost& Eugene Franklin Campbell).

MBT 103: BIOLOGICAL CHEMISTRY

Objectives:

- To make the students knowledgeable on the various biological molecules and their importance
- To study the classification and structural properties of various biological molecules
- To acquire an overall knowledge on enzymes and their kinetics
- To provide knowledge on metabolic pathways and their biochemical importance.

Learning outcomes:

Unit I : The students will learn the classification and structural properties of protein, carbohydrates and lipids.
Unit II: The students will become knowledgeable on classification of enzymes and are able to understand the characteristics of enzyme reactions.
Unit III: The students will be able to understand the structure and the biological activities of Nucleic acid and Vitamins.
Unit IV: The students will be able to understand the concepts of bioenergetics.

UNIT – I (20 hours)

Carbohydrates- Classification, physico chemical properties, separation, Structure, occurrence and distribution, characterization identification and analysis. Biological significance of polysaccharides (starch, cellulose, chitin, peptidoglycons) and glycoproteins.

Lipids- Classification, properties, separation, distribution, characterization, safonification and iodine number. Nomenclature, structure and functions of glycerides, neutral lipids (waxes, fats and oils) phospholipids, spingophospholipids and glycolipids. Steroids- plantsterol, ergosterol, stigmosterol and cholesterol. Lipoproteins- classification, composition and importance of bacterial lipids.

UNIT –II (20 hours)

Proteins – Essential and non essential amino acids. Peptide bond, peptides of non protein origin (glutathione and gramicidin), Acid – base properties of peptides, chemical properties and synthesis of peptides. Proteins – classification, physico-chemical properties, structure (primary, secondary, tertiary and quaternary), folding and biological functions. Ramachandran plot and amino acid sequencing.

Nucleic acids: Types and composition, nucleosides, nucleotides and polynucleotides; structure, properties and biological functions. Denaturation and renaturation of nucleic acids, factors influencing hybridization, cot values and Nucleotide sequencing.

UNIT –III (15 hrs)

Enzymes- Classification and nomenclature. Kinetics of enzyme catalyzed reaction – Michalis –Menten equation, Line weaver-Burk plot. Gibbs free energy concept. Factors effecting enzyme activity (concentration, pH temperature, enzyme and substrate concentration).

Enzyme functional groups, mechanism of action of lysozyme, chymotripsin and RNase. Regulatory enzymes and mechanisms of enzyme regulation, isozymes, ribozymes and abzymes. Enzyme inhibition and Coenzymes.

UNIT -IV (15 hrs)

Bioenergetics- Principles, laws of thermo dynamics, enthalpy, entropy, concept of free energy, chemical equilibrium. Energetics of ATP and other high energy compounds. Oxidation and reduction reactions.

Measurement of redox potentials, electron carriers in bacteria and mitochondria. Chemi–osmotic theory, biological energy transducers, respiration limited proton translocation, photorespiration and bioluminescence.

References:

1. David L. Nelson, Michael Cox. (2021) Lehninger Principles of Biochemistry International Edition (8th edition) by W.H.Freeman& Co Ltd.

2. LubertStryer, Jeremy Berg, John Tymoczko and Gregory Gatto (2019). Biochemistry. (9th edition). W.H. Freeman and company, New York

3. Conn EE, Stump PK, Bruening and Doi RH. (2006). Outlines of Biochemistry (5th edition). Wiley India Pvt. Ltd.

4. Donald Voet and Judith G. Voet (1995). Fundamentals of Biochemistry: life at molecular level – (5th Edition). John Willey and Sons, Inc.

5. U. Satyanarayana and U. Chakrapani (2017) Biochemistry. (5th Edition), Books and allied Publications, India.

6. Geofferey, L and Zubay (1998). Biochemsitry. (Fourth Edition) Wm. C. Brown Publishers.

7. Martin, Mayer and Roadwell Harper's Review of Biochemistry (2006).

8. Thomas M. Devlin. (2002). Textbookof Biochemistry with clinical correlations. (5th Edition). A John Wiley and sons, Inc., publication, New York.

9. Trudy McKee and James R. McKee. (1999). Biochemistry-An Introduction. (2nd Edition).WCB McGraw- Hill, U.S.A

MBT 104: BIOPHYSICAL AND ANALYTICAL TECHNIQUES

Objectives:

To understand the working principles, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.

- To appreciate the importance, concept of research and learn the art of thesis, paper writing and publication.

Learning Outcome:

The Course will provide an overview of would know the general and advanced laboratory procedures and maintenance of research equipments, Instrumentation of equipments.

UNIT – I (14 hrs)

pH and Buffers: Measurement of pH, concept and preparation of Buffers, ionization, Pka, Henderson-Hasselbalch equation. Types of electrodes and biosensors. Viscosity and Osmosis.

Concentration of Biomolecules: Ammonium sulfate precipitation, dialysis, flash evaporation, lyophilization, membrane filtration and their applications.

UNIT – II (18 hrs)

Centrifugation: Principle, methodology and applications of preparative, differential, density gradient, analytical ultra centrifugations and their applications. Analysis of sub cellular fractions.

Chromatography: Principles, methodology and applications of liquid – solid (paper and TLC) and Column chromatography (Ion – exchange, gel permeation, affinity, GC, FPLC and HPLC).

UNIT –III (12 hrs)

Spectrophotometry: Laws governing the light absorption, principles, instrumentation and biological applications of UV-VIS, Infrared (IR), FTIR, Atomic absorption (AAS), electron Spin – resonance (ESR). Nuclear magnetic resonance (NMR).

Spectroscopy: Principle, instrumentation and biological applications of Mass spectrometry, X-Ray crystallography, Circular Dichroism (CD) and Optical Rotary Dispersion (ORD).

UNIT – IV (20 hrs)

Electrophoresis: Electrophoretic process. Native PAGE and SDS - PAGE. Iso electric focusing (IEF), two – dimensional gel electrophoresis, determination of molecular weight, pulsed field electrophoresis. Methodology and applications of Southern, Western and Northern blots.

Radio Isotopes: Half-life, detection and measurement (GM counter, liquid scintillation counter, gama-ray counters), Cerenkov counting, autoradiography and Quenching. Laboratory safety measures in handling isotopes and biological applications.

MBP: 101 – General Microbiology and Bacteriology and Virology

1. Microbiological laboratory safety measures
2. Sterilization Methods a. Physical and chemical methods b. Phenol coefficient method (Redial-Walker test)
3. Preparation of different media for cultivation of bacteria and fungi
4. Plating techniques – streak plate, spread plate and pour plate methods
5. Enumeration of bacteria by serial dilution
6. Isolation and enumeration of bacteria and fungi from soil
7. Isolation of bacteria from diseased plant leaf
8. Isolation of fungi from plant leaves and seeds
9. Slide culture technique
10. Hanging drop technique for bacterial motility
11. Morphological studies - bacteria, fungi and algae
12. Staining techniques : Simple, Gram, negative, spore, capsular, acid fast and Lacto phenol – cotton blue staining
13. Determination of thermal death point of bacteria
14. Biochemical tests - IMVIC Tests; catalase; oxidase; coagulase, amylase, urease; gelatin hydrolysis; oxidation – fermentation tests; sugar fermentation; triple sugar iron test; H_2S production.
15. Isolation of Bacteriophage from sewage water
16. Growth phases of phage and burst size one step growth curve
17. Cultivation of viruses in embryonated Eggs: different routes of inoculation
18. Sap transmission of a plant virus
19. Aphid transmission of a plant virus
20. Graft transmission of plant virus
21. Virus inclusion bodies (slides)

Suggested books/manuals.

1. Microbiological Applications: Laboratory Manual in General Microbiology, 7th ed. By J. Benson.
2. Microbiology: A Laboratory Manual. 4th edition. By J.G. Cappucciono and N. Sherman.
3. Experiments in Microbiology, Plant Pathology, Tissue culture and Mushroom cultivation. 3rd edition. By K.R. Aneja.
4. Practical Microbiology, 2002 by R.C. Dubey and D.K. Maheshwari.
5. Laboratory Manual in Microbiology, 2000. By P. Gunasekaran.
6. Laboratory Experiments in Microbiology by Johnson.
7. Laboratory Manual in Microbiology by Alcamo.
8. Virology – A Laboratory Manual, 1992. By Burleson, et al., Academic Press.
9. Virology Methods Manual, 1996. B.W.J. Mahy and H.O. Kangro. Academic press.
10. A Laboratioy Manual. By SM Reddy and S Rami Reddy. Scientific Publications (2005)

MBP: 102 – Biological Chemistry and Biophysical and Analytical Techniques

1. Qualitative tests for identification of carbohydrates, amino acids and nucleic acids
2. Quantitative tests for Protein (Lowry and Bradford methods), glucose (DNS method), Glycine, bilirubin, cholesterol, Inorganic phosphorous.
3. Determination of activity of peroxidase and polyphenol oxidase from leaves/tubers/fruits
4. Purification and study of acid phosphatase from potato tubers: Extraction of enzyme; Effect of substrate concentration; temperature; pH on enzyme activity.
5. Measurement of pH
6. Micrometry for cell size determination
7. Cell counting by Haemocytometer
8. Verification of Beer's Law
9. Determination of λ max for colored solutions
10. Determination of DNA and RNA by UV spectrophotometry and DPA and Orcinolmethods.
11. Determination of nucleic acid bases by UV spectrometry
12. Paper chromatography for separation of amino acids / pigments
13. TLC for separation of lipids / amino acids
14. Dialysis
15. SDS – PAGE for separation of proteins
16. Agarose gel electrophoresis for DNA separation
17. Isolation of chloroplasts by sucrose density gradient centrifugation
18. Ion – exchange column chromatography
20. Gel permeation column chromatography (demonstration).
21. Spun column chromatography (demonstration).
22Separation and determination of concentration of green / yellow pigments by spectrophotometry

Suggested books/manuals.

1) Biochemical Methods per Agricultural Sciences, 1992. By S. Sadasivam and A. Manikam
2) Practical Biochemistry: Principles and Techniques 1995, 4th Ed. By K. Wilson and J. Walker, Cambridge University Press.
3) Modern Experimental Biochemistry. 1993. 2nd Ed. By R.F. Boyer. The Benjamin Cummings Publ. Company.
4) Physical Biochemistry: Applications to Biochemistry and Molecular Biology, 1982, 2nd Ed. By David Freifelder. W.H. Freeman and Company.
5) Introduction to Practical Biochemistry. 2000. by S.K. Sawhney and Randhir Singh (eds.) Narosa Publ. House.
6) An introduction to Practical Biochemistry, 1987. D.T. Plummer.
7) Laboratory Manual in Biochemistry, 1996. By J.Jayaraman.
8) Florence C. Barseson, Thomas M. Chanders Danny. Wild Brank – Practical Virology.
9) Manual of Biochemistry Deshpande and Shashidhar Rao I K International Publishers.

SEMESTER – II

MBT 201: MICROBIAL PHYSIOLOGY AND METABOLISM

OBJECTIVES:

- To import information on the historical developments in Physiology and Metabolism
- An in-depth study on structure and organization of chromosomes, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various molecular techniques used in the biological research.

LEARNING OUTCOME:

On the completion of the course, students should be able to:

UNIT-I: Students are able tounderstand in depth knowledge on molecular biology.

UNIT-II: Must be able to know types of mutagens and their study for further biological innovations.

UNIT-III: Understand the detailed mechanism of Replication in both pro & Eukaryotes.

UNIT-IV: Understand the overall concepts of Transcription and translation for further translational research (Systems biology)

UNIT – I (12 hrs)

Microbial nutrition- classification of microorganisms based on carbon, energy and electron sources. Major and minor nutritional elements and growth factors.

Chemotrophism - sulphur, ammonia, nitrite, iron, hydrogen and carbon monoxide oxidizers and their importance, Chemoheterotrophism - Acetogens, methanogens, methanogenesis and their importance.

UNIT – II (12 hrs)

Phototrophism - Photosynthetic pigments, photochemistry of PSI and PSII. Modes of CO_2 fixation (Calvin cycle, reductive acetyl CoA pathway, HP pathway). Halobacterial photosynthesis. Anaplerotic reactions.

Carbohydrate metabolism – EMP, ED, HMP and phosphoketolase pathway in microorganisms. Gluconeogenesis and its significance.

UNIT – III (20 hrs)

Aerobic respiration: TCA cycle- intracellular location and reactions, amphibolic nature, Glyoxalate cycle. Mechanisms of substrate–level phosphorylation. Respiratory electron transport in mitochondria and bacteria. Mechanism of oxidative phosphorylation, uncouplers and inhibitors.

Anaerobic respiration: sulphate and nitrate respiration and their ecological significance. Fermentation: alcoholic, lactate, propionate, mixed acid butyrate and butanol fermentations and their industrial importance.

Concepts of primary and secondary metabolism. Biosynthesis of secondary metabolites with special reference to penicillin and polyketides.

UNIT – IV (22 hrs)

Lipid metabolism – Biosynthesis of glycerol's phospholipids and glycolipids, oxidation of saturated and unsaturated fatty acids. Nucleotide metabolism – Biosynthesis of purine and pyrimidines, nucleotide-salvage and de novo pathways. Biosynthesis of deoxy ribonucleotides and regulation.

Protein metabolism – Assimilation of inorganic nitrogen and sulphur, biosynthetic pathways of amino acids and their regulation with emphasis on tryptophane and histidine. Catabolism of amino acids (transamination, decarboxylation, deamination). Degradation of proteins-proteases.

References:

1. Arora D.K and Seema Gupta, (1996). Bacterial Physiology. Anmol Publications. New Delhi.
2. Caldwell, D.R. (1995). Microbial Physiology and metabolism, Wm. C. Brown Publishers, USA
3. Lansing M. Prescott, John P. Harley and Donald A. Klein. (2007). Microbiology. (5th Edition). McGraw-Hill Company, New York
4. Larry McKane and Judy Kandel. (1996). Microbiology-Essentials and applications. (2nd edition).McGraw Hill, Inc., New York.
5. LubertStryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company, New York.
6. Moat, A.G. and Foster, J.W. (1988). Microbial Physiology (Second Edition). John Wiley & Sons, New York.
7. S. Ram Reddy and S.M. Reddy (+92006) Microbial Physiology, Scientific publications (India) Jodhpur .
8. Voet D and Voet J.G. (1995). Biochemistry. 2nd ed. John Wiley and Sons.
9. White, D. (1995). The physiology and biochemistry of Prokaryotes, Oxford University Press, Oxford, New York.
10. Zubay, G. (1998). Biochemistry WCB. Mc Graw – Hill, Iowa.
11. Lehninger, Nelson and Cox Principles of Biochemistry, 3rd Edition.
12. Gotchak. – Bacterial metabolism.

MBT 202-MOLECULARBIOLOGY

OBJECTIVES:

- To import information on the historical developments in molecular biology
- An in-depth study on structure and organization of chromosomes, replication process, transcription process, translation process and mutagenesis.
- To expose the students on the basic understanding of various molecular techniques used in the biological research.

LEARNING OUTCOME:

On the completion of the course, students should be able to:

UNIT-I: Students are able tounderstand in depth knowledge on molecular biology.

UNIT-II: Must be able to know types of mutagens and their study for further biological innovations.

UNIT-III: Understand the detailed mechanism of Replication in both pro & Eukaryotes.

UNIT-IV: Understand the overall concepts of Transcription and translation for further translational research (Systems biology)

UNIT – I (20 hrs)

Introduction & historical development, central dogma of molecular biology, gene types and structure and functions. Chromosome organization in Prokaryotes and eukaryotes. DNA replication - semi conservative, rolling circle, unidirectional and bidirectional. DNA synthesis by reverse transcription, Inhibitors of DNA replication.

DNA damage and repair mechanisms (methyl directed, mismatch repair, short patch repair). excision repair, recombination repair, SOS system.

UNIT – II (15 hrs)

Transcription - Structural features of rRNA, tRNA and mRNA and their functions. General principles, basic apparatus of transcription. RNA polymerases, mechanism, promoters, enhancers and other regulatory sequences, inhibitors of transcription.

Post-transcriptional modifications - Transcriptional attenuation, cutting and trimming of rRNA, mRNA modification (capping, polyadenylation and splicing), cutting and modification of tRNA, catalytic RNA, group I, group II intron splicing and RNase P.

UNIT – III (15hrs)

Translation: Basic features of genetic code, Wobble concept, prokaryotic and eukaryotic ribosomes, RNA pol. I, II and III. Initiation, elongation and termination factors. Inhibitors of protein synthesis.

Post translational modifications: Protein folding, structural analysis, signal hypothesis, protein targeting and *in vitro* transcription and translation systems. CRISPR-Cas 9 technology.

UNIT – IV (20 hrs)

Regulation of gene expression – Operon concept, regulatory elements of operon – inducers, repressors, apo-repressors and co – repressors. Genetic evidence for positive and negative regulation. Catabolite repression. Structure, function and regulation of *lac*, *trp* and *ara*operons as models.

Global regulatory responses- heat shock response, stringent response, SOS response regulation by small molecules such as ppGPP, pppGPP and cAMP. Eukaryotic translational control control by gene, inhibitory RNA (RNAi), Antisense, RNA. Hormone and environmental factors affecting gene expression. Coordinate regulation of unlinked genes (Britten – Davidson model).

References:

1. Baumberg, S ed. (1999): Prokaryotic Gene Expression, Oxford, United Kingdom, Oxford University Press.
2. Brock T.D (1990): The Emergence of Bacterial Genetics, Cold Spring Harbor, New York.
3. Burrel, M.M. (1993). Enzymes of Molecular Biology, Humana Press.
4. Brown, T.A. (1995). Gene Cloning. An introduction 3rd edition. Chapman and Hall.
5. Brown T.A. (1999): Genomes, BIOs Scientific Publishers Oxford.
6. Gardener EJ, Simmons M.J. and Snustad D.P. (2001): principles of Genetics, 8th Edi. John Wiley & Sons, Inc
7. Griffith AJF Gelbart W.M. Lewontin, RC and Miller JH (2002): Modern Genetic Analysis 2nd Edi. W.H. Freeman, New York.
8. Lewin, B. (2004): Genes VIII. Oxford University Press, Oxford.
9. Lodish, H. Biology, 4th ed. Scientific American Books, W.H. Freeman, New York.
10. Maloy S.R. Cronan J.E., (Jr) and Freifelder D (1994): Microbial genetics, Jones and Bartlett Publishers.
11. Molecular Biology of cell. Albert et al 4th Edition Garland Publishing Inc.
12. Macinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology, 3rd Edition, John and Bartlett Publishers.
13. Nelson DL and Cox MM (2000): Lehninger Principles of Biochemistry, 3rd ed. Worth Publishing, New York.
14. Primrose, S. Twyman R and Old B (2001): Principles of Gene Manipulation, 6th ed. Blackwell Science.
15. S. Ram Reddy, K. Venkateshwrlu, V. Krishna Reddy, (2007): Molecular Biotechnology, Kakatiya University.

MBT-203 MICROBIAL GENETICS

OBJECTIVES:

- An in-depth study on genetics
- To understand the importance of g gene transfer mechanisms, plasmid types, transposable elements and cell cycle

LEARNING OUTCOME:

Unit-I: Students should know about the modern gene concept, types of genes, mutations and screening methods.

Unit -II. Students should know the different gene transfer mechanisms, genetic map and recombination stratagies.

Unit -III. Students should about know Plasmids, transposable elements and its applications and use of Bacteriophage in microbial genetics.

Unit- IV. Students should acquire knowledge on cell cycle and its check points &tumarogenisis.

UNIT – I (20 hrs)

Modern concept of gene- gene structure, co-lineartity and one gene - one enzyme concept, types of genes. General properties of mutations- molecular basis of mutations (base substitution, insertion and deletions Frameshift mutations, transitions, transversion, site directed mutagenesis), spontaneous (non-adoptive, mutation rate and hotspot), induced (chemical, physical and base analogue mutagens)**.**

Mutation screening methods (bacteria, bacteriophages and fungi), evaluation of mutagens using microbial systems. Mutation analysis, Benzers concepts with reference to rII locus in T4 bacteriophage.

UNIT – II (15 hrs)

Gene Transfer mechanisms - Transformation, conjugation, transduction and transfection: mechanism and applications. Over view of bacterial genetic map, Mapping of genes.

Molecular recombination (bacteriophages, and *E.coli*) Genetic models of recombinations (Holliday model, invasion model and break repair model) synapse of homologus duplexes, breakage and reunion. Role of RecA in recombination, Legitimate and illegitimate recombinations. Genetic analysis of recombinations (complementation test).

UNIT – III (15 hrs)

Plasmids: Occurrence, types, classification, purification of plasmids and functions. Transfer and replication of plasmids and its applications in modern biology.

Transposons: transposable elements, IS elements, P elements, transposition, reverse transposons and their applications in genetic analysis. Uses of phages in microbial genetics, phenotypic mixing, DI particle and genetic evolution of viruses (Influenza, HIV, Herpes).

UNIT – IV (15 hrs)

Cell cycle – over view, phases of cell cycle, regulations of cell cycle, progression (MPF cyclins and cyclin dependent kinases, cell differentiation) cell cycle check points, inhibitors of cell cycle.

Molecular Biology of tumerogenesis: Terminology, types of tumors, physical, chemical and biological carcinogens. Carcinogenesis, metastasis, Protooncogenes, oncogenes, Tumor suppressor genes, apoptosis, role of oncogene products in signal transduction. Induction of tumors by *Agrobacterium*.

References:

1. Maloy, S.R., Cronan Jr. Je. Freifelder D (1998). Microbial genetics. Jones and Barlett Publishers.
2. Watson, J.D., Hopkins, N.H., Roberts, J.W., Steitz, J.A. and Weiner, A.M. (1998). Molecular biology of the gene, 4th edition, Benjamin/Cummings publishing company.
3. Voet, D, and Voet, J.G (1995): Biochemistry, 2nd ed. John Wiley and Sons, New York.
4. Watson, J.D. Baker T.A., Bell S.P., Gann A, Levine M ad Losick R (2004): Molecular Biology of the gene, 5th Ed. Pearson Education, Inc.
5. Weaver R.F. (2002): Molecualr Biology, 2nd Edi., Mc Graw-Hill Higher Education, New York.
6. Winnacker, E.L. (1987). From genes to /Clones: Introduction to Gene technology VCK Publications, Federal Republic of Gernmany.
7. White R.J (2001): Gene Transcription, Mechanisms and Control.
8. Microbial Genetics by Frifielder.
9. Introduction to Genetics by Gardner.
10. Fundamentals of Microbial Genetics by T.A. Brown.

MBT 204: BIOSTATISTICS, RESEARCH METHODOLOGY AND BIOINFORMATICS

OBJECTIVES:

- Students will be able to make informed decisions based on data and apply statistical tools, data bases and computational techniques in their research works.
- To make the students to understand genome sequence analysis and protein analysis and to know the computational tools in bioinformatics.

LEARNING OUTCOME:

1) Up on completion of the course the students will be able to:
2) Be familiar with statistics, computer applications in biology.
3) Solve problems quantitatively using appropriate statistical measures.
4) Create and interpret visual representation of quantitative information
5) Understand and assess critically from data collection from somes and representations.
6) Understand the importance of biological data bases, programme skills and computational tools, softwares and their applications in future research.
7) Understand the whole genome analysis computational tools microarray techniques and protein analysis.

UNIT – I (20 hrs)

Introduction to biostatistics, Source of biological data, Measures of Central tendency - mean (arithmetic, harmonic and geometric) median and mode, Probability, distribution; Correlation, Co-efficient, Simple linear regression; basic idea of Significance Test, hypothesis tests, levels of significance, Student 't', 'Chi' square and goodness of fit.

Classification, tabulation, frequency distribution and graphical representation of data. Analysis of co–variance: introduction, procedure, t-Test for multiple comparisons. Line fitting through graph points, standard curves, MLR. Construction of histograms and interpretation.

UNIT – II (15 hrs)

Research methodology- Definition, steps in research process, General characteristics of research selection of research problem, literature survey, hypothesis, ability to construct, presentation and interpretation of research data, preparation of abstract/technical report/manuscript for publication in scientific Peer reviewed journals. Report writing methods Discussion, Summary and Bibliography.

Project writing skills – preparation of research proposal for grants, Background analysis of problem, proposed goal, objectives, targets, implementation of plan and annual budget for project proposal. National and international funding agencies for life sciences research. Research fellow ships.

UNIT – III (18 hrs)

Introduction to computers - Components of Computer, Central Processing Unit (CPU), VDU, Keyboard and Mouse, Other input/output Devices, Computer Memory, Concepts of Hardware and Software; Concept of Computing, Data and Information; Applications of IECT; Connecting keyboard, mouse, monitor and printer to CPU and checking power supply Types of operating systems – DOS, UNIX and Windows.

Basics of Micro soft windows software - Creating Presentation; Text Preparation and Power point PresentationSlide Show (Word, Excel and PPT). Basic of networking; LAN, MAN, WAN; Concept of Internet and its applications in biology, New software for microbiological research.

UNIT – IV (22 hrs)

Bioinformatics: Definition, scope and relevance of bioinformatics, databases, visualization tools, genomics, proteomics, molecular mining, molecular modeling, Drug designing, gene therapy, structure and functional relationship of biomolecules.

Sequence analysis:Concepts, importance and alignment methods (pair wise and multiple sequence alignments). Methods of structure prediction for known and unknown folds. (Homology modeling)Applications of bioinformatics - *Ab initio* methods for determining proteins structure, *In silico* Analysis.

References:

1) Bioinformatics Basics: Applications in Biological Science and Medicine, CRC Press
2) London Sokal&Rohif, (1973) Introduction to Biostatistics - Toppan Co. Japan.
3) A Practical Guide to the Analysis of Genes and Proteins by Baxevanis A.D. and
4) Ouellette, Third Edition. John Wiley and Son Inc., 2005.
5) Bioinformatics Sequence and Genome Analysis by Mount D.W., CSHL Press, 2004.
6) Introduction to Bioinformatics by Tramontano A., Chapman & Hall/CRC, 2007.
7) Understanding Bioinformatics by Zvelebil, M. and Baum, Chapman & Hall/CRC, 2008.
8) Introduction to Biostatistics by K.S. Sharma.
9) Introduction to Bioinformatics by Attawood.

NC- 1: Fundamentals of Microbiology

Objectives:

To understand the fundamentals of microbiology, construction and applications of the instruments used in the studies related to various disciplines of biological sciences.

- To appreciate the importance, concept of research and learn the art of thesis, paper writing and publication.

Learning Outcome:

The Course will provide an overview of would know the general and advanced microbiology and understand the applications of microbes in daily life.

UNIT – I (18 hrs)

Basic microbiology- History and achievements, Major contribution ofLeeuwenhoeck, Edward Jenner, Alexander Flemming, Joseph Lister, Robert Koch, Louis Pasteur, Hargobind Khorana.

General Characteristics- Prokaryotic and eukaryotic microbes. Preparation of culture media, Isolation and characterization of microorganisms, pure culture techniques, preservation and maintenance of microorganisms.

UNIT – II (15 hrs)

Microscopy- Dark field, bright field, resolving power, numerical aperture, chromatic aberration, phase contrast microscopy, fluorescent microscopy, inverted microscopy, stereo microscopy, electron microscopy, TEM and SEM.

Staining Techniques- Simple staining, negative staining, differential staining, Gram and acid fast staining, flagella staining, capsule and endospore staining.

UNIT – III (10 hrs)

Whittaker's five– kingdom system of classification- Major characteristics used in identification and classification of microbes: Morphological, physiological, ecological genetic and molecular.

UNIT – IV (18 hrs)

Control of microbes- Sterilisation, disinfection, antiseptic, tyndallisation, pasteurization: Physical- dry heat, moist heat, UV light, ionizing radiation, filtration, HEPA filter, Chemical-phenol and phenolic compounds, (halogen aliphatic alcohol, formaldehyde, ethylene oxide, heavy metals) anionic and cationic detergents.

Scope of Microbiology- significance of microbes in human health, agriculture, food and dairy industries, waste management and environment protection**.**

References:

1. Microbiology Pelczar, Chan and Krieg. (Indian edition)
2. Microbiology Vol II Power and Daginawala.
3. Outlines of Biochemistry Cohn and Stumpf.
4. Microbiology by Dubey &Maheswari
5. Microbiology by Purohit.

MBP 201 - Microbial Metabolism and Molecular biology

1. Determination of microbial growth curve
2. Effect of temperature, pH and salts on bacterial growth
3. Demonstration of Oligodynamic action
4. Isolation of photosynthetic bacteria
5. Estimation of bacteriochlorophyll pigments
6. Isolation of chemoautotroph's : *Thiobacillusferroxidans*
7. Demonstration of microbial stratification in aquatic ecosystem through Winograndsky column
8. Carbohydrate fermentation: acid and gas production
9. Isolation of hydrocarbon utilizing bacteria
10. Alcoholic and lactate fermentations
11. Assay of microbial enzymes (cellulase, pectinase, lipase and proteases)
12. Isolation and cultivation of anaerobic microorganisms
13. Demonstration of microbial toxins
14. Isolation and cultivation of antibiotics producing organisms.
15. Setting of molecular biology/Genetic engineering laboratory
16. Creating ribonuclease free environment in the laboratory
17. Isolation of DNA from microbes, plant/ animal tissues
18. Estimation of DNA by DPA method.
19. Isolation of RNA from bacteria/yeast
20. Estimation of RNA by Bial's Orcinol method
21. Determination of purity of DNA by spectrophotomeric method
22. Transformation
23. Isolation of plasmid DNA

Suggested books/manuals.

1) Biotechnology: A Laboratory Course. 1996. 2nd ed. J.M. Becker, et al. Academic Press.
2) Methods in Biotechnology. 2002. By Ignacimuthu.

MBP 202 – Microbial Genetics and Biostatistics and Bioinformatics

1. Isolation of auxotrophic mutants
2. Replica plating technique
3. UV survival curve
4. Petite mutants
5. Phage titration
6. Induction of mutations in bacteria by physical/chemical agents.
7. Observation of mitotic divisions in onion root tips and meotic divisions in flower buds
8. Observation of lambrush chromosomes in Chironomus salivary glands
9. Demonstration of Ame's test.
10. Demonstration of conjugation in bacteria

b). Problems

I. DNA characteristics (Tm value, GC/AT, Chargaff's rule)
II. Transcription
III. Translation
IV. Mutations
V. Phage titrations
VI. Restriction mapping

11. Graphical representation of data, histograms and frequency curves.
12. Descriptive statistics of distribution: Mean mode, median, variance, standard deviation and standard error.
13. Probability distribution – binomial, poisson and normal distributions.
14. Tests of significance on means and proportions – standard normal deviate test,
15. Paired and unpaired test.
16. Application of Chi square test, contingency tables with Yate's correction.
17. Correlation and regression coefficients and their testing, partial and multiple correlation coefficients, multiple regression.
18. Application of analysis of variance (ANOVA). Distance of similarity analysis
19. Basics of computers – basic commands – file creation, copying, moving and deleting in Linux and Windows.
20. Using email, browsing and search engines
21. Using biological databases – Pubmed, NCBI, Swissprot – protein data bank and genebank
22. Different types of sequence analysis queries in BLAST and FASTA
    Multiple sequence alignments and Phylogenetic alignments (phylogenetic tree analysis).
23. Usage of gene and protein structure prediction softwares.
24. Genomic and proteomics available on the web and their use.
25. Statistical software available on the web and their use.

Suggested books/manuals.

1. Recombinant DNA Laboratory manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Press.

SEMESTER III

MBT-301: RECOMBINANT DNA TECHNOLOGY

OBJECTIVES:

- To impart the knowledge on basic concepts of Recombinant DNA technology and its importance.
- To provide in depth of knowledge on cloning vectors and other molecular techniques used in diagnosis.
- To expose and expertise the students to understanding of clond genes and their applications.

LEARNING OUT COME:

On the completion of the course, students should be able to:

UNIT-I: Students are able to understand the scope of recombinants and importance of enzymes used in Recombinant DNA technology.

UNIT-II: To obtain the knowledge of cloning vectors (Construction & screening mechanisms) in Genetic engineering.

UNIT-III: To knowdifferent tools and molecular biology techniques used in Genetic engineering and other clinical diagnosis.

UNIT-IV: To understand depth of expression and purification of cloned genes in various scientific fields.

UNIT-I **(15 hrs)**

Basic Concepts of Isolation of desired genes, gene manipulation, expression and principles, Scope of recombinants & importance of recombinant DNA technology in Genetic engineering.
Restriction enzymes – Nomenclature, classification, modification and importance. Various enzymes used in genetic engineering like DNA ligages, Polynucleotide Kinase, alkaline phosphotases, S1 nuclease, Terminal transferase, Bal 31 nuclease.

UNIT–II (18 hrs)

Cloning Vectors – Characteristics, classification, advantages and disadvantages. Natural and artificial plasmids and their importance in E. coli (Plasmids, Phagemids, Cosmids and BAC s), Yeast (YAC s, Shuttle Vector), Higher plants (Ti plasmid, binary vectors) and Animal cells (SV 40 and retrovirus vectors). Characteristics of expression vectors.
Vector digestion, Ligation by linkers, adaptors and homopolymer tails. Preparation of DNA probes, construction of DNA libraries (Genomic and cDNA libraries). Screening of recombinants – biochemical and hybridization methods. Microarrays and Macro array methods.

UNIT – III (16 hrs)

Polymerase chain reaction – principle, types (RT-PCR, nested PCR, inverse PCR, immunocapture PCR and Real-Time PCR), primer designing and applications of PCR. Sequencing methods – Sangar's and Maxim-Gilbert's methods. Automated sequencing. Profiling of nucleic acids by DNA fingerprinting, RFLP, RAPD and AFLP & Restriction mapping.
Introduction of recombinant DNA molecules in to appropriate hosts systems – competent cell preparation, Electroporation, Microinjection and Particle Gun-Bombardment methods and selection of transfermants. *Agrobacterium* – mediated transformation. Transfection - Salient features and its significance. *In vitro* packaging of recombinant cosmids.

UNIT – IV (18 hrs)

Expression of cloned genes – IPTG, x-gal, lac, taq promoters. Expression of fusion protein tags, purification of tags, plasmid copy number, inducible expression system, inclusion bodies and solubulization of proteins.

Genetically engineered organisms (GEO): Transgenic Microorganisms, animals and plants as protein/cell factories, genetic engineering for fungal and bacterial diseases. Recombinant DNA technology applications in biology.

References:

1) J.M. Walker and R. Rapley (2002). 4th ed.: Molecular biology and Biotechnology. (Panima Publ.)
2) Demain, A.L., Manual of Industrial Microbiology and Biotechnology, (1999) second edition. Editor in Chief, ASM Press.
3) H. Kreuzer and A. Massey. Recombinant DNA and biotechnology: A guide for Teachers 2nd ed. ASM Press.
4) H. Kreuzer and A Massey. Recombinant DNA and biotechnology: A guide to students 2nd ed. ASM Press.
5) C. Ratledge and B. Kristiansen: .Basic Biotechnology, 2001. 2nd ed. Cambridge University Press.
6) Sambrook and Russel, Molecular Cloning, 2001. Vol. I – III CSH Press.
7) D. Freifelder - Essential of Molecular Biology
8) D. Freifelder - Microbial genetics
9) Gerald Karp (2004) 2nd edition - Cell and Molecular Biology
10) Lewin, B (2004): Genes VIII, Oxford University Press Oxford.
11) LubertStryer. (1995). Biochemistry. (4th edition). W.H. Freeman and company,
12) .Lehninger (2000) Prniciples of Biochemistry, 3rd edition, Nelson and Cox (Worth) Publ.
13) Molecular Biology of the Gene by James Watson, Tania Baker, Stephen Bell, Alexander Gann, Michael Levine & Richard Losick , 6th Edition; CSHL Press; 2007.
14) Molecular Biotechnology by T.A. Brown.

MBT 302: BIO - PROCESSING TECHNOLOGY

Objectives:

- An in-depth study on industries
- To make the students knowledgeable on production of various industrial products.
- To make the students to know various techniques used in industries.

Learning outcomes:

By the end of this course the students will be able to know historical aspects of industrial microbiology and fermentation techniques.

The students will be able to understand screening methods for Industrial microbes.

The students will be able to understand the rules and regulation of industrial microbiology

UNIT – I (15 hrs)

History of fermentation technology, Exploitation of Microorganisms in fermentation Process. Components of fermentation process.

Industrial media and Inoculum: Medium composition, preparation and optimization. Sterilization of media and fermenter. Inoculum development, Starter culture technology and preservation methods of microbial cultures.

UNIT – II (15 hrs)

Fermenter – Design, parts and types of fermenters, probes for online monitoring, physical, chemical and biological sensors. Applications of computer in fermentation process, measurement and control of fermentation process.

Microbial growth kinetics in batch, fed batch and continuous culture systems. Substrate utilization, specific growth rate, yields of biomass, product formation kinetics.

UNIT– III (20 hrs)

Fermentation process: Aeration and agitation. Power requirement, oxygen transfer kinetics. Concepts of Newtonian, Non – Newtonian and plastron fluids, apparent viscosity, foam and antifoam. Scaling up of process.

Downstream processing: Solid-liquid separation, release of intracellular components, concentration of biological products, purification, production, formulation, monitoring of downstream processing, process integration.

UNIT- IV (15 hrs)

Process economics: The starting point, cost estimates, process design, design exercise, capital cost estimates, the operating cost estimates and Goods and Services Tax (GST).

Legal protection and IPR: WTO, IPR in India, Convention on Biodiversity (CBD), Patent Co-operation Treaty (PCT), forms of patents and patentability, process of patenting, Global scenario of patents and India's position, patenting of biological materials.

References:

1. Demain, A.L. and Davies, J.E. (1999). Manual of Industrial Microbiology and Biotechnology. ASM Press.

2. Glick, B.R. and Pasternak, J.J. (1994). Molecular Biotechnology, ASM Press.

3. Stanbury, P.F., Whitaker, A. and Hall, S.J. Principles of Fermentation Technology, Pergamon Press.

4. Doran, P. M. (1995). Bioprocess Engineering principle. Academic Press. London.

5. Moses, V. Cape, R. E. and Springham, D. G. (1999) Biotechnology: The science and the Business. 2nd ed. Harwood Academic. New York.

6. Nielsen, J., Villadsen, J. and Liden, G. (2002). Bioreaction Engineering. 2nd ed. Kluwe Academic/Plenum Publishers. New York.

7. Garcia, A., Bonen, M. R., Ramirez-Vick, J., Sadaka, M. and Vuppu, A. (1999). Bioseparation process science. Blackwell. Massachusetts.

8. Sommleitner, B. (2000). Bioanalysis and biosensors for bioprocess monitoring. Advances in biochemical engineering/biotechnology. Vol.66. Springer-Verlag. Berlin.

MBT-303 IMMUNOLOGY

OBJECTIVES:

- The objective of this course is students will learn about the structural features of the components of the immune system, their functions and responsiveness.
- Functions of HLA system and transplantation immunology
- T-Cell activation and co stimulation and hyper sensitivity reactions.

LEARNING OUTCOME:

At the end of this course students will be able to:

Unit- I: Understand the immune system types of immunity, immune hematology structure and functions of antigen and antibody.

Unit-II: Understand the *in-vitro* and *in-vivo*antigen antibody reactions and principles of compliment system.

Unit- III: Understand HLA System and Transplantation immunology and Auto immunity.

Unit- IV: should understand about the hypersensitivity reactions, immunization objectives and types of vaccines.

UNIT – I (15 hrs)

History and scope of immunology, structure, and function of cells &organs of immune system. Immune response (humoral and cell mediate) Types of immunity, innate immunity, acquired immunity; immunohematology, (Blood groups, Blood transfusion and Rh – incompatibility) phagocytes, inflammation, and extra cellular killing.

Antigens and Antibodies: Antigens – structure, properties and types of antigens (Iso and allo, haptens, adjuvants) and antigenic specificity. Antibodies- structure, heterogeneity, types and sub types, properties (physico chemical and biological), theories of antibody diversity – production of polyclonal, monoclonal and recombinant antibodies and their applications.

UNIT – II (15hrs)

Antigen - Antibody interactions:Invitro methods – Flocculation, Precipitation, Immuno diffusion, Agglutination Phagocytosis Opsonization, Neutralization, Complement fixation. Immuno electrophoresis, Immunoflorescence. RIE, CIE, RIA, ELISA and Western Blot, Flow cytometry.

Complement system: complement components, types, complement activation, regulation of complement system, biological consequences and pathways of complement activation, and complement deficiencies.

UNIT – III (10 hrs)

Structure and functions of MHC and the HLA system; HLA and tissue transplantation tissue typing, graft versus host reaction and rejection. Antigen Processing and presentation, T-Cell maturation and differentiation, T- cell activation, co-stimulation and T-Cell Receptors.

Auto immunity, autoimmune diseases and their treatment, tumor immunology–tumor specific antigens, immune response to tumor, immunodiagnosis of tumors, immunodeficiency, Immunotherapy of tumors (alphafeto-protein, carcino embryonic antigen).

UNIT – IV (20 hrs)

Hypersensitivity reactions:classification and types (type I. Anaphylaxis; type II Antibody dependent cell cytotoxicity; Type III Immune complex mediated reactions; type IV cell mediated hypersensitivity reactions)

Immunization:Objectives of immunization, Active and passive, types of vaccines: whole organism vaccines, recombinant vector vaccines, DNA vaccines, synthetic peptide vaccines, subunit vaccines, immunization procedures, adverse reactions of vaccines, Immunotherapy.

References:

1. Coleman, R.M Lambard, M. F and Siccard R.E. 1992, Fundamentals of Immunology 2nd Ed.
2. Kuby, J. 1992 Immunology New York, W.H. Freeman.
3. Paul, W.E 1990 Fundamental Immunology 2nd Ed.
4. Riott, I.M. 1991, Essential Immunology 7th Ed.
5. Tizarrd, I.R. 1998. Immunology An Introduction 2nd Ed
6. Ross, G.D. Ed Immuno biology of the Complement System.
7. Riott, I.M. Brostoff, J. and Male, R.K. 1989. Immunology 2nd Ed.
8. Leskowitz, Alan R. Lisi (1988).Immunology – a short course elibezamini and Sidney Inc. New York.
9. J.H.L. Playfier (1987) 4th Ed. Immunology at a glance Blackwell Scientific Publication.
10. John W. Kinball –Introduction to Immunology.
11. Abul Abbas, Andrew K. KichAmn Jordan S. Pober. Cellular and Molecular Immunology 3rd ed
12. Bacterial Evasion of the Host Immune System Edited by: Pedro Escoll Published: 2017

MBT-304 MEDICL MICROBIOLOGY

OBJECTIVES:

- The student will able to learn the basic concepts of medical microbiology and microbial pathogenesis: study of microbes, antimicrobial agents, epidemiology, and virulence factors associated with the pathogen.
- Types of specimans, collection processing of material for laboratory diagnosis, molecular diagnosis etc.

LEARNING OUTCOME:

At the end of this course students will be able to:

Unit- I: Understand the role of bacterial pathogen in causing infectious disease in humans, natural barriers to infection and inflammation

Unit -II: Understand the detailed study of bacterial and viral pathogens and mycotic infections protozoal and helminthic infections

Unit -III: Understand medical laborotary diagnostic procedures including molecular diagnosis.

Unit -IV: Chemotherapy and chemotherapeutic agents and drug resistance.

UNIT – I (20 hrs)

Classification and characteristics of medically important microorganisms: infection, virulence, pathogenicity, sources and modes of transmission of infections. Normal Microflora of human body: Detailed study of morphology, cultural characteristics, biochemical properties, pathogenesis, diagnostic laboratory tests, epidemiology and prophylaxis of the following organisms, *Haemolytic Streptococci*, *Pneumococci,Corynebacterium diphtheria Mycobacterium tuberculosis* and *M. leprae*, *Neisseria meninigitdis*, *Hemophilus influenzae*.

Bacteria causing sexually transmitted diseases – clinical significances - *Treponema*, *Neisseria gonorrhea*, LGV agent (*chlamydia H. ducreyi, Calymmoto Bacterium, Grannulomatis*). Bacteria causing water borne infections *(E. coli, Salmonella, Shigella, Vibrio*), and wound infections (C*lostridium tetani, C. welchii, Staphylococci, Pseudomonas*).

UNIT – II (15 hrs)

Detailed study of morphology, cultivation, pathogenesis, diagnostic laboratory tests, epidemiology, prevention and treatment of air borne, waterborn, insect borne, contact, and sexually transmitted viral diseases. *Enterovirus,* and zoonotic viral infections. *Influenza virus, Chicken gunea,* Rhinovirus, *rubella, adenovirus, mumps, measles, varicella, zoster* virus *rabies,Japanese encephalitis*.HAV, HBV, HCV, HIV.

Superficial mycoses, cutaneous and subcutaneous mycoses, Opportunistic mycoses and their control. Detailed study of morphology, pathogenesis, Prevention of Malaria. Amoebiasis, Leshmaniasis, Toxoplasmosis, Exhninococcusgrannulosus, Ascariasis, Ancylostomiasis, Filariasis.

UNIT - III (15 hrs)

Types of specimens, specimen collection, handling, transport, processing of material for laboratory investigations, specific and non specific laboratory tests, morphological identification (light and electron microscopy), culture isolation detection of antigen by immunological assays, serological tests, antibody stains, Immuno blotting.

Molecular diagnosis:- DNA – DNA or DNA – RNA hybridization, 16srRNA, target ramification systems (PCR, reverse transcript PCR, TMA, NASBA, LAMP) probe amplification systems – Ligase chain reaction (LCR), signal amplification techniques. Applications of nanotechnology in clinical diagnosis.

UNIT – IV (20 hrs)

Antimicrobial agents: Bacterial, viral, fungal and protozoan. Microorganisms producing the antimicrobials, screening and assay of antimicrobial compounds, *(in vitro* and *in vivo)* minimum inhibitory concentrations (MIC), MLC.

Mode of action of antimicrobials: Cell wall, nucleic acid, purine, pyromidine, protein. respiration, oxidative phosphorylation ,enzyme inhibitors, cell membrane disruptors, and metabolites, analogues, drug resistance and its side effects.

References:

1. G.F. Brooks, J.S. Butel and S.A. Morse, (2002) 5th edition Medical Microbiology Mc Graw – Hill pebbles.
2. Murray PR et al (1999) Manual of clinical Microbiology (Ed.) American Society for Microbiology.
3. Lippincott – Raven, (1996) Fields Virology (3rd Edition) Fields BN et al (editions)
4. Davies et al Microbiology 4th edition.
5. Ananthanarayana, R &Panicker CKJ 6th Ed Test Book of Microbiology, Orient Longman, (2000).
6. Evans EGV et al (ed.) Medical Mycology Oxford University press
7. Reichmann, DD et al Churchill Livingstone, 1997 Clinical virology,
8. Skinner, FA and Carr, JG 1974 (ed.) The Normal microbial Flora of Man, Academic press, London,
9. Beily and Scott (2001) Diagnostic Microbiology 4th ed. ASM Press. Principles and Applications, American Society for Microbiology, 1993.
10. Panjarathinam R Orient Longman (1990). Text book of Medical Parasitology.
11. Foot-and-Mouth Disease Virus: Current Research and Emerging Trends Edited by: Francisco Sobrino and Esteban Domingo Published: 2017

11. Clinical Microbiology 8th Edition- **An Introduction for Healthcare** Professionals: Jennie Wilson (2018) Paperback ISBN: 9780702023163

NC-2: Microbial Technology and Entrepreneurship

OBJECTIVES:

- The student will able to learn the basic concepts of microbiology and microbial technology, study of microbes, antimicrobial agents, epidemiology, and virulence
- Use of Microbiology in daily liferand human welfare

LEARNING OUT COME:

At the end of this course students will be able to:

Unit- I: Understand the role of Microorganisms in the service of man and society andMicroorganisms of Industrial importance

Unit -II: Understand the detailed study Raw materials for Microbial Processes and Microbial products such as enzymes vitamins and antimicrobial compunds

Unit -III: Understand Microbes in Agriculture and food science and technology.

Unit -IV: Get the knowledge on Microbial entrepreneurship and Legal and statutory requirements and Marketing

UNIT – I (15 hrs)

Microorganisms in the service of man and society– Past, Present and Future. Traditional Microbial Technologies – Curdling of Milk, Bread and Wine, making other traditional foods of India and the World.

Microorganisms of Industrial importance – Over view of Isolation, Screening and Maintenance, Microbial Industries and Commercially important products, Status and Demand and Production – Indian and Global Scenario.

UNIT – II (15 hrs)

Raw materials for Microbial Processes – Availability and utilization, Significance of locally available raw material. Production of Pharmaceutically and Commercially important products – Alcohol and Alcoholic beverages.

Antibiotics, Enzymes, Vitamins and Monoclonal antibodies. Production of fermented milk products Yogurt and Cheese.

UNIT – III (15 hrs)

Microbes in Agriculture – Composting, Nitrogen fixation, Vermi composting, over view of bio fertilizers and bio pesticides – Production and applications. Microbial fuels – Alternate sources of energy – Methane and Hydrogen production, their significance, microorganisms in the recovery of precious metals, bio degradable polymers from microorganisms.

Microbes in Food - Single cell proteins and Single cell oil – Mushroom cultivation, Genetically engineered micro organisms – Applications in health, industries, agriculture, environment, fate of genetically engineered micro organisms in the environment.

UNIT – IV (15 hrs)

Microbial entrepreneurship – Government schemes for commercialization of microbial (Biotech) technology, Govt. regulations, Entrepreneurship – Developing a business plan, basic concept of financial, management, major financial statement – over view of Human resource management.

Legal and statutory requirements, Marketing, Negotiation skills, Rural and Women entrepreneurship. Patenting and intellectual property rights

References:

1. Martin Gross, 2003, Entrepreneurships in Biotechnology
2. De Hayne and J Kapelers, 2006, Innovation and Entrepreneurships in Biotechnology
3. Richard Dana Ono, 1991, Business of Biotechnology, Butterworths
4. Crueger and Crueger, Biotechnology: A Text book of Industrial Microbiology, 2nd Ed.
5. Casida, Industrial Microbiology
6. Demain AL, Biology of Industrial Microorganisms
7. Frazier WC and Westhof DC, Food Microbiology, 3rd Ed. TMH
8. Doyle PM et al, Food Microbiology- Fundamentals and Frontiers, 2nd Ed. ASM Press
9. Ananta Krishnan CP et al, 1994, Dairy Microbiology, Sri Lakshmi Publications, Chennai
10. Rabinson RK, 1990, Dairy Microbiology, Elsewhere applied Science, London

MBP: 301 – Recombinant DNA Technology and Bio process Technology

1. Restriction digestion of sticky ends and blunt ends
2. RNA polymerase activity
3. Polyribosome's
4. Southern blotting
5. Ti plasmid / crown gall disease
6. Replica plating
7. DNA Ladder 1000bp (super coiled plasmid)
8. Lambda DNA (ECORI/ Digest)
9. λ DNA/ ECORI/ Hind III digest
10. PBR 322 DNA/ Hinf 1 digest
11. PBR 322 DNA/ Ahe 1 Digest
12. Lambda / Hind III PUC 18 / save 3A1 PUC 18/ Taq / digest
13. Restriction analysis and Agarose electrophoresis
14. Dioxic growth
15. Preparation of competent cells.
16. Use of logerttherms in microbial growth during fermentation process.
17. Determination of mid of the bacterial growth curve.
18. Harvesting of microbial cells and demonstration of yield of products.
19. Manometric study in fermentation process.
20. Bacterial growth kinetics
21. Mid point of bacterial growth curve
22. Mono metric study in fermentation process
23. Design of fermenter

Suggested Books/Manuals.

1) Recombinant DNA Laboratory Manual. 1989. J.W. Zyskind and S.I. Bernstein. Academic Pess.
2) Manual of Industrial Microbiology and Biotechnology, 2nd edition, by Demam A.L., Editor in chief 1999, ASM Press.
3) Recombinant DNA and Biotechnology: A Practical guide to students 2nd edition. H. Kreuzer and A. Massey.
4) Molecular clonming Vol. I, II, III, A Practical by Sambrook, and Russel (2001) CSH press.
5) Experimental Biochemistry, A Student companion (2003) Vijay Deshpandes. I.K. Int. Pvt. Ltd.

MBP: 302 – Immunology, Medical and Diagnostic Microbiology

1.Separation of serum proteins by SDS PAGE.
2.Production of polyclonal antibodies- demonstration of different routes of immunization, bleeding of experimental animals, collection of blood, serum separation, purification and characterization of immunoglobulins.
3.*In vitro* serological tests: single radial immuno diffusion and double diffusion, Ochterlonly double diffusion, immunoelectrophoresis--counter immunoelectrophoresis, rocket immune electrophoresis, DAC- ELISA. DAS-ELISA.
4.Agglutination reactions, Widal, HA, blood typing
5.Floculation- VDRL.
6.Neutralization tests.
7.Separation of serum WBC, RBC, Plasma proteins.
8.CBP and differential blood picture.
9.Lymphoblast transformation B Jerme plaque test
10. Blot Transfer and detection of protein on blot by staining
11. Lymphocyte viability test
12. Indirect Agglutination a. Hepatitis; b. Pregnancy test (HCG)
13. Identification of Staphylococcus and Mycobacteria using Gram and acid fast Staining.
14. Collection and culture of nosocomial microorganisms
15. Bacterial examination of blood, urine and pus.
16. Examination of Blood smear for malaria.
17. Blood hemoglobin estimation
18. Erythrocyte sedimentation rate.
19. Liver function test for hepatitis virus
20. Slide observations: *Candida albicans, Mycobacterium leprae,* bacterial spores, *Corynebacterium* sp., *Clostridium tetani, Aspergillus fumigatus.*
21. Preparation of different types of culture media, stating techniques – Gram's staining, F.B. Staining, Albert staining, Capsular staining etc.,
22. Identification of various pathogenic bacteria by biochemical, enzymatic and serological methods.
23. Bacteriological examination of urine, blood, pus, sputum, stools etc, from patients for diagnosis.
24. Microscopic studies of virus infected materials.
25. Handling of lab animals.
26. Examination of pathogenic fungi.
27. Examination of stools for helminthes and Amoeba.
28.Examination of blood smear to identify malarial parasite.
29. Isolation, observation and identification of normal microbial flora of human body.

Suggested Books/Manuals.

1. Manual of clinical Microbiology by Murray PR et al (1999) ASM.
2. A Practical Manual for Medical Microbiology – M aechie and Maecortney 4th ed. (1990).
3. Practical Medical Microbiology (14th ed.) collect JG et al Edinburgh: Churchill living (1996).
4. A Practical book for Microbiology, Techniques and Immunology by Ochie et al (1996) 4thed. ASM Press.

SMESTER IV

MBT 401: Agricultural Microbiology

OBJECTIVES:

- The student will able to learn the basic concepts of Agricultural microbiology and microbialpathogenesis: study of microbes, antimicrobial agents, epidemiology, and virulence factors associated with the pathogen.
- Types of specimans, collection processing of material for laboratory diagnosis, molecular diagnosis etc.

LEARNING OUTCOME:

At the end of this course students will be able to:

Unit- I: Understand the role of bacterial pathogen in causing infectious disease in humans, natural barriers to infection and inflammation

Unit -II: Understand the detailed study of bacterial and viral pathogens and mycotic infections protozoal and helminthic infections

Unit -III: Understand medical laborotary diagnostic procedures including molecular diagnosis.

Unit -IV: Chemotherapy and chemotherapeutic agents and drug resistance.

UNIT – I (15 hrs)

The soil: Definition, components, physical chemical characteristics and classification. Qualitative and quantitative nature of bacteria, actinomycetes, fungi, algae, protozoa and nematodes. Influence of environmental factors on soil microflora. Methods of isolation and enumeration of soil microflora.

Soil organic matter – nature, microbial degradation of carbohydrates, Proteins and other nitrogenous substances, fats, hydrocarbons and pesticides in soil. Humous significance and degradation. Soil enzymes – Nature, isolation, occurrence and ecological significance.

UNIT – II (15 hrs)

Plant – microbe interactions - Rhizosphere. Microflora on plant growth, Ecology of phyllosphere microflora, Biological importance of Phyllosphere microorganisms, Plant growth promoting rhizobacteria (PGPR). Diversity of nitrogen fixers; Mechanism of symbiotic and asymbiotic nitrogen fixation; nodule formation and gene regulation of nitrogen fixation.

Biofertilizers- Microorganisms used in biofertilizers, cultivation and mass production of biofertilizers and bioinoculants (Rhizobium, Frankia, Azotobacter, Azolla, Azospirillum, and Blue-green algae, Mycorrhizae), Phosphate solubilizing bacteria (PSB), Vermicomposting, methods and applications.

UNIT – III (15 hrs)

Plant pathology: Brief history and development of plant pathology, types of plant diseases and their significance. Symptoms of plant diseases. Basic procedures in the diagnosis of plant diseases. Host pathogen interactions- virulence factors of pathogens and defense mechanisms of plants against pathogens. Environmental effects on disease development and disease epidemiology. Control of plant diseases by various approaches.

Biocontrol of Pests and pathogens: Introduction, biocontrol of foliar and soil borne pathogens and microbial pesticides (bacteria, virus, fungi) production, formulations, economics, safety, advantages and disadvantages. Development of genetically modified crop plants for control of pests, integrated pest management.

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UNIT – IV (20 hrs)

Plant diseases:Symptomatology, etiology, epidemiology, disease cycle, control measures of fungal diseases: damping off of seedlings, Phytopthora leaf rot and stem rots, downy mildew of grapes, rust of groundnut, red rot of sugarcane, tikka disease of groundnut, blast disease of rice.

Bacterial diseases: Citrus canker, blight of rice and angular leaf spot of cotton. Viral and viroid: rice tungro, sugarcane mosaic/ streak, potato spindle tuber viroid diseases, tomato/ tobacco leaf curl, tobacco mosaic, citrus yellow mosaic, papaya ring spot, banana bunchy top. Phytoplasmal diseases: Little leaf of brinjal.

References:

1. Stolop H.- Microbial ecology : Principles, methods, & applications & biological nitrogen fixation.
2. N.S. Subba Rao - Soil microorganisms and plant growth
3. R.S. Singh - An introduction to principles of plant pathology
4. Lynch poole - Microbial ecology : A conceptual approach
5. N. S. Subba Rao - Advances in Agriculture Microbiology
6. G. Rangaswamy and D.J. Bhagya Raj - Agricultural Microbiology
7. B.N. Richard - An introduction to soil ecosystem
8. N.S. Subba Rao - Bio fertilizers
9. R.S. Methortra - Plant pathology
10. Vander Plank - Plant disease resistance
11. Vidyasekaran - Molecular plant pathology
12. Charudattan R (1982), . John Wiley & Sons. Biological Control of Weeds with Plant Pathogens
13. George N Agrios (2000), Plant Pathology. 4th Ed. Academic Press.
14. Norris J.R. and Pettipher G.L, (1987), Essays in agricultural and Food Microbiology. John Wiley and Sons. Singapore.
15. Singh. R.S (1997), Introduction to Principles of Plant Pathology. 3rd Ed. Oxford and IBH.
16. Subba Rao N.S (1995), Soil Microorganisms and Plant Growth. Oxford and IBH.Sylvia D M, Jeffrey J Fuhrmann, Peter G Hartel, David A Zuberer (1997), Principles and Applications of Soil Microbiology. 1st Edition, Prentice Hall

MBT-402: ENVIRONMENTAL MICROBIOLOGY

OBJECTIVES:

- This course aims to provide the student with an understanding of the current views of microbial association in various environments & also to evaluate the containing roles played by microbes in the environment, and to consider the non pathogenic roles of microbes in the human body.

LEARNING OUTCOME:

On the completion of the course, students should be able to:

UNIT-I: Understand the soil characteristics and Bio-geo chemical cycling.

UNIT-II: Know the microbial analysis of drinking water and aeromicrobiology.

UNIT-III: Acquire the knowledge on bioremediation and microbial leaching, and also know the bio-safety and environmental monitoring regulations.

UNIT-IV: Know on the different aspects of waste management and sewage treatment systems.

UNIT – I (18 hrs)

Natural Habitat for microorganisms: General description of soil, water, air. Influence of physical and chemical factors on distribution of microbial flora. Types of microbial interactions and community dynamics.

Bio–geochemical cycling of nutrients and its ecological significance. Role of microorganisms in cycling (Bioelements – carbon, nitrogen, sulphur, phosphorus and iron). Ecological significance of ammonification, nitrification and denitrification.

UNIT – II (12 hrs)

Aerobiology- Brief account on Phylloplane microflora (Morphology, Physiology, nutrients reduction and Relative humidity & temperature), Microbes and microbial propagules in air. Methods for air microbial flora analysis, Brief account of air–borne transmission of microbes (viruses, bacteria and fungi), their disease fore casting and preventive measures.

Aquatic Microbiology–**T**ypes of Water ecosystems– fresh water (ponds, lakes, streams). Marine habitats (esturies, mangroves, deep sea, hydrothermal vents , saltpans, coral reefs). Zonations of water ecosystem, eutrophication, food chain. Potability of water, Sampling and microbial assessment of water quality and water purification.

UNIT – III (12 hrs)

Bioremediation- Bioremediation of contaminated soil and water using microbial consortia, reversal of global warming, Degradation of xenobiotics (oil slicks, detergents, plastics,) recalcitrance of pesticides (eg. DDT), volatilization of toxic metals by microorganisms Fate of genetic engineered microorganisms in the environment.

Biofouling and corrosion- Biofouling organisms, problems due to biofouling, antifouling paints and its environmental pollution, biotechnological approach to biofouling control, aerobic and anaerobic corrosion.

UNIT – IV (20 hrs)

Extremophiles – Microbes in extreme environments, adoption mechanisms, applications of extremophiles. Microbial leaching of mineral ores – organisms involved, factors affecting leaching, leaching process of uranium, copper and gold by microorganisms.

Waste treatment - Solid and liquid wastes and their characterization. Liquid waste treatment (microbial diversity and treatments), solid waste treatment- saccharification, gasification, composting, utilization of solid wastes for food (SCP, mushroom, composting, yeast), fuel (ethanol, methanol) and fertilizers. Treatment of industrial fermentation unit effluents.

References:

1) Alexander, M. (1977). Introduction to Soil Microbiology. John Wiley and Sons Inc New York.
2) Alexander, M. (1971). Microbial Exology. John Wiley and Sons Inc. New York.
3) Baker K. H. and Herson, D.S. (1994), Bioremediation. Mc Graw Hill Inc., New York
4) Burns R.G. and Slater J.H. (1982), experimental Microbial Ecology, Blackwell Scientific Publications. Oxford, London.
5) Burges A. and Raw F, (1967), soil Biology. Academic Press, London.
6) Metagenomics: Current Advances and Emerging concepts. Edited by: Diana Marco Published**:** 2017
7) Gabriel bitton, (1999), Waste Water Microbiology. 2nd Edition. Wiley – Liss.Harriet A. Burge, (1995), Bioaerosols. Lewis Publishers Inc.
8) Ian L. pepper, Charles P Gerba, Jeffrey W (1995), Environmental Microbiology: Laboratory Manual. Academic Press.
9) Marshall K. C (1985), Advances in Microbial Ecology. Vol 8, Plenum press.
10) Robert L. Tate, (2000), Soil Microbiology 2nd Edition. John Wiley and Sons.
11) Atlas and Batra - Microbial Ecology – Fundamentals and applications 1998
12) D. Colwd 1999 Microbial diversity Academic press.
13) C.J. Hurst, editor inchief 2002, ASM press 2nd edition Manual of environmental Microbiology
14) Paul A. Rochell 2004, Environmental Molecular Microbiology – Protocols & Applications.
15) Eugenia J. Alguin, Gloriasanchez, Elizabethhernandez, environmental Biotechnology cleaner, Bioprocess 2005.
16) Mark coyne, 2004, Soil Microbiology: An exploratory approach.
17) Brewing Microbiology: Current Research, Omics and Microbial Ecology Edited by: Nicholas A. Bokulich and Charles W. Bamforth Published: 2017.

MBT 403: FOOD MICROBIOLOGY

Objectives:

- To provide practical knowledge and skills in production as well as evaluate the microbial quality of the food product.
- To give students confidence in modern technical capabilities to analyse food for specific microorganisms
- To encourage development of skills in co-operative learning in small groups to design methods for microbial food analysis as a team and communicate the decisions of the design to peers.
- To extend students knowledge on traditional fermented products to industrial fermentation products in the applied area of food microbiology.

Learning Outcome: By the end of this course students will be able to:

- Identify standard methods for the isolation and identification of microorganisms in food sample.
- Be impressed on the application of rapid microbial techniques for the microbial analysis of food.
- Be able to comprehend observations, evaluate the data obtained and report accurately on the findings.
- Be able to understand the microbial principles relating to the production of fermented foods

UNIT – I (15 hrs)

Introduction- Definition, concepts and scope of food microbiology. Importance of microbes in food, food as substrate for microbes. microbial growth, survival and death in food. Food safety.

Detection of microbes in food - Direct microscopic count (DMC), standard plate count, MPN method, reductase test, membrane filters and molecular methods.

UNIT – II (15 hrs)

Food fermentation - Bread, cheese, vinegar, fermented vegetables, dairy, meat, poultry and fish products. Fermented foods of therapeutic value (probiotics and prebiotics), spoilage and defects of fermented dairy products – oriental fermented foods, their quality standards and control.

Microbes as Food - Single cell proteins (SCPs), edible mushrooms and their cultivation, bioconversions, production of alcohol, fermented beverage, beer and wine. Genetically modified foods.

UNIT – III (15 hrs)

Food borne disease and control - Food infection and intoxication, bacterial and non-bacterial food borne pathogens, Risk factors associated with food borne illness detection of food borne pathogens and their toxins by conventional, rapid automated, molecular and immunological techniques.

Food control agencies and its regulations, Laboratory Accreditation,Employee's health standards, waste treatment, disposal and quality control. Quality Systems: BS 5750 and ISO 9000 Series.

UNIT – IV (20 hrs)

Contamination and spoilage - Microbiological (yeasts, bacteria) contamination of food. Factors influencing food spoilage (intrinsic and extrinsic). Microbial spoilage of cereals, sugar products, vegetables, fruits, meat and meat products, milk and milk products, fish and sea foods, poultry. Spoilage of canned foods. Detection of spoilage and characterization.

Food preservation- Preservation methods, Factors influencing microbial growth in food (extrinsic and intrinsic factors). Food additives, canning, processing for heat treatment – D, Z, and F values and working out treatment parameters. Hazard analysis and critical control points (HACCP). Good manufacturing process (GMP). Microbiological standards - Codex Alimentarius and Food legislation**.**

References:

1. M.P Dolye, Diez-Gonzalez F and HillC.(2019) Food Microbiology: Fundamentals and frontiers. (5^{th} edition). ASM Press.USA.

2. Adams, M.R. and Moss M.O. (1995) Food Microbiology. Royal Society of Chemistry Publication, Cambridge.

3. Frazier WC and Westhoff DC (2017). Food Microbiology. (5^{th} edition). Tata Mc Graw Hill Publishing Company Ltd., New Delhi.

4. Stanbury, PF., Whitekar, A and Hall, S.J. (1995) Principles of Fermentation Technology. 2^{nd} Edition. Pergamon Press.

5. S.N. Tripathy (2004) Food Biotechnology Dominant Publishers and Distributors, Delhi.

6. S.P. Narang (2004) Food Microbiology methods of Enumeration. APH Publishing Corporation, Delhi.

7. A.H. Patel Industrial Microbiology (2004) Rajiv Beri for micmillan India Ltd. New Delhi.

8. Alexander N: Microbial Biotechnology – Fundamentals of Applied Microbiology (1995).

MBT 404: INDUSTRIAL MICROBIOLOGY

Objectives:

- An in-depth study on industrially important microbial products
- To make the students knowledgeable on production process of various industrial products.
- To make the students to know various techniques used in industries.

Learning outcomes:

By the end of this course the students will be able to know historical aspects of industrial microbiology and fermentation techniques.

The students will be able to understand production process for Industrial products using microbes.
The students will be able to understand the industrial microbiology

UNIT – I (10 hrs)

Introduction- History, industrially important microorganisms and their characteristics, Strain improvement through conventional and modern genetic engineering approaches.

Screening of microbes for products – Primary and secondary screening, detection and assay of products by physico- chemical and biological assays. Strategies for selection and preservation of Industrial strains. Culture collection centers.

UNIT – II (18 hrs)

Yeast and Yeast products –Yeast, production of active dry baker's yeast, instant yeast, quality of bakers yeast, production of brewer's yeast, food and fodders yeasts.

Immobilization of cells and enzymes - Techniques and supports – Adsorption, covalent linkage, entrapment and cross-linkage and their advantages and disadvantages, applications of microbial fermentations with immobilized cells / enzymes.

UNIT – III (20 hrs)

Industrial enzymes production - amylases, cellulases, pectinases, xylanases, proteases and lipases. Scope, utility and methodology of biotransformation, biotransformation of antibiotics, steroids and nonsteroids.

Biofuels and Biomolecules Production - ethanol, methane, hydrogen from starch and lignocellulose. Production methods and applications of organic acids- citric acid, lactic acid, acetic acid. Industrial production of Vitamin B_{12}.

UNIT – IV (20 hrs)

Biopolymers- Single cell oils (SCOs). PHAs and PHBs, extra cellular polymers (xanthenes, rhamnosan, dextrans, pullalan), Biosurfactants-classification, production and applications.

Antibiotic and Vaccine production – History of antibiotics, producing organisms, industrial production of penicillin, streptomycin, avermectins. Production of anticarcinogenic agents from microbes. Production of bacterial and viral vaccines.

References:

1) P. F.Stanbury, A. Whitaker and S.J. Hall .(2017). Principles of Fermentation Technology. (3rdedition). published by Elsevier, Reed Elsevier India Pvt. Ltd.

2) Murray Moo-Young (2019). Comprehensive Biotechnology, (3rdEdition). Pergamon (AP)

3) Cruger&Cruger (2004) Ed. Biotechnology: A text book of Industrial Microbiology. Panima publishing corporation New Delhi/Bangalore.

4) Nduka Okfor (2007) Modern Industrial Microbiology and Biotechnology, Published by Science Publishers, Enfield NH, USA.

5) Peppler H.J Pertman D (2014). Microbial Technology, Vol-1and 2.(2nd edition). Academic Press New York

6) L. E. Casida Jr . Industrial Microbiology. Wiley International Ltd

7) Ratiedge and B. Kristiansen (2001). 2nd ed. Basic Biotechnology, Cambridge University Press.

8) A.L. Demain and Davis Second edition. (1999) Manual of Industrial Microbiology and biotechnology Editor in chief, ASM press.

9) Prescot & Dunn (2002) Industrial Microbiology published by Agrobios (India)

10) E.M.T EL-MANSI and C.F.A BRYCE, (2004Reprinted), Fermentation Microbiology and Biotechnology Taylor and Francis Ltd, New Fatter Lane London Ec4P 4EE.

MBP: 401 – Agricultural Microbiology and Environmental Microbiology

1. Determination of physico – chemical characteristics of the soil environment – Soil Texture and P^H and conductivity.
2. Estimation of organic matter content in soils.
3. Study of microbial activity in soil by respirometry (CO2 evolution)
4. Decomposition of cellulose in soil by microflora
5. Isolation and study of Rhizosphere microflora, determination of R:S ratio.
6. Isolation of Rhizobium from root nodule.
7. Population estimation of Azotobacter form rhizosphere soil
8. Population estimation of Azospillum sp. in rhizosphere soil
9. Population estimation of nitrifiers form rhizosphere soil
10. Isolation of phosphate solubilising bacteria from rhizosphere soil
11. Observation of VA mycorrhizae in crop plants
12. Estimation and enumeration of bacteria, actinomycetes and fungi in soil by Dilution – Planting method
13. Visit to local field crops for observation of diseases caused by bacteria, fungi and viruses.
14. Humus estimation in the soil
15. Estimation of moisture content of soil
16. Observation of bacteroids of rhizobia by section cutting
17. Observation of Phyllosphere microbial flora
18. Contact slide technique
19. Winogradsky's column
20. Ammonification in soil
21. Nitrification in soil
22. Denitrification in soil
23. Isolation of antibiotic producing microorganisms from soil
24. Most probable Number Test for coli forms
25. Quantitative analysis of water for microbial members (SPC)
26. Chemical oxygen demand (COD)
27. Effect of heavy metals on the growth of bacteria.
28. Microbial inter relationships (Synergism), Antagonism

Suggested Books / Manuals

1. APHA 5th edition (2001) Prince Hall.
2. Experiments in Microbiology, Plant Pathology and Biotechnology. IV edition K.R. Aneja
3. Principles and Methods of Plant Molecular Biology, Biochemistry and genetics (2005) Agrobios. India.
4. Practical Microbiology by, RC. Dubey and D.K. Maheswari (2008) S. Chand Publ.
5. Manual Industrial Microbiology and Biotechnology Second edition. (1999) A.L. Demain, Editor in chief, ASM press.

MBP: 402 – Food Microbiology and Industrial Microbiology

1. Assay of microbial product (A) in the given culture broth
   Draw the conclusions base on your observations.
   (a). Streptomycin
   (b). Lactic acid
   (c). Ethyl alcohol
   (d). Penicillin
   (e). Indole acetic acid

2. Assay of microbial enzyme / product in the given culture broth and
   Write principle, procedure and conclusions of the experimental results
   (a). DMC of milk
   (b). β - Amylase
   (c). Protease
   (d). Lipase
   (e). Asparginase
   (f). Phosphatase
   (g). Siderophore
   (h). Characterization of wine
3. Write the principle, procedure and critical notes on given experiment
   (a). Mycotoxin (Aflatoxin)
   (b). Litmus milk
   (d). Bioassay of vit. B12
   (d). Antagonism
   (e). Preparation of Immobilized cells
   (f). Mycorrhizal root infection index

4. Isolation of Yeasts from grapes
5. Preparation of wine from grape juice and estimation of alcohol
6. Estimation of ethanol by dichromate method
7. Production of citric acid by fungus and its estimation
8. Determination of lactic acid concentration In commercial curd samples
9. Antibiotic Sensitivity test
10. Microbiological examination of spoiled foods
11. Enumeration of surface Microflora of vegetables
12. Microbiological examination of milk
13. Detection of number of bacteria in milk by breeds count
14. Determination of milk quality by Methylene blue reduction test (MBRT)
15. Role of yeasts in bread making
16. Extraction and analysis of aflotoxins
17. Immobilization of microbial cells/enzymes.
18. Culturing of mushrooms
19. Visits to Food and Industrial chemical production units

Suggested Books / Manuals

1) Manual of Industrial Microbiology and Biotechnology 2nd edition (1999) A.L. Demain
2) and Davis Editor in chief, ASM press.
3) Experiments in Microbiology, Plant Pathology and Biotechnology by K.R. Aneja 4th
4) ed. (2005).
5) Practical Microbiology by R.C. Dubey and D.K. Maheswari (2008)
6) Microbiology – A Laboratory Manual by S.M. Reddy and S.Ram Reddy, 3rd Ed.
7) (2005).
8) Laboratory experiments in Microbiology by Gopal Reddy et al (2005) 1st ed. Himalaya Publications.

Yogi Vemana University: Kadapa
Internal Examinations
Microbiology

Time: 1 Hour **Max. Marks: 25**

PART-A

Answer any FIVE of the following questions **5 x 2 = 10 Marka**

Each question carries Three (3) Marks

I.

1. Unit-1/3
2. Unit-1/3
3. Unit-1/3
4. Unit-1/3
5. Unit-2/4
6. Unit-2/4
7. Unit-2/4
8. Unit-2/4

II.

PART-B

Answer any ONE of the following questions **1 x 15 = 15 M**

Each question carries Fifteen (15) Marks

9. Unit-1/3

OR

10. Unit-2/4

Yogi Vemana University: Kadapa
M.Sc Degree Examinations-November/April
Model question paper
Microbiology
I/II/III/IV Semesters

Time: 3 Hours **Max. Marks: 75**

PART-A

Answer any FIVE of the following questions **5 x 3 = 15 Marks**

Each question carries Three (3) Marks

1.
2.
3.
4.
5.
6.
7.

8.

PART-B

Answer all questions **4 x 15 = 60 Marks**

Each question carries Fifteen (15) Marks

9. Essay Question

OR

10. Essay Question

11.Essay Question

OR

12.Essay Question

13.Essay Question

OR

14.Essay Question

15.Essay Question

OR

16.Essay Question

Yogi Vemana University: Kadapa
M.ScMicrobiology
PRACTICAL EXAMINATIONS

Time:4 Hour **Max. Marks: 100**

1. Major question 25 Marks
2. Minor question
   A) 10 Marks
   B) 10 Marks

3. Spotters (A,B,C,D,E,F & G) 35 Marks
4. Viva-Voice 10 Marks
5. Record 10 Marks

M.Sc Microbiology CBCS Pattern (W.E.F 2018-19)
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Department of Materials Science and Nanotechnology, Kadapa

Course		Outcomes
Code	**Title of the Paper**	
MSNT 101	Classical and Statistical Mechanics	**Objectives:** • To provide understanding of the fundamental concepts in ✓ Newtoniam Mechanics-Conservation Laws ✓ Dynamics of system of particles ✓ Lagrangian and Hamiltonian formulation of mechanics ✓ To understand the basics of statistical methods **Outcomes:** After successfully completion of the course, student will be able to • Define and understand the basic concepts in classical mechanics • Solve problems using conservation laws, Lagrangian and Hamiltonian formulation. • Analyze the appropriateness of statistical methods.
MSNT 102	Concepts in Materials Science	**Objectives:** • Give basic knowledge of science behind different materials • Introduce the concept of structure property relations. • Lay the groundwork for studies in fields such as solid-state physics and mechanical behavior of materials, **Outcomes:** • Analyze the Structure of materials at different levels, basic concepts of crystalline materials like unit cell, FCC, BCC, HCP, APF (Atomic Packing Factor), Co-ordination Number etc. • Describe different modes of lattice vibrations • Explain the two methods for determining an electron's energy levels in a crystal. • Explain how the energy structure of a crystal has energy bands and gaps. • What makes some materials good conductors and others good insulators? • Define the terms insulator and semiconductor.
MSNT 103	Fundamentals of Chemistry	**Objectives:** To provide the understanding of the basic concepts in ❖ Chemical bonding ❖ Theories of chemical bonding ❖ Reactivity of metal complexes ❖ Chemistry of halogen compounds **Outcomes:** After successful completion of this course student will be able to

		• Differentiate types of chemical bonds and its theory • How different bonding theories explain chemical bonding also elaborate its limitations and evolution. • Classify different reactivity of metal complexes and its mechanism. • Some of the important chemical reactions using halogen compounds and its energy profile diagram.
MSNT 104	Polymeric Materials	**Objectives:** To provide the understanding of the concepts in ❖ Polymers, Classification and Polymerization techniques ❖ Polymer molecular weight and its determination ❖ Physical properties of polymer ❖ Polymer solutions **Outcomes:** After successful completion of this course student will be able to • Define the monomer, polymer and polymerization process and the significance in each of: initiation, propagation, termination, branching; copolymerisation and blends • Explain methods for determining molecular weight of polymers and describe the significance of melting point and glass transition temperature and rheology of polymers • Describe the significance of polymer solubility
MSNT 201	Quantum Mechanics	**Objectives:** • To provide understanding of the basic concepts in the quantum mechanics • To provide basic knowledge on various approximation methods on perturbation for solving modern physics problems • To understand the formulation of relativistic quantum mechanics **Outcomes:** After successfully completion of the course, student will be able to • Define and derive various operators in quantum mechanics • Grasp the concepts in angular momentum, spin and their quantization and addition rules • Solve problems on oscillators, planetary motion and atomic models using various approximation methods
MSNT 202	Properties of Bulk and Nanomaterials - I	**Objectives:** The goal of this course is to educate students with a fundamental grasp of the electrical, magnetic, and optical properties of materials, as well as to use those fundamentals in the selection and development

		of materials for various applications. **Outcomes:** • Understand the conductivity, semiconductivity, superconductivity, dielectricity, ferroelectricity, and piezoelectricity of materials. • Distinguish between diamagnetic, paramagnetic, ferromagnetic, ferromagnetic, and antiferromagnetic material behaviour. • Semiconductor synthesis and processing for engineering applications • Investigate the effect of material qualities on composition, structure, and temperature. • Explain how light interacts with materials and what happens at the interface. • Understand the principles of operation of solid-state devices, for example.
MSNT 203	Polymeric Processing, Composites and Heat Resistance Polymers	**Objectives:** To provide the understanding of the concepts in ❖ Plastic additives and degradation of polymers ❖ Polymer processing techniques ❖ Polymer composites and its importance ❖ Engineering and highly stable polymers **Outcomes:** After successful completion of this course student will be able to • Understand the significance of additives in polymer and also various types of polymer degradation • Explain the various polymer processing techniques and their • Describe the significance of composites and its properties and fabrication methods. • Understand the synthesis and structure properties relationship of various engineering/heat resistance polymers
MSNT 204	Introduction to Nanoscience and Synthesis of Nanomaterials	**Objectives:** To provide the understanding of the basic concepts in ❖ Nanoscience and Nanotechnology ❖ Methods for preparation of nanomaterials ❖ Selected applications of nanomaterials **Outcomes:** After successful completion of this course student will be able to • Define and understand the basic concepts of nanoscience and nanotechnology • How particle size influence the physical, chemical and surface properties of the material • To identify the suitable method and prepare different nanomaterial based on the required properties and quantity. • How to utilize the nanomaterials for practical applications.

Non-core-1	***Concepts of Nanomaterials***	**Objectives:** ❖ Methods for preparing nanomaterials to have an understanding of the basic ideas in nanoscience and nanotechnology. **Outcomes:** After successful completion of this course student will be able to • To create quantum nanostructures of desired size, shapes, and surface features, select a suitable synthesis technique.
MSNT 301	Characterization Techniques	**Objectives:** To familiarise students with the fundamentals of optical and electron microscopy, X-ray diffraction, and other spectroscopy techniques. **Outcomes:** • Use proper characterization techniques for microstructure investigation at various magnification levels to better understand the microstructure of various materials. • measure the specimen's crystal structure and crystallite size and tension • Measure vibrational / electronic transitions using appropriate spectroscopic techniques to determine parameters such as energy band gap, elemental concentration, and so on.
MSNT 302	Semiconductors and Devices	**Objectives:** • To provide basic understanding on the basic concepts in semiconductors • To explain different scattering mechanism leading to resistivity in materials • To understand the concept of p-n junction diode and various parameters affecting the I-V characteristics • To understand the two junction devices and its applications. **Outcomes:** After successfully completion of the course, student will be able to • Depict the energy variation in Fermi level with respect to temperature • Explain as to why conductivity increases or decreases in a material • Distinguish between real and ideal diode with a practical aspect • Elucidate the Transistor function for Amplification applications

MSNT 303	Alloys and Paints	**Objectives:** To provide the understanding of the basic concepts in ❖ Alloys and Shape memory alloys ❖ Phase rules and phase diagrams ❖ Paints and chemistry of paints ❖ Properties of paints and evaluation of paint quality **Outcomes:** After successful completion of this course student will be able to • Understand the alloys and shape memory alloys and their significance and applications • Explain the phase ruls and unary and binary phase diagrams. • Classify the paints and understand the methods of film formation. • Know the significance of various tests used in evaluation of paints characteristics.
MSNT 304	Nanocatalysis and its Applications	**Objectives:** To provide the understanding of the basic concepts in ❖ Catalysis, essential role catalysis in chemical industries and cleaner environment. ❖ Synthesis and applications of Microporous and mesoporous materials ❖ Photocatalysis and preparation/catalytic applications of gold nanoparticles ❖ Applications of catalysis in chemical industries **Outcomes:** After successful completion of this course student will be able to • Explain the basic concepts of catalysis and catalytic reactions, surface area determination. • How synthesize zeolites, zeotypes, mesoprous materials and its surface characteristics • Elaborate the photocatalytic processes and preparation of gold nanoparticles through different routes. • What are the major functions of crude oil refinery and importance of various process for value added chemicals. ➢ Evaluate evaporation, crystallization, and drying methods.
Non-core-2	***Characterization Techniques and Applications of Nanomaterials***	**Objectives:** Students will master the fundamentals of optical and electron microscopy, as well as X-ray diffraction and other spectroscopic techniques for application in understanding nanomaterials. **Outcomes:** • Use proper characterization techniques for microstructure investigation at various magnification levels to better understand the microstructure of various materials. • to explore the microstructure of materials at high resolution using appropriate electron microscopy techniques

		• measure the specimen's crystal structure and crystallite size and tension • Measure vibrational / electronic transitions using appropriate spectroscopic techniques to determine parameters such as energy band gap, elemental concentration, and so on. • determine the specimen's thermal stability and thermodynamic changes using thermal analysis techniques
MSNT 401	Advanced Characterization Techniques	**Objectives:** Students will master the fundamentals of thermal and electron microscopy, other spectroscopic techniques **Outcomes:** • to explore the microstructure of materials at high resolution using appropriate electron microscopy techniques. • determine the specimen's thermal stability and thermodynamic changes using thermal analysis techniques
MSNT 402	Properties of Bulk and Nanomaterials – II	**Objectives:** The goal of this course is to educate students with a fundamental grasp of the electrical, magnetic, and optical properties of materials, as well as to use those fundamentals in the selection and development of materials for various applications. **Outcomes:** • Understand the conductivity, semiconductivity, superconductivity, dielectricity, ferroelectricity, and piezoelectricity of materials. • Distinguish between diamagnetic, paramagnetic, ferromagnetic, ferromagnetic, and antiferromagnetic material behaviour. • Semiconductor synthesis and processing for engineering applications • Investigate the effect of material qualities on composition, structure, and temperature. • Explain how light interacts with materials and what happens at the interface. • Understand the principles of operation of solid-state devices, for example.
MSNT 403	Applications of Nanomaterials and Nanotechnology	**Objectives:** • To provide basic knowledge on MEMS, Photonics and spintronics • Basic concepts of sensors and role of nanomaterials in sensor application. • Nanomaterials for environmental purification and monitoring. • Fundamental knowledge on nanomaterials for drug delivery applications.

		Outcomes: After successfully completion of the course, student will be able to • To apply the principle of MEMs to pressure sensor • To understand the principle of memory devices using spintronics • Explain working principle of sensors and its sensitivity for specific chemical or application. • How to use nanomaterial for water purification and sensors based environmental monitoring. • Clarify drug loaded with nanoparticles to reach targeted sites.
MSNT 404	Energy Conversion Technologies	**Objectives:** To provide the understanding of the basic concepts in ❖ Renewable energy and role of nanomaterials in energy sector. ❖ Energy storage devices ❖ Energy conversion using fuel cells ❖ Solar energy conversion technologies **Outcomes:** After successful completion of this course student will be able to • Demonstrate importance of energy generation or conversion suing renewable process. • Explain principles, components and importance of different types of batteries. • Illustrate the importance of fuel cells and different types of fuel cells. • Distinguish the importance of different types of solar cells, principles and its functions.

Department of Environmental Science (P.G.)

Course	Outcomes
Semester I	
Paper : ENV 101	To acquire the knowledge of principles of ecology and to understand the nature of environmental influences or individual organism , their populations, communities, on ecosystems and at the level of biosphere.
Paper : ENV 102	To gain knowledge on the reaction of pollutants in the environment, analysis of physical chemical characteristics of water and soil.
Paper : ENV 103	To obtain knowledge on environmental issues will helpful to protect the ecosystems in turn human community and other organisms.
Paper : ENV 104	Basic concepts of Energy, work, power will be introduced, Classification of Energy resources, availability and utilization pattern of both Renewable and non-renewable resources in India will be taught. Special focus will be given to the importance of Non Conventional energy resources with a focus to improve their efficiency and policy changes to increase their share in total energy consumption
Semester II	
Paper : ENV 201	To maintain ecological diversity, to provide resources for further generations and to explain the sustainable consumption of the important natural resource like food, water, land, minerals, forest etc. To know how to reduce damages and deaths, avoid the potential losses from hazards assume prompt and appropriate assistance to victims of disaster and achieve rapid and effective recovery
Paper : ENV 202	To learn the sources, effects and control of soil, water and air pollution, Solid waste pollution and management.
Paper : ENV 203	This course is helpful to understand the microorganism and their effects on environment. Studies on toxicology will certainly useful to show the remedies for certain toxic events. Overall, this topic will helpful to show industrial opportunities as well advanced research.
Paper : ENV 204	Basic idea of occupational health, Industrial hygiene and importance of safety measures with specific reference to the occupational environment will be introduced. An insight into occupational hazards and diseases that are commonly seen in our industries like mining, engineering, construction, textile etc will be given. The role of OSH department, importance of First Aid will be taught
Semester III	
Paper : ENV 301	To achieve the knowledge of biodiversity at different levels, maintaining stable eco system and to know the strategies of conservation of biodiversity
Paper : ENV 302	Basic concepts and physical foundation of Remote sensing will be introduced. Various satellites of India and global and their utilities and limitations will be taught. Introduction and components of GIS will be taught. Application of Remote sensing and GIS in various disciplines in order to take a decision will be taught in this paper.

Paper : ENV 303	Environmental biotechnology topic is a solution for many environmental issues through current advanced scientific knowledge. Overall gaining knowledge in this course will helpful to show research and industrial opportunities.
Paper : ENV 304	To understand the sewage treatment and effluent treatment, sludge processing and disposal as well as air pollution control measures
Semester IV	
Paper : ENV 401	The importance of National Environmental policy and Policy changes taken by the government to achieve sustainable development will be taught. Basics of Environmental Economics will be provided to make the students to value the Biodiversity and Ecosystem Services.
Paper : ENV 402	The students have taught to understand the **b**asic concepts of EIA, Environmental Audit and Environmental law.
Paper : ENV 403	Knowledge on instrumentation and techniques is compulsory to do experiments. Also this topic covers how to deal the instruments which will be basic thing for scientific community.
Paper : ENV 404	The final semester students have to undertake individual minor Research project. The orientation of class work will be based on the above objective. Fundamentals of Biostatistics like types and importance of sampling, measures of central tendency, measures of dispersion will be introduced. The importance of Hypothesis, significance level and data dependent statistical tests will be taught. Students are provided inputs to analyse the data and to prepare a research project.

Semester -I		
Code	**Paper Title**	**Outcomes**
101	Micro Economics	I. At the end of the course the students will understand the concept of Demand and supply and will be able to know the reasons for changes. II. Students understand different types of market and levels of competition prevailing in the market. III. Understand how factor market works, illustrate basic tools in welfare economics, and illustrate the concept of social welfare functions and compensation principles
102	Macro Economics	I. Get an overview of the basics of macro variables such as Circular flow of Income, National Income concepts and its measures and to understand different macroeconomics issues in detail and assess the impact of macroeconomic policies. II. The course aims to provide an understanding of Keynesian Theories, also to explore later developments in macroeconomic theory, like Real Business Cycle Hypothesis vs. New Keynesian Economics.
103	The Evolution of Economic Doctrines	I. Develop a chronological understanding of the development of Economic Thought. II. Interrelate the developments in different schools of thought with contemporary issues.
104	Public Finance	I. To understand the economics of government expenditure and taxation. II. To critically analyze fiscal policies and its implication in Indian Economy.
105	Mathematical Methods in Economics	I. Students will familiar with a wide range of the mathematical concept and techniques that are standard in economic analysis. II. Students have command of the mathematical techniques required for modelling and analysing the economic problems
Semester -II		
201	International Economics	I. Students learn about the classical, modern theories of trade, and Trade Policy and theory of Trade Interventions. II. The second half elucidate, the Balance of Payments and Foreign Exchange, these theories will be helpful to understanding the trade barriers like tariffs, quotas, Nontariff Barriers. III. The final module helps to understand the Global Institutions an overview
202	Labour Economics	I. Demonstrate understanding of the core concepts and tools

		of Labour Economics and Polices. II. It provides a details analysis on the latest development of labour market in developing countries with reference to India III. The paper laid a special emphasis on international emigration.
203	Development Economics	I. At the end of the course the students will be able to differentiate between economic growth and economic development. II. Evaluate theories of economic growth and development. III. Examine the role of Labour Capital and technology in the development process
204	Indian Economy	I. Develop ideas of the basic characteristics of Indian economy, its potential on natural resources. II. Understand the importance, causes and impact of population growth and its distribution, translate and relate them with economic development. III. Grasp the importance of planning undertaken by the government of India IV. Understand the poverty, employment and unemployment issues and the remedial measures to overcome of these problems
205	Statistical Methods in Economics	This course introduces the basic knowledge in statistics measures of Central Tendency, Dispersion, Skewness and Kurtosis, correlation and regression analysis to familiarize the application of various statistical tools in Economics
NC-1	*Fundamentals of Economics*	I. Demonstrate an understanding of the concept, definitions and various kinds of economic systems and their classifications in the field of economics. II. Define and explain the process of calculating national income, identify its components. III. Deliver effectively various concepts of budget
Semester -III		
301	Rural Economics	I. Familiarizing the concepts and importance of rural economics. II. Acquainting the structure of rural economies – farming, industrialization and problems in rural economies. III. Awareness on rural employment generation schemes and Government poverty alleviation programmes.

302	Indian Financial System	I. II.	Course exposes students to the theory and functioning of the monetary and financial sectors of the economy. It highlights the organization, structure and role of financial markets and institutions.
303	Industrial Economics	I. II.	Understand the role of industrialization and industrial development under different plan periods in India. Understand the different industrial policies over a period of time in India and how these policies influence industrial development in the country.
304	Economics of Health and Education	I. II.	The first half of the module covers study of Health Economics. It includes Introductory Health Economics and Nutrition. This help to impart knowledge of economic dimensions of health care, demand and supply, financing, constraints and inequalities in health, class, caste, gender Perspectives and regional biases. The second part of the paper includes Economics of Education. It helpful to understand private and social rates of returns to education, human capital , education and economic development, contribution of education to the economy.
305	Advanced Statistical Techniques	I. II.	This course introduces the types of sampling methods and testing of hypotheses. The course prepares the students to various statistical techniques which are helped in collection of data and its analysis and interpretation
NC-2	*Contemporary Indian Economic Issues*	I. II.	After completing this course students are expected to have a comprehensive understanding of Indian Economy regarding National Income, government policies and Indian tax system, Finance Commission, etc. At the end of the course a student should be able to understand the role of economic policies in shaping and improving economic performance in agriculture, manufacturing and services.
Semester -IV			
401	Agricultural Economics	I. II. III.	Understand agricultural policies and its effect on sustainable Agricultural development. to acquire knowledge in addressing the issues of agricultural marketing. Generating awareness about the relationship between technical change and peasant agriculture as well as the WTO impact on Indian agriculture
402	Environmental Economics	I.	Students become familiar with approaches on linkage between Natural Environment and Human Economy.

		II. Learn about our environment and elicit collective response for its protection. III. Understanding about Climate change and Sustainable development and international agreements
403	Economics of Infrastructure	I. Students will understand basic Economics theories and models required for infrastructure sector understanding. II. At the end of the course, the participants would be able to reflect on the challenges in the development of sustainable infrastructure
404	Economics of Andhra Pradesh	I. After completion of the course, students understand the theoretical, empirical and policy issues relating to the society, polity and Economy of Andhra Pradesh. II. To gain knowledge on the reforms, demography, five years plans, State finance, primary, secondary and territory sectors on contemporary issues of Andhra Pradesh economy.
405	Money and Banking	I. Demonstrate the meaning and function of money, high powered money, monetary and paper system, illustrate various version of quantity theory of money. I. Identify types of banks, explain the meaning and function of commercial banks, illustrate how banks create credit, and suggest the instruments to control credit.

DEPARTMENT OF CHEMISTRY
(Programme: M. Sc Organic Chemistry, Duration: 2 years)

Course	Outcomes
SEMESTER - I	
CHE-15031 (Inorganic Chemistry)	After completion of this course students should be able to: ➢ Understand the nature of metal – ligand bonding in coordination complexes through crystal field theory, molecular orbital theory and ligand field theory. ➢ Further, students will familiarize the nature of reaction mechanism of transition metal complexes. ➢ Students will also understand the concepts of bonding and structure of metal carbonyls and nitrosyls.
CHE-15032 (Organic Chemistry)	After successfully completing this course, students will be able to understand: ➢ Concept of aromaticity and calculations involved in predicting the aromaticity of organic compounds. ➢ Understand various methods of Carbanion generation and their applications in Organic synthesis. ➢ Correlate the reaction mechanisms with practical procedures. ➢ Differentiate between various organic reactive intermediates. ➢ Develop interest in writing and finding mechanisms of new reactions. ➢ Understand various terminologies of stereochemistry. ➢ Will be able to draw the stereochemical structures of different molecules. ➢ Understand the stereoisomerism in molecules without chiral center.
CHE-15033 (Physical Chemistry)	Students will be able to: ➢ Understand the significance of Schrodinger wave equation, electronic and Hamiltonian operatoers ➢ Understand the quantum chemical description of angular momentum. ➢ Understand the rate law of the elementary and chair reaction. ➢ Understand the theories for the determination of the rate of the reactions. ➢ Describe different methods to determine the rate law and derive the rate law for various chemical reactions. ➢ Understand the thermodynamics of spontaneity of a

	process and the conditions required for a spontaneous process. ➢ Understand the key concepts of statistical thermodynamics. ➢ Explain Debye-Huckel theory and determination of activity and activity coefficient. ➢ Understand the theory of strong electrolytes. ➢ Understand the concepts of reversible electrochemical cells.
CHE-15034 (General Chemistry)	By learning this course, students are able to: ➢ Derive the symmetry of chemical substances that is needed in designing the chemical substances and estimating the physical properties of matter including spectroscopic characteristics. ➢ Students are also estimates the errors in chemical analysis, understands the limits of errors, perform the corrections and realizes the significance of chemical analysis. ➢ Further students gain knowledge in choosing proper spectroscopic, photometric or spectrometric technique based on the nature of interactions, physical and chemical properties of the chemical substances while their analysis.
CHE-15031P (Inorganic Chemistry Practicals)	➢ Students will get hands-on-experience in preparing the coordination complexes. ➢ Further, students will understand how to estimate the amount of metals present in the complexes using complexometric titrations.
CHE-15032P (Organic Chemistry Practicals)	By learning this course, ➢ Students can understand to separate the organic mixtures based on the functional groups available in the organic substrates. ➢ They can also understand the selection of the reagent for the separation of organic substances connected to the nature of functional groups. ➢ Students can also gain knowledge in the organic synthesis by performing a variety of simple and one step chemical process including alkylation, condensation, electrophilic substitution, substitution, functional group protection, cyclization and pericyclic reactions. These are the fundamental reactions in the field of organic synthesis and hence the students can be educated towards their future research carrier in academia and industry.
SEMESTER-II	
CHE-25031 (Inorganic Chemistry)	By learning this course: ➢ Understand the role of organometallic reagents in various important reactions like hydroformylation,

	oxopalladation, Ziegler – Natta polymerization. ➢ Understand the preparation and properties, nature of bonding and structure of transition metal pi-complexes. ➢ Understand the electronic spectra of complexes, calculation of microstates, find out ground state terms with their energies, spin and orbital selection rules, energy correlation diagrams (Orgel and Tanabe-Sugano diagrams), charge transfer spectra. ➢ Gain knowledge on the magnetic properties of complexes and understand spin-only and effective magnetic moments, determination of magnetic susceptibility.
CHE-25032 (Organic Chemistry)	By learning this course, students will ➢ Develop knowledge of addition and elimination reactions. ➢ Understand the conformational analysis of acyclic molecules, cyclic systems, Heterocycles. ➢ Mechanistic pathway of organic reactions. ➢ Conversion of different functional groups via rearrangement reactions.
CHE-25033 (Physical Chemistry)	By learning this course, students will ➢ Develop knowledge about the quantum chemical aspects of angular momentum, molecular orbital theory. ➢ Learn the concepts of catalysis including acid-base, homogeneous, heterogeneous, and enzyme catalysis. ➢ Understand the phase rule, solid-liquid equilibria, application of phase rule to three component system. ➢ Learn the key concepts involved in irreversible electrode phenomenon, Principles involved in the fabrication of batteries and fuel cells.
CHE-25034 (General Chemistry)	By learning this course, students will ➢ Develop knowledge of chromatography as a separation technique. ➢ Understand isolation, general methods of structural eludication of terpenoids and alkaloids.
CHE-25035NC	By learning this course, students will ➢ Know the fundamentals of organic chemistry, basic parameters of sample preparation for analysis, polymer chemistry, bioinorganic chemistry.
CHE-25031P (Organic Chemistry Practicals)	By learning this course, students will ➢ Understand the islation procedures for important natural products like: caffeine from tea leaves, eugenol from cloves, isolation of casein and lactose from milk powder, isolation of piperine from black pepper, isolation of lycopene from tomatoes, hesperidin from orange peel , isolation of curcumin from Turmeric powder, isolation of arachin and conarachin from groundnuts, isolation of carotenes from carrot.

CHE-25032P (Physical Chemistry Practicals)	By learning this course, students will ➢ To conduct the experiments of critical solution temperature of phenol-water system ➢ To develop knowledge in the determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, reactant concentration and temperature. ➢ To interpret the experimental results obtained by conductometry, potentiometry and nuclear techniques.
SEMESTER-III	
CHE-35031 (Inorganic Chemistry)	By learning this course, students will ➢ Describe the fundamental principles and applications of Electron spin resonance and Mossbauer spectroscopy. ➢ Understand the key aspects of Photoelectron spectroscopy and its instrumentation, application to chemical analysis. ➢ Understand the basic concepts of bioinorganic chemistry like storage and transport of oxygen, electron transfer in biology. ➢ Describe the key concepts of nanomaterials synthesis, characterization.
CHE-35032 (Organic Chemistry)	By learning this course, students will ➢ Students will be expected to gain knowledge on the basic concepts of pericyclic reactions, molecular orbital concept applicable to percyclic reactions. ➢ Understand the principles of photochemistry, photochemistry of carbonyl compounds, rearrangements associated with photochemistry. ➢ Understand the basics of photochemical reactions of alkenes. ➢ Understand the concepts of green technology in organic synthesis. ➢ Develop knowledge to predict the enantioselective product. ➢ Understand the mechanisms associated with asymmetric reactions.
CHE-35033 (Physical Chemistry)	By learning this course, students will ➢ Students will understand the concepts of theoretical treatment of liquid surfaces, thermodynamics of binary system, adsorption isotherms, surface phenomena. ➢ Understand the types of polymerizations, concepts of average molecular weight. ➢ Understand the principle and instrumentation of X-ray techniques like X-ray diffraction, X-ray Fluorescence. ➢ Gain knowledge of fundamentals of nuclear techniques
CHE-35034 (Spectroscopy)	By learning this course, students will

	➢ Understand how to interpret nuclear magnetic resonance spectrum. ➢ How to solve problems based on ^{1}H and ^{13}C NMR ➢ Understand applications of mass spectroscopy in determination of structures. ➢ Understand methods of solving combines problems on all spectroscopic techniques.
CHE-35031P (Multistep synthesis of Organic Compounds)	By learning this course, students will ➢ Understand the detailed procedures and experiments on multistep synthesis of important organic molecules. ➢ Students will gain knowledge how to conduct the synthesis and maintenance of reaction conditions.
CHE-35032P (Estimations)	By learning this course, students will ➢ Understand the procedures and experiments on estimations of important organic compounds like glucose, phenol, aniline, aspirin, paracetamol, ibuprofen.
CHE-35035NC (Drug Discovery, Design and Development)	By learning this course, students will ➢ Comprehend drug designing and development, their SAR and QSAR. ➢ Explain mode of action of different drugs.
SEMESTER-IV	
CHE-45031 (Reagents in Organic Synthesis)	By learning this course, students will ➢ Students will understand the oxidations and reductions associated with various organic reactions. ➢ Gain knowledge of oxidizing and reducing agents in organic synthesis. ➢ Understand the structure, reactivity and applications of non-metallic reagents (B, P, S, Si) in organic synthesis. ➢ Understand the role of metallic reagents in organic synthesis. ➢ Gain knowledge on metal-mediated cross-coupling reactions.
CHE-45032 (Designing and Modern Topics of Organic Synthesis)	By learning this course, students will ➢ Students recall the fundamental organic reactions which are obvious in planning organic synthesis. They gain knowledge on different approaches which can be utilized in the synthesis of organic compounds. ➢ Students also gain knowledge on proper choice of protecting groups during total synthesis of targeted complex organic molecules. ➢ Students get knowledge on the several reported routes of synthesis of drugs/intermediates and their strategic improvements/modifications. ➢ Students can also obtain knowledge on the modern methods available in organic synthesis.
CHE-45033 (Chemistry of Heterocyclic Compounds)	By learning this course, students will ➢ Comprehend nomenclature of different heterocyclic compounds.

	➢ Interpret the synthesis and reactivity of fused, six membered and smaller heterocyclic compounds.
CHE-45034 (Medicinal Chemistry and Natural Products)	By learning this course, students will ➢ Categorize and understand the importance of various natural products
CHE-45031 P (Spectral Identification of Organic Compounds)	By learning this course, students will ➢ Understand the procedures for the structural elucidation of organic compounds by using the spectral data of UV, IR, NMR, Mass.
CHE-45032 P (Project work)	By learning this course, students will ➢ Analyze current literature for research topic ➢ Comprehend expertise for writing the research reports.

DEPARTMENT OF BIOTECHNOLOGY & BIOINFORMATICS

Course	Outcomes
Semester I	
PAPER: 16012	To learn the basic introductory principles of origin of life, cell and its physiological functions. To understand how life originated, cell functions physiologically, and metabolically in organisms.
PAPER: 16015	Students will understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles. To learn how these cellular components are used to generate and utilize energy in cells.
Semester II	
PAPER: 26015	To increase public awareness through media, government agencies, NGOs, etc. and implement strict restrictions on export of rare plants and animals. To preserve all varieties of old and new flora, fauna and microbes, natural habitats, critically endangered, endangered, and rare species. To reduce pollution, maintain ecological balance to utilize the natural resources in a sustainable way. To study ecology at organism, population, community, and ecosystem.
Semester III	
PAPER: 36015	To provide basic knowledge on different types of micro-organisms characteristics, classifications and their growth kinetics. Students understand the general, distinctive characteristics and their classification systems. Students develop knowledge on isolation, culture and identification of different microorganisms.
Semester IV	
PAPER: 46012	Environmental outcomes capture the firm's impact on the natural environment (e.g., carbon emissions, pollution, and waste). To reduce pollution, maintain ecological balance to utilize the natural resources in a sustainable way. To study ecology at organism, population, community, and ecosystem.
PAPER: 46014	Students can get the knowledge on basic concepts of internet, introduction to bioinformatics, biological databases and evolutionary relationship among different species by phylogenetic analysis.
PAPER: 46015	To provide knowledge on classifications, structures and functions of various biomolecules of living organisms. Students able to write basic structures of various molecules. Students understand the different functions of biomolecules are related to their structures.
Semester V	
PAPER: 56011	The Biochemical and biophysical tools aims to provide basic and advanced understanding of the core principles of molecular biology, and biochemistry on experimental basis. Demonstrate knowledge and implement biochemical and biophysical tools for isolation and characterization of biomolecules, and also for molecular biology and metabolism studies. Able to carry out simple biochemical investigations by using tools appropriately.
PAPER: 56012	Retains the knowledge on mendelian laws of inheritance and their extension in transferring the traits from one generation to the other generation. Acquire knowledge on gene mapping methods in all prokaryotes, organelles and eukaryotes. Role of mutagenesis role in ploidy development.

PAPER: 56013	To provide knowledge on gene regulation and expression. Knowledge on DNA replication, repair, recombination, Transcription, Translation. Students develop skills to isolate DNA and RNA from various sources (Plant and microbes).
PAPER: 56014	Enzymology is the branch of biochemistry aiming to understand how enzymes work through the relationship between structure and function and how they fold into their native state. It involves the enzyme catalysis, regulation and Bioenergetics.
PAPER: 56015	Identify and use UNIX/Linux utilities to create and manage simple file processing operations, organize directory structures with appropriate security, and develop shell scripts to perform more complex tasks. Effectively use the UNIX/Linux system to accomplish typical personal, office, technical, and software development tasks.
Semester VI	
PAPER: 66011	Student gain a broad foundation base and understand the defense mechanisms of the human body. Course also aims to develop research aptitude in immunology by having discussions based on current research papers. Understand the mechanisms and differences between primary and secondary responses and their relevance to immunizations. Understand the biology of different vaccines against infectious agents and cancer and solutions to produce better vaccines
PAPER: 66012	The Genetic engineering aims to modify the genes to enhance the capabilities of the organism beyond what is normal. To familiarize the students with basic concepts in genetic engineering to acquire knowledge on versatile tools and appraise them in various applications including academic and industrial importance.
PAPER: 66013	Intermediary metabolism is traditionally viewed as the large, highly integrated network of reactions that provides cells with metabolic energy, reducing power and biosynthetic intermediates. Emphasis is now increasingly placed on the involvement of metabolic dysfunction in human disease.
PAPER: 66014	Applications of data mining to bioinformatics include gene finding, protein function domain detection, function motif detection, protein function inference, disease diagnosis, disease prognosis, disease treatment optimization, protein and gene interaction network reconstruction, data cleansing.
PAPER: 66015	To gain knowledge on plant tissue culture, and genetic engineering techniques. Tissue culture includes propagation of plants under invitro conditions**.** Various methods of production of transgenic plants and their application in agriculture. Genetic engineering techniques in the agriculture field to produce stress resistant plants.
Semester VII	
PAPER: 76011	To learn about the various model organisms genome sequencing projects, genome mapping and bioinformatics tools for genome analysis and their genomic centers. To understand functional genomics and reverse genetics tools for gene function assignment and global gene expression analysis.
PAPER: 76012	To provide basic knowledge on different types of isolation methods of industrial microorganisms, preservation, and strain improvement. To motivate and provide knowledge on industrially important products (organic acids, antibiotics, vitamins, food products etc.). Students able to define industrial-biotechnology. Students able to explain, learn about different types of industrially important products applications of industrial biotechnology.
PAPER: 76013	This course will provide a knowledge in applications of biotechnology in animal sciences, Aquaculture, pearl culture. Students will understand the various applications of animal cell technology in research, clinics and industry. Methods of production of transgenic animals/cells and their application in various arenas of

	biotechnology will be discussed in detail which will equip the students fit for biotechnology research and industry
PAPER: 76014	To understand the concept of molecular modeling, mechanics and interactions. Enables the student to gain knowledge on classical and statistical mechanics and Quantum mechanics and its applications. Understand the theoretical and practical challenges associated with computational modeling.
PAPER: 76015	To learn and understand all aspects and manifestations of plant life. Ultimately, the objective of plant physiology is to explain the life processes of plants like photosynthesis, respiration, growth hormones, sensory photobiology, secondary metabolite production and stress physiology.

Semester VIII	
PAPER: 86011	To study the environmental biotechnology is to understand the current applications of biotechnology to environmental quality evaluation, monitoring and remediation of contaminated environments.
PAPER: 86012	Stem cell therapy, also known as regenerative medicine, promotes the repair response of diseased, dysfunctional or injured tissue using stem cells or their derivatives. It is the next chapter in organ transplantation and uses cells instead of donor organs, which are limited in supply.
PAPER: 86013	Proteomics is the study of the entire set of proteins produced by a cell type in order to understand its structure and function. To learn and understand various techniques like two dimensional gel electrophoresis, X-ray crystallography and NMR, Mass Spectrometry. Protein expression analysis at global scale by protein microarrays, yeast microarrays etc. Identifying those proteins whose expression is affected by disease processes can be used to improve screening and early detection of cancer.
PAPER: 86014	The ultimate goal of drug development is to bring a new compound with proven therapeutic effect to the market. In this context, the transition from preclinical research to clinical stages marks a critical turning point, as it nears the new medicinal product to the market
PAPER: 86015	To learn how animals work, and the biological processes that occur in animal life to exist. These processes can be studied at various levels of organization from membranes through to organelles, cells, organs, organ systems, and to the whole animal.
Semester IX	
PAPER: 96011	Students gain knowledge on cell signaling pathways and the recent advancements in contributing to various disease conditions. To understand the molecular mechanism of cancer development and the molecular approaches to cancer diagnostics and treatment. The extrinsic and intrinsic pathways of apoptosis and the mechanism of angiogenesis.
PAPER: 96012	Students will develop a solid knowledge on how cells able to differentiate any cell of an organism and have the ability of self-renewal. Stem cells exist both in embryos and adult cells. These cells can later develop either into any of the three germ layers or form a placenta. Students can develop knowledge on regenerative medicine and tissue engineering.
PAPER: 96013	To provide basic knowledge on different types of nanoparticles synthesis, characterization, biomedical applications and their toxic effects. Students acquire knowledge on different types of nanoparticles and motivate towards Nanotechnology. Students develop knowledge on nanoparticles synthesis methods, characterization techniques and advanced biomedical applications of Nanotechnology.

PAPER: 96014	Understand the basics in R programming in terms of constructs, control statements, functions & able to appreciate and apply the R programming from a statistical perspective. To acquaint students with backgrounds in the biological, physical, mathematical or computational sciences with the concepts and techniques of each other disciplines that are relevant to an integrated approach to the study of living systems. To equip students with the skills to generate comprehensive biological data sets, analyses them using appropriate statistical techniques, and use such data to generate mathematical or computational models of biological systems with predictive and explanatory power.
PAPER: 96015	To learn the organism's development from fertilization to till the complete development of organisms in various model organisms in plant and animal system. Students get familiar with animal and plant system development process.
Semester X	
PAPER: 06011	Demonstrate the ability to choose methods appropriate to research aims and objectives. Understand the limitations of particular research methods. To develop skills in qualitative and quantitative data analysis and presentation. To develop advanced critical thinking skills.

Department of Biotechnology, Kadapa

Course		Outcomes
Code	**Title of the Paper**	
15081	Cell Biology and Genetics	At the formal end of the course student will be able to ➢ Get basic knowledge of Difference Cell types, Molecular insights of Plasmamembrane and Cytoskeleton ➢ II: It will enhance their knowledge on the molecular structures of sub-compartments and components of living cell ➢ III: It will enhance their knowledge on the genetic inheritance of the traits and will lay a strong base for their upcoming semesters as well for their future research in Biological Sciences ➢ IV: It will give the knowledge of the molecular mechanisms of cell division, cell division and control and basics of cancers induction.
15082	Biomolecules	➢ students will demonstrate knowledge in Biomolecular science, including an understanding of: a) The connection between molecular properties and cellular activities; b) The connection between cellular activities and biological responses; c) Cellular structure and function, including chemical composition, physiochemical and functional organization of organelles, and basic cellular metabolism; ➢ students will develop research questions and the approach they will use to address that question. ➢ students will do a research project, analyse and evaluate the data generated and present their findings in both an oral and written format.
15083	Microbiology and Microbial Genetics	➢ At the end of this course, student will have thorough knowledge of the history of microbiology, classification, culturing & preservation techniques and control of microorganism. ➢ By the end of this course, student will be well equipped with the knowledge of the morphology, nutrition and growth of bacteria. ➢ By the end of this course, student will have detailed knowledge of microbial metabolism. ➢ Understanding of fundamental concepts in microbial genetics ➢ At the end of this course, the student will be well equipped with the knowledge of diverse group of prokaryotic organisms and also the structure and classification of viruses. ➢ By the end of this course, the student will have a thorough knowledge of different types of Gene transfer mechanisms. Understanding of fundamental concepts in microbial genetics

15084	Biochemical and Biophysical Techniques	The goal of the instructor in this course is to introduce the students to the concept various techniques that will be used and applied in Biotechnology for various applications. ➢ Understand microscopy and centrifugation. ➢ Understand different chromatography and Electrophoresis techniques for bio molecules separation ➢ Understand Spectroscopy techniques analysis. ➢ Understand Radioisotope tracer techniques
25081	Molecular Biology	➢ The goal of the instructor in this course is to introduce the students to the concept of molecular biology viz. ➢ To explain the concept of DNA replication and study the enzymes involved at both prokaryotic and eukaryotic levels. ➢ To learn about eukaryotic and prokaryotic promoters, RNA polymerase, mechanism and inhibition of transcription. ➢ To outline the concept of translation, genetic code, mechanism of protein synthesis, post translation modifications in eukaryotes, protein processing and targeting ➢ To study prokaryotic and eukaryotic gene regulation
25082	Computer Applications & Biostatistics	At the formal end of the course student will be able to ➢ It will give the basic knowledge on the computer and its components. Different operating systems and applications ➢ II: It will give the knowledge on various databases and programs that are useful solving some of the problems in biological data ➢ III: & IV: They give the knowledge on the methodologies and their applications for the prediction of the biological data authenticity as well the results outcome from the biological data generated from various experiments.
25083	Immunology	➢ By the end of the course the students will be able understand role of importance of Innate and Adaptive Immunity. ➢ Students will be able to understand role on antigen antibody interactions in various immune techniques ➢ They will be able to understand the mechanisms generating diversity and specificity in Immune System ➢ They will be able to understand the behavior of body towards complex disorders ➢ At the end of this course the student will have a thorough understanding of immunotherapy ➢ Upon completion students will gain theoretical knowledge of Hybridoma technology ➢ Will be able to apply the knowledge gained to understand the phenomena like host defense, hypersensitivity (allergy), organ transplantation and certain immunological diseases
25084	Enzymology	➢ 1.Students will gain awareness about Intellectual Property

		Rights (IPRs) to take measure for the protecting their ideas. ➢ 2.They will able to devise business strategies by taking account of IPRs. ➢ 3.They will be able to assists in technology upgradation and enhancing competitiveness. ➢ 4.They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health. ➢ 5.They will gain more insights into the regulatory affairs.
Non-core-1	**Essentials of Biotechnology**	Students will be able to ➢ History and introduction of biotechnology and living cells ➢ Apply systems engineering to living systems with applications across a wide domain of biological sciences. ➢ Study about applications of industrial, agricultural and medical biotechnology. ➢ Understand Property rights, bio safety and patents of biotechnology
35081	Genetic Engineering	By the end of this unit, the student will be able to ➢ To learn about Genomic DNA Libraries and cDNA Libraries, Sequencing Techniques and Principle and applications of Polymerase chain reaction. ➢ Explain the features of Transformation, selection of recombinants and Strategies of gene delivery, gene replacement/ augmentation ➢ Role of Genetic Engineering in Medicine, Agriculture and Industry.
35082	Medical and Pharmaceutical Biotechnology	➢ By knowing the upto date information about the achievements in the development of pharmaceutical products by biotechnology, which will provide the basis and scope for production of new potential drugs to cure various diseases and health complications in humans as well as animals. ➢ This could be useful for the students in such way to gain more knowledge and to attarct them towards research in the field of pharmacetical biotechnology. ➢ Drug desining techniques are very useful for the students to gain knowledge about how to design and develop potential drug for target deasease or affectd organ in the body. ➢ Knowing the effective methods for the development of various types of vaccines such as recombinant, vector based vaccines (Live, subunit) could provide an idea about the scope for development of potential vaccines to prevent various dreadful

		diseases.
35083	Food and Industrial Biotechnology	➢ 1.The students will be able to demonstrate basic knowledge in Food industry sciences ➢ 2. The students would acquire basic knowledge to design and conduct experiments, analyse data ➢ and interpret the results. ➢ 3.The students will be able to demonstrate understanding of basic knowledge and its application in Food and Industrial Biotechnology disciplines. ➢ 4.The students will be able to acquire knowledge to apply solutions in various industries and be able to integrate scientific and technological knowledge on the use of bioprocesses for industrial products ➢ 6.The students will be able to communicate effectively and demonstrate professional and ethical ➢ responsibilities ➢ 7. Students will master the basics of Food and industrial biotechnology
35084	Bioprocess Technology	➢ Acquire the knowledge of isolation and identification of microorganisms. ➢ Determine the mathematical expression of microbial growth kinetics & media formulation ➢ Design the process of fermentation ➢ The course imparts advanced knowledge on bioreactor design and it also gives knowledge on efficient utilization of the principles in bioprocess technology ➢ Understand the fundamentals downstream purification steps, role of bioprocess economics and cell disruption methods. ➢ Understand the techniques used for product isolation ➢ Evaluate the product purification techniques ➢ Evaluate evaporation, crystallization, and drying methods.
Non-core-2	**Introduction to Bioethics in Biotechnology**	➢ 1.Students will gain awareness about Intellectual Property Rights (IPRs) to take measure for the protecting their ideas. ➢ 2.They will able to devise business strategies by taking account of IPRs. ➢ 3.They will be able to assists in technology upgradation and enhancing competitiveness. ➢ 4.They will acquire adequate knowledge in the use of genetically modified organisms and its effect on human health. ➢ 5.They will gain more insights into the regulatory affairs.

45081	Plant Biotechnology	Distinguish plant culture techniques and culture types. ➢ •Learn about plant transformation methods and development of transgenic plants. Agrobacterium and Ti Plasmid based and physical DNA delivery methods. ➢ •Analysis of transgenic plants. ➢ •Design strategies for plant genetic manipulation against biotic and abiotic stressors. ➢ •Develop skills in plant tissueculture techniques ,which will make them employable in plant biotech industries.
45082	Animal Biotechnology	➢ Cell culture technology is a potential technology that involves diverse disciplines. From this couser students could undersatnd about the culture media, animal tissue culture facilities and several cell characterization tools, which are used in biotechnology. ➢ The students can also know about the basics of animal tissue culture with historical background, types of cultures, their maintenance, and characterization tools involved in this process. It also includes animal tissue cultures facilities and biosafety guidelines while working on animal cells under *in vitro* conditions. ➢ One of the most challenging tasks in animal tissue culture laboratory is to prevent contamination; thus this course also involves steps that must be considered to prevent contamination. ➢ Clones are superior breeding animals used to produce healthier offspring. Animal cloning offers great benefits to consumers, farmers, and endangered species: Cloning allows farmers and ranchers to accelerate the reproduction of their most productive livestock in order to better produce safe and healthy food. ➢ Stem cells have the remarkable potential to renew themselves. They can develop into many different cell types in the body during early life and growth. ➢ The students can understand the different potential culture practices for the culturing of various types fishes, crabs and prawns etc. and the advanced technology for the prduction of silk.
45083	Functional Genomics	At the formal end of the course student will be able to ➢ It will give knowledge on the various model organisms that can be used to ask some of the biological questions as well the latest sequencing technologies available in area of Life

		Sciences ➢ II: It will give the through knowledge on the basic to advanced molecular markers that have a tremendous applications in the Biological systems. ➢ III: I will give enlitght the students thirst, how the technological developments can solve the ever ending problems of studying thousands of genes at a given point of time in any Biological Systems. As well the wonder in biological genome / systems editing for desired traits. ➢ IV: It will provide the knowledge on the application of the knowledge what they got in the entire course of their two year journey from most primitive cell types to unknown cell types that we may not be able to culture / see with our naked eye even we apply any microscopes available.
45084	Bioethics and Biosafety	Students will be able to ➢ interpret basics of biosafety and bioethics and its impact on all the biological sciences and the quality of human life ➢ recognize importance of biosafety practices and guidelines in research ➢ comprehend benefits of GM technology and related issues ➢ recognize importance of protection of new knowledge and innovations and its role in business

Department of Commerce (P.G)

Yogi Vemana University

Course	Outcomes
1st Semester	
Paper: Com101	To describe how people behave under different conditions and understand why people behave as they do. Analyze and understand the implications of organizational behavior on the process of management. Evaluate various leadership styles and conflict management strategies used in organizations. Explain change and culture affects working relationships within organizations
Paper: Com102	To understand and financial analysis in optimal decision making in business environment. To analyze the demand and supply conditions and assess the position of a company. To analyze real-world business problems with a systematic theoretical framework. Designing competition strategies and costing, pricing, etc. and the structures of the markets.
Paper: Com103	Understand different environments in business climate. To know the minor and major factors affecting the business in various streams. To know the State policies, economic legislations and economic reforms laid by the government with regard to business.
Paper: Com104	Provide practical knowledge of financial accounting and decision making skills in the financial analysis context. To have the ability to identify and analyze financial accounting problems and opportunities in real life situations. To analyze the corporate finance under different conditions and understand why people describe the financial statements in different manner.
Paper: Com105	understand the technology and infrastructure components: hardware, software, and data communications systems. To understand formatting techniques skills to produce word documents. To acquire basic skills about spreadsheet functions and generate reports. Create presentations using text, visual / sound elements.
2nd Semester	
Paper: Com201	To impart basic understanding of human resources and HR policies, functioning of an organization and management. Evaluate the process of recruitment and selection. Understand the different training programs also understand remuneration policies and their significance. To understand the employee health and safety measurements in developing human resource management in the globalized contest.
Paper: Com202	Peoples will demonstrate strong conceptual knowledge in the functional area of marketing management. It will impart analytical skills in identification and resolution of problems pertaining to marketing management. To enable the students understand the techniques to scan Marketing Environment. Enlighten the students about the current trends in marketing . To know consumer buying behavior.
Paper: Com203	To understand the basic features of financial management, constant-growth and dividend discount model. Enable alternative techniques for analyzing project opportunities and budgeting capital also capital budgeting problems. Understand the measures of cost of capital and financial leverage to form long-term financial policies for business.
Paper: Com204	To understand the Quantitative and Qualitative Methods for conducting research. To Know different types of research methodologies and sampling methods and different types of data analysis tools. To write the research report using hypothetical data.
Paper: Com205	To Understand concept of Ecommerce. Be familiarized with technologies for Ecommerce and different types of Online Payment systems, E-business Models and various E-business Strategies

3rd Semester	
Paper: Com301	Identify cost according to their associated activities and apply costing techniques for computing cost of products or services. Prepare various statements using variable costing and absorption costing. Make various managerial decisions on the basis of learning concepts and issues involved therein.
Paper: Com302	Ability to identify Tax policies, deductions, rebates and reliefs to reduce the taxable income and tax liability of a firm. Keeping in view the Income Tax Rules also Knowledge of Double Taxation Avoidance.
Paper: Com303	Acquire the skill of financial decision making in a systemized manner. Interpret the financial statements as well as evaluation of stock at the end. bank statement, do accrual adjustments, and also print financial statements, etc. in Tally ERP.9
Paper: Com304(A)	Understand the environment of investment avenues and risk return framework. Analyse bonds in terms of valuation, yields and risks. Analyse equity shares using different approaches and models. Construct, analyze and evaluate portfolios along with a deep understanding of Capital market theory and associated models.
Paper: Com305(A)	Understand Merchant Banking and its functions. Knowing the concept of Public issue management, Post –Issue activities and portfolio management services. Practicing Underwriting and global debt instruments and Depository receipts and stock exchanges
4th Semester	
Paper: Com401	Students will be able to demonstrate their ability in speaking and learning skills, skills in reading, notes making, précis writing, role played by Audio Visual aids in communication knowledge about traditions. Skills that can intervene in their career growth and help them to grow. Soft skills like positive attitude, communication skills, maintaining work ethics, teamwork abilities, and time management skills to be surpassingly requisite to enhance career perspectives.
Paper: Com402	Provides cutting edge knowledge and skills on how to successfully develop captivating products and services to solve challenging problems in a highly uncertain environment, often under considerable time constraints with very limited resources. To know Institutional and Policy Initiatives for Promotion of ED.
Paper: Com403(A)	Enlighten the students knowledge in Stock market with derivatives & risk management, control.
Paper: Com404(A)	Knowledge of various components and progress of Indian financial system. Detailed understanding about the Banking Structure of the country and its recent developments. Understanding the cross border (offshore) settlements. Clarity of stock market operations and the clearing and settlement procedures of stock exchanges.
Paper: Com405	Project Work