Bachelor of Technology (Biotechnology), UIET, KUK
Credit-Based (w.e.f. 2024-2025)
Modified SCHEME OF STUDIES/EXAMINATIONS *(*Semester-VII*)*

S.No	CourseNo./Code	Subject	L:T:P	Hours/Week	Credits	Examination Schedule (Marks)				Duration Of exam (Hours)
						MajorTest	MinorTest	Practical	Total	
1	PTC-401	Food and Nutrition Technology	3:0:0	3	3	75	25	0	100	3
2	PTC-403	Biocatalysis and Biotransformation	3:0:0	3	3	75	25	0	100	3
3	PTE-III	Program Elective-III*	2:0:0	2	2	75	25	0	100	3
4	PTE-IV	Program Elective-IV *	2:0:0	2	2	75	25	0	100	3
5	OTS-III	Open Subject-III**	3:0:0	3	3	75	25	0	100	3
6	OTS-IV	Open Subject-IV**	2:0:0	2	2	75	25	0	100	3
7	HSMC-II	Elective-II***	3:0:0	3	3	75	25	0	100	3
8	PTC-405	Food and Nutrition Biology Lab	0:0:3	3	1.5	-	40	60	100	3
9	PTS-401	Project-I	0:0:4	4	2	-	40	60	100	3
10	PTS-403	Industrial Training	0:0:1	1	0.5	-	100	-	100	3
		Total	18:0:8	26	22	525	355	120	1000	-

Students shall have to select one elective from each group of Program Elective-III/IV, Open Subjects-III/IV and HSMC Elective-II.

Program Elective-III*

PTE-401 Gene Expression and Transgenics
PTE-403 Quality Control Management in Biotechnology
PTE-405 Tissue Engineering
PTE-407 Biostatistics

Program Elective-IV*

PTE-409 Essentials of Virology
PTE-411 Biosensors & Bioinstrumentation
PTE-413 Biomedical Engineering
PTE-415 Omics Technology

Open Subject-III**	Open Subject-IV**	HSMC Elective-II***
OTS-401 Robotics	OTS-409 Bioterrorism and National Security	HSMC-401 Introduction to Industrial Management
OTS-403 Virtual Reality	OTS-411 Biosimilar Technology	HSMC-402 Industrial Psychology
OTS-405 Pharmaceutical Biotechnology	OTS-413 Comparative and Functional Genomics	HSMC-403 Innovation, Startups & Entrepreneurship
		HSMC-404 Intellectual Property Rights (IPR) & Regulators

Open subject III and IV may also be offered in online mode through MOOC offered by SWAYAM & NPTEL.

PTC-401	Food and Nutrition Technology (B.Tech. Biotechnology) Semester VII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To familiarize the students with various aspects of Food Biotechnology**						
Course outcome							
CO1	**Student to learn about significance of fermentation and know about fermented foods and waste disposal methods from food industries**						
CO2	**To learn the development of novel food and food ingredients.**						
CO3	**Able to understand various methods of preservation**						
CO4	**Student will learn about monitoring of food quality and packaging techniques.**						

UNIT I

1. **Classification of foods.**
2. **Food Fermentation Technology:** Important fermented foods and beverages, Significance of fermentation.
3. **Waste Disposal:** Methods of waste disposal from various food industries.

UNIT II

4. **Novel Food and Functional Foods:** Artificial sweeteners, food supplements, food colorings, probiotics, cereals.
5. **Neutraceuticals:** Sources, Classification, Types, Significance.

UNIT III

6. **Food Spoilage :** Factors affecting spoilage- Intrinsic and extrinsic factors affecting microbial growth in foods: Intrinsic factors (Nutrient contents, pH, moisture contents/water activity, Antimicrobial substances), Extrinsic factors (relative humidity, temperature, gaseous atmosphere).
7. F**ood Processing and preservation-** Objectives of food processing.Thermal processing- Pasteurization, Canning. Cold preservation – Freezing and Chilling. Chemical preservatives and food dehydration, Class I and Class II preservatives, Use of Radiations for food preservation. Preservation by fermentation.

UNIT IV

8. **Monitoring of food quality - HACCP.**
9. **Packaging of Food:** Need for packaging, requirements for packaging, Containers for packaging (glass, metal, plastics and aluminium foil). Types of Packaging- Primary, Secondary and Tertiary; Flexible Packaging, Biodegradable Packaging, Edible films. Aseptic Packaging, Modified Atmosphere Packaging.

Text Books:

1 Food Science and Nutrition: Sunetra Roday (2013) Oxford University Press, New Delhi.

2 Food Microbiology: Fundamentals and Frontier. Beuchat, Doyle & Montville. (2001). Blackwell Synergy.

3 Food Microbiology. Frazier, W.C. and Westhoff, D.C. (2010) Tata Mc-Graw Hill, New Delhi.

4 Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi

5 Foods: Facts and Principles. N. Shakuntala Manay and M. Shadakshara Swami.(2012) New Age International (P) Ltd, Publishers.

Reference Books:

6. Biotechnology Food Fermentation Vol. I & II. Eds. Joshi, V.K. & Pandey, A. (1999) Educa tional Publishers and Distributers, Kerala.

7. Biotechnological Strategies in Agroprocessing. Eds. Marwaha S.S & Arora, J.K. (2003)

8. Ray, Bibek.(1996). Fundamental Food Microbiology .CRC Press.

9. Food Microbiology: 2nd ed, Adam, M. R. and Moss (2003) Panima Pub, New Delhi.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

PTC 403	Biocatalysis & Biotransformation (B.Tech. Biotechnology Semester-VII)						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3 Hrs
Purpose	To familiarize the students with Concepts of Biocatalysis and Biotransformation						
Course outcome	After completion of this course the students will be able						
CO1	To articulate the concepts of Biocatalysis and Biotransformation.						
CO2	To differentiate between different strategies for production of succinic acid.						
CO3	To appreciate the use of peptide in pharmaceutical industry..						
CO4	To compare computational tools for enzyme function prediction.						

UNIT I

1. **Introduction to biocatalysis, Current market of biocatalysis, fermentation, concept of biotransformation and advantages and limitations of biotransformation.**
2. **Development of chemo enzymatic processes: synthetic route design and integration of biocatalysis, chemo-enzymatic process development.**

UNIT II

3. **Production of Dicarboxylic Acid Using Yeasts: Current Uses and Production of Dicarboxylic Acids, Selection and Improvement of Yeast Strains, Selection and Improvement of Yeast Strains, Metabolic Engineering Strategies for Biotechnological Production of Succinic Acid.**
4. **Engineering Proteases for Industrial Applications: Proteases in Industry, Serine Proteases and Subtilisins, serine and cysteine protease for peptide synthesis . Protease discovery.**

UNIT III

5. **Biocatalysis for drug discovery and development: Introduction, hydrolytic reactions, reduction, oxidation, whole cell biocatalyst, biocatalyst for pharmaceutical industry.**
6. **Transaminases: Transaminases as a Biosynthetic Route for Chiral Amines, Kinetic Resolution of Amines Employing ATAs, Recent Advances in Industrially Relevant Asymmetric Reductive Amination Reactions, ATA Screening Kit.**

UNIT IV

7. **Structural Bioinformatics and Biocatalysis Research: Computational Tools for Function Prediction and Analysis of Enzymes.**
8. **Recent development in biotransformation: current challenges and future scopes of biotransformation process.**

Reference/Text books

1. **Green Biocatalysis edited by Ramesh N. Patel, John Wiley and Sons, 2016.**
2. **Biotransformation of Agricultural Waste and By-Products edited by Palmiro Poltronieri and Oscar Fernando D'Urso, Elsevier Inc, 2016.**
3. **Applied Biocatalysis edited by Lutz Hilterhaus, Andreas Liese, Ulrich Kettling, and Garabed Antranikian, Wiley-VCH, 2016.**
4. **Journal of Biocatalysis and Biotransformation.**

PTC-405	Food and Nutrition Biology LAB (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Practical**	**Total**	**Time**
-	**-**	**3**	**1.5**	**40**	**60**	**100**	**3 Hrs**
Purpose	**To learn the practical aspects of Food and Nutrition Technology**						
Course Outcomes							
CO1	**Students will microbiologically analyse different food samples.**						
CO2	**Students will learn to test the quality of water and milk**						
CO3	**Students will learn the technique of analyzing protein, fat , carbohydrates and fibre in different food samples**						
CO4	**Students will explore the vermicomposting and biogas plant and learn the technique of vermicomposting and biogas formation**						

LABORATORY EXPERIMENTS

1. Estimation of proteins in different food samples.
2. Microbiological analysis of water and food samples.
3. Determination of pH and TDS in water samples.
4. Analysis of carbohydrates in various food products.
5 Testing of Milk and M ilk Products- Testing the adulterants present in milk.
6. Analysis of fibre using Fibre Analyzer in various food products.
7 Analysis of proteins using protein analyzer in various food products
8. Analysis of fats using fat analyzer in various food products.
9. Analysis of Phytochemical activity of medicinal plants.
10. Visit to Vermicomposting and Biogas Plant.

Text Books:

1 Food Science and Nutrition: Sunetra Roday (2013) Oxford University Press, New Delhi.
2 Food Microbiology: Fundamentals and Frontier. Beuchat, Doyle & Montville. (2001). Blackwell Synergy.
3 Food Microbiology. Frazier, W.C. and Westhoff, D.C. (2010) Tata Mc-Graw Hill, New Delhi.
4 Modern Food Microbiology. Jay, J.M. (1996) CBS Publishers and Distributors, New Delhi
5 Foods: Facts and Principles. N. Shakuntala Manay and M. Shadakshara Swami.(2012) New Age International (P) Ltd, Publishers.

Reference Books:

6. Biotechnology Food Fermentation Vol. I & II. Eds. Joshi, V.K. & Pandey, A. (1999) Educa tional Publishers and Distributers, Kerala.
7. Biotechnological Strategies in Agroprocessing. Eds. Marwaha S.S & Arora, J.K. (2003) 8. Ray, Bibek.(1996). Fundamental Food Microbiology .CRC Press.
9. Food Microbiology: 2nd ed, Adam, M. R. and Moss (2003) Panima Pub, New Delhi.

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PTE-401	Gene Expression and Transgenics (B. Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3 Hrs**
Purpose	**To provide detail about various aspects of protein expression in different expression system and creation of transgenic animals**						
Course Outcomes							
CO 1	**Students will learn about the different expression vectors**						
CO 2	**Students will have knowledge nabout different gene expression systems for over expression of recombinant proteins and protein complexes for different applications.**						
CO 3	**Students will learn about purification of proteins expressed in different expression systems**						
CO 4	**Students will learn the methods of transgenic animals generation and their applications in research.**						

UNIT I

Overview of recombinant protein expression vectors and promoters, Vectors with tags His, GST, MBP, GFP, Cleavable tag and non-cleavable tags, Vectors for tag free protein expressions.

UNIT II

Over-expression of integral membrane proteins, Over-expression in E. coli, B. subtilis, yeasts like S. cerevisiae Mammalian cell line like Chinese Hamster ovary (CHO) and Human embryonic kidney (HEK), Plant single cell. Chloroplast transformation and protein expression in chloroplasts

UNIT III

Cell free protein Expression-Cell free extracts from E. coli, rabbit, wheat germ, insects. Purification of tagged and tag-free proteins,

UNIT-IV

Use of transgenic animals. History, safety and ethics of transgenic animals. Methods for creation of transgenic animals-DNA microinjection, Embryonic stem cell-mediated gene transfer, Retrovirus-mediated gene transfer. Use transgenic animals in toxicology, in mammalian developmental genetics, in molecular biology in the pharmaceutical industry, in biotechnology, Humanized animal models

Text Books:

1. Gene Expression Systems, Using Nature for the Art of Expression. Edited by Joseph M. Fernandez and James P. Hoeffler.
2. Regulation of Gene Expression, By Perdew, Gary H., Vanden Heuvel, Jack P., Peters, Jeffrey M. Springer.
3. Prokaryotic Gene Expression. Edited by Simon Baumberg. Oxford Press

Reference Books:

1. Transgenic Animal Technology,3rd Edition, A Laboratory Handbook By Carl Pinkert. Elsevier.
2. Ethical Use of Transgenic Animals (English, Paperback, Shah Krunal V). Lambert.
3. Transgenic Animals as Model Systems for Human Diseases. Edited E. F. Wagner F. Theuring. Springer

PTE-403	Quality Control Management in Biotechnology (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credits**	**Minor Test**	**Major Test**	**Total**	**Time**
2	**-**	**-**	**2**	**25**	**75**	**100**	**3 Hrs**
Purpose	**To learn various aspects of Quality control management in Biotechnology**						
Course Outcomes							
CO1	**Students will learn the regulatory requirements governing quality control management in Biotechnology**						
CO2	**Students will be able to understand the principles of quality assurance, including Good Laboratory Practices (GLP), Good Manufacturing Practices (GMP), and Good Documentation Practices (GDP).**						
CO3	**Students will learn how to interpret analytical data obtained from quality control testing and make informed decisions regarding the quality and safety of biotechnological products.**						
CO4	**Students will understand the principles of risk management as applied to biotechnological processes and products and familiarity with quality management systems.**						

UNIT-I

1. **Regulatory Compliance**: Ensure adherence to relevant regulations and standards such as Good Manufacturing Practices (GMP), Good Laboratory Practices (GLP), and ISO standards applicable to the biotechnology industry.
2. **Training and Education**: Provide regular training to personnel involved in quality control competency and awareness of regulatory requirements.
3. **Documented Procedures**: Develop and maintain comprehensive standard operating procedures (SOPs) for all quality control processes including sampling, testing, and data analysis.

UNIT-II

4. Instrumentation and Equipment: Regularly calibrate and maintain laboratory equipment and instrumentation to ensure accurate and reliable results.

5. Raw Material Testing: Perform thorough testing of raw materials to verify their identity, purity, and quality before use in manufacturing processes.

6. In-process Testing: Implement in-process testing at various stages of production to monitor critical parameters and ensure product quality and consistency.

UNIT-III

7. Finished Product Testing: Conduct comprehensive testing of finished biotechnology products to assess their safety, efficacy, and compliance with specifications.

8. Monitoring: Monitor environmental conditions in manufacturing facilities to prevent contamination and ensure product integrity.

Unit IV

9. Data Management and Analysis: Establish robust systems for data management, analysis, and documentation to maintain traceability and facilitate regulatory compliance.

10. Continuous Improvement: Implement a system for ongoing review and improvement of quality control processes through methods such as root cause analysis, corrective and preventive actions (CAPA), and risk assessment.

Text Books:

1. "Quality Control" by Dale H. Besterfield et al. Statistical.
2. "Quality Control" by Eugene L. Grant and Richard S. Leavenworth.
3. "Introduction to Statistical Quality Control" by Douglas C. Montgomery.
4. "Quality Management for Organizational Excellence: Introduction to Total Quality" by David L. Goetsch and Stanley Davis.
5. "Quality Management: Essential Planning for Breweries" by Mary Pellettier.

Reference Books:

1. "Quality Management: Introduction to Total Quality Management for Production, Processing, and Services" by Stanley E. Portny et al.
2. "The Lean Six Sigma Pocket Toolbook": A Quick Reference Guide to 100 Tools for Improving Quality and Speed" by Michael L. George, John Maxey, David Rowlands, and Malcolm Upton.
3. "Six Sigma: The Breakthrough Management Strategy Revolutionizing the World's Top Corporations" by Mikel Harry and Richard Schroede.
4. "Quality Planning and Analysis": From Product Development Through Use" by J.M. Juran and F.M. Gryna.

PTE-405	TISSUE ENGINEERING (B. Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Minor Test**	**Major Test**	**Total**	**Time**	**Credit**
2	**-**	**-**	**25**	**75**	**100**	**3 Hrs.**	**2**
Purpose	**To introduce the basics of Tissue Engineering to the students for applications in Biotechnology**						
Course Outcomes							
CO1	**The students will gain knowledge of biomaterials**						
CO 2	**To make the students aware of the basic biology involved in the cell-polymer interactions.**						
CO 3	**To introduce various methods involved to develop scaffolds for tissue engineering**						
CO 4	**To make aware of the applications of tissue engineering in the organ regeneration**						

UNIT-I

1. **Biomaterials**: Natural and synthetic polymers.

UNIT-II

2. **Basic biology**: Fibrous extracellular matrix of the human body and their characteristic features, Cell-Polymer interaction.

UNIT-III

3. **Methods to develop Scaffolds for Tissue engineering**: hydrogel, porous scaffold, and Textile-based techniques used for medical application, Rapid prototyping/3D printing, Wound healing.

UNIT-IV

4. **Organ regeneration**: Cartilage, Skin, Liver, Blood Vessel, Kidney, Urinary bladder, Tendons, Ligaments, Cornea.

Text Books-

1. Principles of Tissue Engineering 2013. Eds: Robert Lanza, Robert Langer, Joseph Vacanti, eBook, 4/e. Imprint: Academic Press.
2. Tissue Engineering: Principles and Practices. 2012. John P. Fisher, Antonios G. Mikos, Joseph D. Bronzino, Donald R. Peterson, 1/e CRC Press.
3. Biomaterials for Musculoskeletal Regeneration- Applications 2017. By Bikramjit Basu, Sourabh Ghosh, Springer.

PTE-407	Biostatistics (B. Tech Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3**
Purpose	To Introduce statistical concept for biological data interpretation						
	Course Outcomes						
CO 1	To develop basic understanding about statistics.						
CO 2	To develop basic knowledge of probability and different tests.						
CO 3	To derive numerical approach between data correlation and their variations.						
CO 4	To understand the numbers and errors						

Unit- I

Introduction: Basic concept of statistics, Difference between statistics and mathematics, Samples and variables, Frequency distribution curve and basic quantitative method: Mean median, mode, standard deviation and variance.

Unit-II

Probability distribution: Basic concept of probability, binomial distribution, Poisson Distribution and normal distribution.

Hypothesis testing: Students Ttest, estimation of null hypothesis, confidence limit of variance and chisquare test.

Unit-III

Analysis of Variance: F-test, One way ANOVA and Two way ANOVA.

Correlation and Regression: Analysis of correlation and their different types, analysis of covariance and multiple regressions.

Unit-IV

Approximation and error: Introduction, Accuracy of numbers: approximate number, significant number, rounding off. Different types of error.

Role of computer in solving biostatical problem: Genetic Algorithm, Application of statistical methods in biotechnology.

Text Books

1. 1. Statistical Methods. S.P.Gupta. Sultan chand and sons, New delhi.

Reference Books:

1. Introduction to Biostatistics. Glover T. and Mitchell K. (2002). MacGraw Hill, New York.
2. 2. Fundamentals of Biostatistics. Rosner Bernard. (1999), Duxbury Press.

PTE-409	Essentials of Virology (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3 Hrs**
Purpose	This course will introduce students to the key concepts in virology that will help to understand how viral replication and multiplication occur in Prokaryotes as well as in Eukaryotes.						
Course Outcomes							
CO 1	Knowledge regarding the basics of Virology.						
CO 2	Building the foundation of Viral Replication & Multiplication.						
CO 3	Students will learn about Viruses of Prokaryotes.						
CO 4	Students will learn about Viruses of Eukaryotes.						

Unit 1

Introduction:

Virus and Virion: General properties of viruses, nature of the virion. Nomenclature and Classification of Viruses. Subviral particles- Viroids and Prions.

Unit 2

Viral Replication & Multiplication:

Growth & Quantification: The virus host, Quantification of virus. Virus replication: General features of Viral replication, virus multiplication- attachment and penetration, production of viral nucleic acid and Protein.

Unit 3

Viral Diversity-Viruses of Prokaryotes:

Overview of bacterial viruses, Virulent Bacteriophage, Temperate Bacteriophages, Bacteriophage Lambda. RNA Bacteriophages; Icosohedral single stranded DNA Bacteriophages, Filamentous single Stranded DNA Bacteriophages- T7, Mu: Double Stranded transposable DNA Bacteriophage.

Unit 4

Viral diversity- Viruses of Eukaryotes:

Plant viruses. Positive strand RNA Viruses of animals- Poliovirus and Coronavirus. Negative strand RNA Viruses of animals- Rabies & Influenza. Double stranded DNA Viruses-Herpesvirus and Adenovirus. Viruses with reverse transcriptase- Retroviruses.

REFERENCES:

1. Brock: Biology of Microorganisms. By Madigan and Martinko. 11th Ed. 2005. Prentice Hall-Pearson Publications. New Jersey, US.

2. Microbiology. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. Tata McGraw Hill, New Delhi.
3. Introduction to Modern Virology. Dimmock, N.J. and Primrose, S.B.4th Ed. Blackwell Science Publications, Oxford.
4. Medical Virology. Morag, C & Tinbury, M.C. Churchil Livingstone, London.
5. Functionals of Plant virology. Mathew, R.E. Academic Press. San Diego, US.
6. The genetics of bacteria and their viruses. William Hayes. Blackwell Scientific Publishers, Oxford.

PTE-411	Biosensors and Bioinstrumentation (B.Tech. Biotechnology) Semester- VII						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3**
Purpose	**To familiarize the students with the Biosensors and Bioinstrumentation**						
Course Outcomes							
CO1	Students will become familiar to transducer and laboratory instruments						
CO2	Students known about assay and automation						
CO3	Students will know about the sensor used in cardiac and respiratory system						
CO4	Students will focus on the application part of biosensor						

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

UNIT – I

Transducers: Classification, resistive strain gauges, piezoelectric transducers, Electromagnetic transducers, Optical transducers, Transducers for biomedical science and their applications.

Analytical Instruments: pH meters, radiometric devices, fluorescence spectrophotometers, chromatology (chromatographic techniques- GC and HPLC), lab on a chip – related instrumentation, Validation, commissioning and maintenance of the above equipment's.

UNIT – II

Assay Technologies: Radiometric assay, scintillation proximity assay, fluorescence methodology to cover all types of fluorescence measurements and instrumentation.

Automation and Robotics: Introduction: management and services issues of a centralized robotics HTS (high throughput screening) core, flexible use of people and machines, Bar-code technology and a centralized database.

UNIT – III

Cardiac and vascular system: Overview of cardiovascular system, types of blood pressure sensors, Lumped parameters modeling of a catheter- sensor/system, heart sounds, cardiac catheterization, measuring blood flow rate, pacemakers, cardiac-assist devices and heart valves- related instrumentation of equipments and involved sensors.

Respiratory system: Modeling the respiratory system, measuring gas flow rate and lung volume, tests of respiratory mechanics, measuring gas concentration, ventilators, anesthesia machines- related instrumentation of equipments and involved sensors.

UNIT – IV

Biosensors: Introduction and concepts, biosensors for personal diabetes management, micro fabricated sensors, commercial development of biosensors, electrochemical sensors, chemical fibrosensors, noninvasive blood-gas monitoring, blood-glucose sensors BIA core- an optical biosensors. Noninvasive biosensors in clinical analysis, Applications of biosensors based instruments to bioprocess industry. Applications of biosensors to environmental samples, Biochips and their application to genomics

REFERNECES:

1. Introduction to Bio-analytical Sensors by Alice J Cunningham New York, John Wiley, 1998.
2. Biosensors and their applications by C Yang Victor & TNgo That, Plenum Press NY, 2000.
3. Biosensors- An Introduction by R. Eggins Brain.
4. Transducers and instrumentation by D V S Murthy, Prentice Hall, 1995.
5. Commercial sensors by Graham Ramasay, John Wiley & Son, INC, 1998.
6. Biosensors by Jon Cooper and Tony Cass, Oxford University Press, 2004

PTE- 413	Biomedical Engineering (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3 Hrs**
Purpose	To enlighten student's knowledge about biomedical Engineering by acquiring knowledge of equipments and techniques involved						
Course Outcomes							
CO 1	Students will learn about basics of bioelectric signals and electrodes						
CO 2	Students will learn about various equipments involved in diagnostic						
CO 3	Students will be able to understand the working principle of various therapeutic equipments						
CO 4	Students will have learn calibration and testing of equipments						

UNIT I

Basics of Biomedical Engineering: - Sources of Biomedical Signals, Basic medical Instrumentation system, Microprocessors & Computers in medical instruments. Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Bio-potential electrodes, generalized medical instrumentation system-Man machine interface.

UNIT II

Diagnostic Equipments: Specifications of instruments, ECG: normal and abnormal waveform, diagnosis interpretation, ECG leads connections, Einthoven triangle, Plethysmography, Blood pressure measurement: direct and indirect methods, Cardiac output measurements, Respiratory volume measurement, Impedance pneumograph, Spirometers, Pneumotachometers. EEG: signal amplitudes and frequency bands, EEG machine. Blood cell counter, Endoscopes, Laparoscopes and Camera pill.

UNIT III

Therapeutic Equipments: Heart lung machine, Dialyzers: basic principle of dialysis, different types of dialyzer, membranes, portable type. Cardiac pacemakers: external and Implantable pacemaker. Cardiac defibrillator: DC defibrillator, implantable defibrillator and defibrillator analyzer. Ventilators, Anesthesia machine, Short wave diathermy, microwave diathermy, ultrasonic therapy unit, electrotherapy

UNIT IV

Patient Safety: Selection of system parameters, Electric shock hazards, leakage currents, electrical safety analyzer, testing of biomedical equipments. Calibration and testing of biomedical equipments. Modern biomedical equipments and systems: Market scenario.

Books Recommended:

1. John G. Webster, "Medical Instrumentation Application and Design" 4th Ed, Wiley, 2011.
2. Joseph J Carr, John M Brown, "Introduction to Biomedical Equipment Technology", Pearson Education, NewDelhi, 2011.

3. L. J. Street, “Introduction to Biomedical Engineering Technology”, 2 nd Ed, CRC Press, 2011.
4. Khandpur R S, “Medical Instrumentation: Application and Design”, 3Rd Ed, John Wiley & Sons, 2009.

PTE-415	Omics Technology (B.Tech. Biotechnology Semester VII)						
Lecture	Tutorial	Practical	Credit	Major Test	Minor Test	Total	Time
2	0	-	2	75	25	100	3 Hrs.
Purpose	To familiarize the students with the concepts of technologies pertinent to Genomics, Transcriptomics, and Proteomics, and to demonstrate their applications..						
Course Outcomes							
CO1	Analyse the genome of a simple organism to understand its functioning						
CO2	Appreciate the usage of proteomics and transcriptomics approaches to obtain a global picture of cellular activities						
CO3	Understand the concept of Metabolomic and data anaylsis.						
CO4	Appreciate the use of Omics in different fields						

UNIT 1

Brief overview of prokaryotic and eukaryotic genome; Extrachromosomal DNA: bacterial plasmids, mitochondria and chloroplast; Organization of the genome, Genome mapping

UNIT-II

Basics of protein chemistry and proteomics; Separation of proteins, Detection of post-translational modifications Yeast Two Hybrid System, overview of transcriptomics and its applications

UNIT-III

Basics of Metabolomics, Analysis of metabolome: NMR for metabolomics, Gas chromatography, High-performance liquid chromatography , Mass spectrometry and data anaysis.

UNIT-IV

Applications of Omics: Genomics & proteomics in Medicine, personalized medicine, Microbial genomes , Proteomics and metabolomics for biomarker discovery & disease diagnosis .

Recommend Books:

Textbooks:

1. S. B. Primrose and R. M. Twyman , Blackwell Publishing (2006) 7 th Edition.

Reference Books 1. A. M. Lesk, Introduction to Genomics, Oxford University Press (2017), 3rd Edition.

2. R. Twyman, Principles of Proteomics, CRC Press (2013), 2nd Edition.

Self-Learning Material 1. https://nptel.ac.in/courses/102/103/102103017/

3) Functional Genomics (Methods in Molecular Biology) by Kaufmann, Michael, Klinger, Claudia, Savelsbergh, Andreas, Humana Press; ISBN: 978-1-4939-7230-2.

4) Proteomics: From Protein Sequence to Function. Stephen Pennington, Michael J Dunn, Viva Books Private Limited, ISBN: 9789386105998.

5) Discovering genomics, proteomics, and bioinformatics, by A Malcolm Campbell; Laurie J Heyer; Cold Spring Harbor Laboratory Press.; Benjamin/Cummings Publishing Company, ISBN: 0805382194 9780805382198.
6) Principles of Gene manipulation and Genomics, 7th edition/S. By Sandy B. Primrose, Richard Twyman. Wiley-Blackwell, ISBN: 978-1-405-13544-3.

B. Tech. 7th Semester Biotechnology Engineering							
Code OTS-401	**ROBOTICS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	The purpose of this course is to make the students understand about the fundamental of robotics technology, its components and robotics cell design and control.						
Course Outcomes							
CO1	Students will be able to understand the fundamentals of robotics and find its applications.						
CO2	Students will be able to explain the use of different sensors and end effectors in robotics.						
CO3	Students will be able to describe the application of robotics in manufacturing.						
CO4	Students will be able to design and analyze the work cell and robotic motion.						

UNIT-I

Introduction: Automation and robotics, a brief history of robotics, Introduction, Definition, Functions, Advantages, Disadvantages, applications,

Fundamental of robotics: Robot anatomy, robotic components, classification of robots, Robotic specifications

UNIT-II

Sensors in robotics: Type of sensors in robotics, force and torque sensors, proximity sensors (position sensors), range sensors, machine vision sensors, velocity sensors, acceleration sensors. tactile sensor, use of sensor in robotics.

Robot end effectors: Types of end effectors, characteristics of end-of-arm tooling, elements of end-of-arm tooling.

UNIT-III

Material transfer and equipment: General consideration in robot material handling, material transfer applications, machine loading and unloading,

Grippers: Tool selection of gripper, gripping mechanism, types of gripper, mechanical gripper, vacuum and magnetic grippers.

UNIT-IV

Robot cell design and control: Robot cell layouts, multiple robots and machine interface, other considerations in work cell design, work cell control, interlocks, the work cell controller, robot motion

analysis and control: introduction to manipulator kinematics, manipulator path control, robot dynamics, and configuration of robot control.

Text books:

1. Robot Analysis and Control- Asada, H., and J. J. Slotine, Wiley.
2. CAD/CAM: Computer Aided Design and Manufacturing- Groover M.P. and Zimmers E. W., Prentice Hall International, New Delhi.

Reference Books:

1. Robotics and Control-R. K. Mittal, I. J. Nagrath, McGraw Hill.
2. Fundamental of Robotics Analysis and Control-Robert J Schilling, Pearson
3. Industrial Automation and Robotics-J K Arora, Laxmi Publications

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Note: The paper setter will set the paper as per the question paper templates provided.

OTS-403	Virtual Reality						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	0	0	3	75	25	**100**	3Hrs

Purpose	To introduce the concept of virtual reality along with augmented & mixed reality and their applications in real world.
CO 1	Describe how VR systems work and list the applications of VR.
CO 2	Study of various input & output devices used in VR systems.
CO3	Learning about the applications of virtual reality.
CO4	To Understand about Augmented and mixed reality

UNIT- 1

Virtual Reality And Virtual Environments: The historical development of VR: Scientific landmarks Computer Graphics, Real-time computer graphics, Flight simulation, Virtual environments, Requirements for VR, benefits of Virtual reality.

Introduction, Components of a VR system, 3D User Interface Input and Output devices, 3D viewing, Designing & Building VR Systems

UNIT- II

3d User Interface Input Hardware: Input device characteristics, Desktop input devices, Tracking Devices, 3D Mice, Special Purpose Input Devices, Direct Human Input, Home - Brewed Input Devices, Choosing Input Devices for 3D Interfaces.

UNIT- III

Travel and Wayfinding in Virtual Environments, Strategies for Designing and Developing 3D UIs, Evaluation of 3D User Interfaces.

Virtual Reality Applications: Engineering, Architecture, Education, Medicine, Entertainment, Science, Training.

UNIT- IV

Introduction to Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality, Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems.

Text/Refrence Books:

1. Alan B Craig, William R Sherman and Jeffrey D Will, “Developing Virtual Reality Applications: Foundations of Effective Design”, Morgan Kaufmann, 2009.

2. Gerard Jounghyun Kim, “Designing Virtual Systems: The Structured Approach”, 2005.
3. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, “3D User Interfaces, Theory and Practice”, Addison Wesley, USA, 2005.
4. Oliver Bimber and Ramesh Raskar, “Spatial Augmented Reality: Meging Real and Virtual Worlds”, 2005.
5. Burdea, Grigore C and Philippe Coiffet, “Virtual Reality Technology”, Wiley Interscience, India, 2003.
6. John Vince, “Virtual Reality Systems”, Addison Wesley, 1995.

Note: The paper setter will set the paper as per the question paper templates provided.

7th Semester B.Tech (Bio-Technology)

OTS-405	**Pharmaceutical Biotechnology (B.Tech. Biotechnology Semester VII)**						
Lecture	**Tutorial**	**Practical**	**Credit**	**Minor Test**	**Major Test**	**Total**	**Time**
3	**-**	**-**	**3**	**25**	**75**	**100**	**3 Hrs**
Purpose	**To learn various aspects of pharmaceutical biotechnology**						
Course Outcomes							
CO1	**Students will learn the procedure for discovery and development of drugs**						
CO2	**Students will be able to understand the metabolism of drug in the body and effects of drug on the human body**						
CO3	**Students will learn the basic concepts involved in the preparation of various drugs and their formulations**						
CO4	**Students will understand the management of different Life Style Diseases and know the procedure of Quality control and assurance.**						

UNIT-I

1. Introduction and Different Disciplines of Pharmacy

2. New Drug Discovery and Development Procedure – Preclinical and Clinical trials of drugs. Pharmacogenomics.

UNIT-II

3. ADME: Drug Bioavailability, route of administration (oral, parental, inhalations, topical) Basic Principle of Drug Absorption, Distribution, Metabolism and Excretion.
Pharmacodynamics, Drug receptors.

4. Therapeutic applications of radioisotopes, Applications of Nano technology in Pharmaceuticals.

UNIT-III

5. Basic concepts involved in the preparations of different Drugs and their Dosage forms.

Solid Dosage Forms- Tablets , Capsules, Powders
Semisolid Dosage Forms -Creams, Ointments, Pastes, lotions,
Liquid Dosage Forms like Mixtures, Solutions, Emulsion, Ophthalmic etc.

6. Additives and Excipients used in drug formulations- Colors , flavours, sweeteners, binders, Disintegrating agents and other additives used in prescriptions.

UNIT- IV

7. Management of Life style diseases like obesity, diabetes, B.P., cholesterol heart stroke, cancer, joint problems etc**. -** Precautions, symptoms and treatment. Use of herbs in management of these diseases.

8. **Pharmaceutical products and their Types**
Laxatives, Analgesics, Antiseptics, Antacids, Antibiotics.

9**. Quality control and assurance**- GMP, GLP, ISO- 9000, ISO-9001 validation and Drug Regulatory affairs.

Text Books:

1. Principles of Medicinal Chemistry Vol. 1 Dr. S.S.Kadam, Dr. K.R. Mahadik, Dr. K.G.Bothara
2. Principles of Medicinal Chemistry Vol. 1 Dr. S.S.Kadam, Dr. K.R. Mahadik, Dr. K.G.Bothara
3. Pharmaceutical Dispensing.(2010) Pratibha Anand and Roop K. Khar. CBS Publishers and Distributors Pvt. Ltd.
4. R. M. Mehta, "*Dispensing Pharmacy*", Vallabh Prakashan, New Delhi.
5. Brahmankar, CBS Publishers.

Reference Books:

6. Lipin Cott's Illustrated Reviews Pharmacology. Richard Maria, Pamela, Mary, Sheldon .
7. . Cooper and Guunn's,*"Dispensing for Pharmaceutical Students",* CBS Publishers, Delhi
8. A Owunwonne, *"Hand Book of Radiopharmaceuticals",* Narosa Publishing House, New Delhi.
9. . H C Ansel, *" Introduction to Pharmaceutical Dosage Forms",* K M Varghese& Co., Mumbai.
10. S.N.Pandeya: A Textbook of Inorganic Medicinal Chemistry, S.G.Publishers, Varanasi.
11. Clarke, E. C. G., "*Isolation and Identification of Drugs*", The Pharmaceutical Press, London

OTS-409	Bioterrorism and National Security (B. Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3 Hrs**
Purpose	**To familiarize the students with various aspects of Bioterrorism with concern to security of Nation.**						
Course Outcomes							
CO 1	**Student to learn the types of terrorism and historical concept of different weapons used in terrorism.**						
CO 2	**To learn the development of pathogenesis using microbes as weapons and pathogenecity mechanism**						
CO 3	**Able to understand various methods of prevention, enforcement, and government protocols regarding control measures.**						
CO 4	**Student will learn about monitoring techniques by Government and Health Agencies in management of nation wise threat and panic**.						

UNIT I

Terrorism and Bioterrorism- Definition-Traditional Terrorists-New Terrorists-Nuclear, chemical, and radiological weapons-The psychology of Bioterrorism-Historical perspective.

Bioterrorism agents – Bacteria-Anthrax(*Bacillus anthracis*), Botulism(*Clostridium botulinum* toxin),Plague(*Yersinia pestis*)Small Pox(*Variola major*) Virus- Filoviruses(Ebola ,Marburg), Arenaviruses(Lassa,Machupo) and VHF.

UNIT II

Bioterrorism Weapons and Techniques

Characteristics of microbes and the reasons for their use-Symptoms-Pathogenecity-Epidemiology-natural and targeted release-The biological, techniques of dispersal, and case studies reported in literature.

UNIT III

Prevention and Control of Bioterrorism –

Surveillance and detection- Detection equipment and sensors – Diagnosis-Treatment-Vaccinations-Supplies- Effectiveness-Liability-Public Resistance-Response-First Responders-Infectious Control-Hospital-Prevention- Protection-Decontamination-Notification-Role of Law Enforcement-Economic impact.

UNIT-IV

Bioterrorism Management

Ethical issues: personal, national, the need to inform the public without creating fear, cost-benefit Rations- Information Management-Government control and industry Support-Microbial forensics.

Text Books:

1. Bioterrorism: Guidelines for Medical and Public Health Management, Henderson, Donald, American Medical Association, 1st Edition, 2002.

2. Biological Weapons: Limiting the Threat (BCSIA Studies in International Security), Lederberg, Joshua (Editor), MIT Press, 1999.

3. Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century (Emerging Infectious Diseases of the 21st Century), I.W. Fong and Kenneth Alibek, Springer, 2005.

Reference Books:

1. The Demon in the Freezer: A True Story, Preston, Richard, Fawcett Books, 2003.

2. The Anthrax Letters: A Medical Detective Story, Cole, Leonard A., Joseph Henry Press, 2003.

3. Biotechnology research in an age of terrorism: confronting the dual use dilemma, National Academies of Science, 2003.

4.http://www.centerforhealthsecurity.org/our-work/pubs_archive/pubs-pdfs/2012/sloan_book/Preparing%20for%20Bioterrorism_Gigi%20Kwik%20Gronvall_December%202012.pdf

OTS-411	Biosimilar Technology (B.Tech. Biotechnology Semester VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**-**	**-**	**2**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To introduce the students with the concepts of Biosimiliar Technology**						
Course Outcomes							
CO1	**To introduce students about design and development of biologics.**						
CO2	**To learn about different biomolecules as biosimilar drugs**						
CO3	**To learn different characterization techniques**						
CO4	**To have knowledge of regulatory framework about biosimilars.**						

Unit I

Introduction to Biopharma:Generics in Biopharma, definition of biologics, biosimilars, super biologics, differences between chemical genetics and biosimilars, The developmental and regulatory challenges in biosimilar development, Prerequisites for Biosimilar development, Biosimilar market potential.

UNIT II

Types of biosimilar drugs*:* Peptides, proteins, antibodies, Enzymes, Vaccines, Nucleic acid based therapies (DNA, RNA, etc), Cell based therapies (including stem cells)

UNIT III

Characterization methods: Aggregation-precipitation, floccules strength, adsorption of proteins & peptides on surfaces, effect of temperature on protein structure, hydration & thermal stability of proteins - solid powders, suspension on non-aqueous solvents, reversed micelles, aqueoussolution of polyols, analytical and spectrophotometric characterization of proteins.

UNIT IV

Bioequivalence studies: Immunogenicity & allergenicity of biosimilars; factors affectingimmunogenicitystructural,postranslationalmodifications,formulations,impurities,manufacturingand formulation methods for biosimilars; Casestudies Indian companies working in this space & their product pipeline (Biocon, Intas, Dr Reddy's, Bharat Biotech, Lupin, Cipla, Shanta, etc);productsErythropoietin,growthhormone,granulocytestimulatingfactors,interferons,streptokinase,monoclonal antibodies.

Text Books/References:

1.LaszloEndrenyi,PaulDeclerckandSheinChungChow,BiosimilarDrugDevelopment, Drugs and Pharmaceutical Sciences, Vol 216, CRC Press.
2.Cheng Liu and K. John Morrow Jr., Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley, Dec 2016.
3.https://www.drugs.com/medical-answers/many-biosimilars-approved-united states-3463281/

Bioequivalence studies: Immunogenicity & allergenicity of biosimilars; factors affectingimmunogenicitystructural,postranslationalmodifications,formulations,impurities,manufacturingand formulation methods for biosimilars; Casestudies Indian companies working in this space & their product pipeline (Biocon, Intas, Dr Reddy's, Bharat Biotech, Lupin, Cipla, Shanta, etc);productsErythropoietin,growthhormone,granulocytestimulatingfactors,interferons,streptokinase,monoclonal antibodies.

Text Books/References:

1.LaszloEndrenyi,PaulDeclerckandSheinChungChow,BiosimilarDrugDevelopment, Drugs and Pharmaceutical Sciences, Vol 216, CRC Press.

2.Cheng Liu and K. John Morrow Jr., Biosimilars of Monoclonal Antibodies: A Practical Guide to Manufacturing, Preclinical and Clinical Development, Wiley, Dec 2016.

3.https://www.drugs.com/medical-answers/many-biosimilars-approved-united states-3463281/

OTS-413	Comparative and Functional Genomics (VII)						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
2	**0**	**0**	**2.0**	**75**	**25**	**100**	**3 Hours**
Course Outcomes							
CO1	Students will have a clear idea about various genomic technologies such as whole genome mapping & sequencing, genome annotation, global gene cloning and gene expression technologies, comparative genomics, introduction to pharmacogenomics						
CO2	The students will know the vast amount of genome information in publically available databases and how to access and best utilize for practical purposes.						
CO3	Able to analyze the gene expression data sets to derive the biologically meaning information						
CO4	Able to apply the knowledge of function genomics in public health						

Unit-I

Introduction to genomics: Genome organization of Model organism- E. coli, Yeast, Mice, A. thaliana, Human etc. Genome statistics

Unit-II

First and 2nd generation sequencing: Sanger sequencing and next generation sequencing; Reverse termination sequencing, Single cell RNA sequencing or single cell RNA sequencing and Applications

Unit-III

Comparative genomics: Genome Annotation i.e. Mining Genomic Sequence Data, gene prediction methods, Physical mapping, Metagenomics, evolutionary relationship, Genome Analysis, Functional maps (Transcriptome, proteome, metabolome) Metabolic network maps

Functional genomics tools: Hybridization and sequencing based approaches. Serial Analysis of Gene Expression-SAGE, DNA- Microarray, Application of DNA Microarray, cDNA-PCR, etc.

SNP: SNP Technologies: Platforms & Analysis Haplotyping: Concepts and Applications and relevance in cancer Biology

Unit-IV

Regulation of gene expression:Gene Function Technologies (Gene Targeting, Gene Silencing (RNAi), micro RNA-human and Drosophila
Biomarkers Pharmacogenomics: Concepts and Applications in Healthcare Role of genotype in drug metabolism Identification & Utilisation of cancer bio-marker

Suggested Text Book(s):

1. Discovering Genomics, proteomics & bioinformatics. Second edition by A Malcolm Campbell, Davidson College; Laurie J. Heyer Davidson College ; With Foreword by Francis S. Collins
2. Molecular Biology of the Gene (1987) Watson J. D., Hopking N., Robast J. and Steiz, J.
3. BIOINFORMATICS: A Practical Guide to the Analysis of Genes and Proteins (Third edition) Andreas D. Baxevanis& B. F. Francis Ouellette Suggested

Reference Book(s):

1. Ronaghi M. Pyrosequencing sheds light on DNA sequencing. Genome Res. 2001 10. Jan;11(1):3-11. Review. PubMed PMID: 11156611
2. Schulze A, Downward J. Navigating gene expression using microarrays—a technology review. Nat Cell Biol. 2001 Aug;3(8):E190-5. Review. PubMed PMID: 11483980
3. Kim JB, Porreca GJ, Song L, Greenway SC, Gorham JM, Church GM, Seidman CE, Seidman JG. Polony multiplex analysis of gene expression (PMAGE) in mouse hypertrophic cardiomyopathy. Science. 2007 Jun 8;316(5830):1481-
4. PubMed PMID: 17556586 4. MacBeath G, Schreiber SL. Printing proteins as microarrays for high-throughput function determination. Science. 2000 Sep 8;289(5485):1760-3. PubMed PMID: 10976071.
5. Shankar J, Wu TD, Clemons KV, Monteiro JP, Mirels LF, et al. (2011) Influence of 17b-Estradiol on Gene Expression of Paracoccidioides during Mycelia-to- Yeast Transition. PLoS ONE 6(12): e28402. doi:10.1371/journal.pone.0028402
6. Mary V. Relling, William E. Evans Nature. Author manuscript; available in PMC 2016 Jan 13.
7. Published in final edited form as: Nature. 2015 Oct 15; 526(7573): 343–350. doi: 10.1038/nature15817

HSMC-401	Introduction to Industrial Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	The aim of undergoing this course is to enable the students to gain understanding of concepts and the environment of industrial management.						
	Course Outcomes						
CO1	The students will become familiar with the detailed concept of industrial management.						
CO2	The students will understand the concept of Industrial Productivity and Work Environment						
CO3	The students will become familiar with concept of Total Quality Management, it's methods and quality standards						
CO4	The students will be able to understand the importance of Industrial Safety and Occupational Health						

Unit I

Introduction to Industrial Management:
Concept of Industrial Management – Importance of Industrial Management. Scientific approach to Industrial Management- Concept, principles and significance of scientific management. Meaning and factors determining factory location. Concept, objectives and importance of plant layout, factors influencing layout, types of layout, problems of layout.

Unit II

Industrial Productivity and Work Environment :
Meaning of Productivity: Factors affecting Industrial Productivity – Significance of higher Industrial Productivity — Suggestions for Productivity improvement.
Work environment - Factors affecting Work Environment - Lighting, air, ventilation, temperature, water, sanitation and noise. Occupational Hazards- Meaning and types - Biological Hazards, Chemical Hazards and Psychological Hazards. Measures to minimize occupational hazards.

Unit III

Total Quality Management
Concept of TQM ,Principles of TQM – Benefits of TQM.Methods of TQM –Benchmarking, Deming Wheel, Just in time- Objectives and Characteristics of Just in Time, Quality Circles- Concept and features of Quality Circles, Six Sigma Analytical methods – Critical Path Method – Process and advantages of Critical Path Method, Force Field Analysis – Driving and restraining forces, decision making, Failure Mode and Effect Analysis –Meaning and steps in Failure Mode and effect analysis. ISO-9000-Concept, Standards and guidelines.

Unit IV

Industrial Safety and Occupational Health :Definition of safety – Objectives of Safety Management. Industrial Accidents – Causes of Accidents (a) Mechanical causes (b) Human Causes Effects of Industrial accidents on employers, workers and society. Code of practices for accident prevention. Occupational Health- Concept- Health program in industries – Role of National Institute of Occupational Health(NIOH) - legal provisions regarding health- OHSAS 18000- (Occupational Health and Safety Standards)

References:
1) Industrial Safety Chronicle, Quarterly Journal published by National Safety Council.
2) Khanna, O.P. Industrial Engineering and Management. Dhanpat Rai Publications, New Delhi.
3) Ahuja, K.K. Industrial Management and Organisational Behaviour. Khanna Publishers, Delhi.
4) Rao, Thukaram. Industrial Management. Himalaya Publishing House, Mumbai.
5) Aswathappa, K. Factory Organisation and Management. Himalaya Publishing House, Mumbai.
6) Telsang. Martand. Industrial and Business Management. S Chand Publications, New Delhi. 7) Deshpande, A.S. Industrial Organisation and Management. Vora & Co Publishers,Mumbai. 8) Rao, Sunil S. & Jain R.K., Industrial Safety, Health and Environment Management Systems. Khanna Publishers, Delhi.
9) Sarma, A.M., Industrial Health and Safety Management. Himalaya Publishing House, Mumbai.
10) Mukherjee, P.N. Total Quality Management. Prentice Hall, New Delhi.

Note: The paper setter will set the paper as per the question paper templates provided.

HSMC-402	Industrial Psychology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	The aim of undergoing this course is to develop an awareness of the major perspectives underlying the field of Industrial Psychology and understanding for the potential Industrial Psychology has for society and organizations now and in the future.						
	Course Outcomes						
CO1	The student will be able to understand the key concepts, theoretical perspectives, and trends in industrial psychology.						
CO2	The students will be able to evaluate the problems thorough and systematic competency model.						
CO3	The students will be able to analyze the problems present in the environment and design a job analysis method.						
CO4	The students will be able to understand consumer behavior and organization culture.						

UNIT-I

Introduction: Nature and Meaning of Industrial Psychology, Role of Industrial Psychology, Organizational Attitude.
Motivation & Work behavior. (Theory X and Y, McClelland's, Need Theory, Herzberg's Two Factor Theory, Cultural Differences in Motivation.

UNIT-II

Design of Work Environments: Human engineering and physical environment techniques of job analysis, Social environment: Groups & work teams, Group Behavior, Group formation & development, Decision making process, individual influences, group decision process.

UNIT-III

Work Methods: Efficiency at work, the concept of efficiency, the work methods; hours of work, nature of work, fatigue and boredom. The personal factors; age abilities, interest, job satisfaction, the working environment, noise, atmospheric conditions, increasing efficiency at work; improving the work methods, Time and motion study, its contribution and failure resistance to time and motion studies, need for allowances in time and motion study.

UNIT-IV

Functions of organizational culture, Organizational Socialization, Assessing Cultural Values and Fit, Cross Cultural issues, Meaning, Application of Personality theory in organization, traits, Common personality measurement tools.
Understanding Consumer Behavior: Consumer behavior, study of consumer preference, effects of advertising, Industrial morale: The nature and scope of engineering psychology, its application to industry.

Suggested readings:

1. Nelson, Quick and Khandelwal, ORGB : An innovative approach to learning and teaching Organizational Behavior. A South Asian Perspective, Cengage Learning, 2012
2.Luthans, Fred, Organizational Behavior, McGraw Hill 2008
3. Gilmer, B. V. H. (1961). *Industrial psychology*. McGraw-Hill.
4. Dunnete, M.D., Handbook of Industrial and Organizational Psychology. (1992)
5. Blum & Taylor, Industrial Psychology.

HSMC-403		Innovation, Start ups and Entrepreneurship					
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	Time
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hours**
Purpose	**The objective of this Course The purpose is to inspire students and help them imbibe entrepreneurial mindset.**						
	Course Outcomes						
CO 1	Understanding the essence of innovation and features of innovative processes; models and methods of innovative entrepreneurship, the role of innovation as a major factor in creating the value of companies						
CO 2	Understanding, the dynamic role of entrepreneurship and small businesses, , types of business structure, organizing and managing a Small Business						
CO 3	Understanding concept of start ups, Control Strategic Marketing Planning , concept of incubation and proto type, new Product Development, Business Plan Creation.						
CO 4	Understanding risk analysis in business, financing methods, role of government in supporting entrepreneurship						

Unit -I

Introduction to Innovation : Idea Generation and Identifying Business Opportunities, Management Skills for Entrepreneurs, Innovations and their forms, it's features and characteristics, Factors initiating innovations, Innovation process and its stages, Statistical measurement of innovation, Model of innovation, Source of innovation, Technological transfer, Information technology to support innovation, difference between technological and non-technological innovation

Unit-II

Introduction to Entrepreneurship - Definitions, Traits of an entrepreneur, Intrapreneurship,Entrepreneurial Motivation ,Concept and Growth of Entrepreneurship in India, Types of Business Structures, Similarities /differences between entrepreneurs and managers, Business Ideas and their implementation, Discovering ideas and visualizing the business, Activity map, Types of start ups, role of entrepreneurs in economic development, future of entrepreneurs, entrepreneurial process

Unit –III

Start ups - Initial idea generation and planning stages, and incubation referring to the development, process of identifying and developing new ideas for products, services, or processes, and creating a working model or prototype to test the feasibility of the concept.

Market Analysis – Identifying the target market, Competition evaluation and Strategy Development, Five Cs of Opportunity Identification, Market Opportunity Identification in emerging technology companies, Process of creating and growing a new business venture, Business plan of the innovation project.

Unit –IV

Risk Analysis: Risk management in venture projects, Financing and Protection of Ideas- Financing methods available for start-ups in India, Communication of Ideas to potential investors – Investor Pitch, Patenting and Licenses, Exit strategies for entrepreneurs, bankruptcy, and succession and harvesting strategy, venture capital, angel investment, and crowd funding.

Government support- programs and initiatives aimed at supporting the development of new ideas, innovations, and startups, funding and mentorship, IPR - legal protection of a person's or organization's rights to their invention, brand, or creative work.

Text Books/Reference Books

- Shrutin N Shetty, (2018), Design the Future: Simplifying Design Thinking to Help You, Notion Press
- "Entrepreneurship development small business enterprises", Pearson, Poornima M Charantimath,2013.
- Roy Rajiv, "Entrepreneurship", Oxford University Press, 2011.
- "Innovation and Entrepreneurship",Harper business- Drucker.F, Peter, 2006.
- "Entrepreneurship", Tata Mc-graw Hill Publishing Co.ltd new Delhi- Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, 8th Edition, 2012
- The Three-Box Solution: A Strategy for Leading Innovation By Vijay Govindarajan
- Boutellier, Roman; Gassmann, Oliver; von Zedtwitz, Maximilian (2000). Managing Global Innovation. Berlin: Springer.. ISBN 3-540-66832-2.
- K. and Stephen P. Osborne (2005) Managing change and innovation in public service organisation. New York: Routledge
- Cappellin R. and Wink R. (2009) International Knowledge and Innovation Networks Knowledge Creation and Innovation in Medium-technology Clusters. UK: Edward Elgar

Publishing Limited.

- Eveleens, C. (2010). Innovation management; a literature review of innovation process models and their implications. Working Paper HAN University of Applied Sciences.
- Entrepreneurship Development- S.Chand & Co.,Delhi- S.S.Khanka 1999
- Small-Scale Industries and Entrepreneurship. Himalaya Publishing House, Delhi – Vasant Desai 2003.
- Entrepreneurship Management -Cynthia, Kaulgud, Aruna, Vikas Publishing House, Delhi, 2003.
- Entrepreneurship Ideas in Action- L. Greene, Thomson Asia Pvt. Ltd., Singapore, 2007

Note: The paper setter will set the paper as per the question paper templates provided.

HSMC-404	Intellectual Property Rights (IPR) & Regulatory						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hours**
Course Outcomes							
Purpose	The course is designed to provide comprehensive knowledge to the students regarding the general principles of IPR, Concept and Theories, International Regime Relating to IPR						
CO1	Students will be familiarized with the introduction about patent concept and legal implications						
CO2	Students will be able understand the concept of copyright in detail						
CO3	Students will be able to understand trademark and law associated with it						
CO4	Students will be able to know about geographical Indications and various IPR matters concerning biotechnology						

Unit-I

Indian patent law: The patents act, 1970,amendments to the patents act, patentable subject matter, patentability criteria, procedure for filing patent applications, patent granting procedure, revocation, patent infringement and remedies, relevant provisions of the biological diversity act, 2002, access and benefit sharing issues, objectives, rights, patent act 1970 and its amendments. procedure of obtaining patents, working of patents. infringement.

Unit-II

Copyrights :Introduction, works protected under copyright law, infringement. introduction to copyright, conceptual basis, international protection of copyright and related rights- Indian copyright act, 1957 with its amendments, copyright works, ownership, transfer and duration of copyright, renewal and termination of copyright

Industrial Designs: Need for protection of industrial designs, subject matter of protection and requirements, the designs act, 2000,procedure for obtaining design protection, revocation, infringement and remedies.

Unit-III

Trademarks : Objectives, types, rights, protection of goodwill, infringement, passing off, need for

protection of trademark, kinds of trademark, process of protection of trademarks, content of the rights, exhaustion of rights, content of the rights, exhaustion of rights, assignment under licensing, infringement, right of goodwill, passing off, domain names and effects of new technology (internet).

Unit-IV

Geographical Indications: Objectives, features, Industrial Designs: Objectives, Rights, Assignments, Infringements, Information Technology Related Intellectual Property Rights, Computer Software and Intellectual Property, Database and Data Protection, Domain Name Protection, Patentability of Biotechnology invention and its commercialization, Budapest treaty , Special issues in Biotechnology Patents: Disclosure Requirements, Collaborative research,competitive research, Necessity of Bioethics and Biosafety measures, Ethical issues against the molecular technologies, Biosafety Levels of Specific Microorganisms.

References:

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3 Susan K Sell, Private Power, Public Law: The Globalization of Intellectual Property Rights, Cambridge University Press, 2003

4 N.S. Gopalakrishnan & T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company,2nd Edition , 2014

5 Jayashree Watal, Intellectual Property Rights in the WTO and Developing Countries, Oxford University Press, 2001

6 Lionel Bently & Brad Sherman, Intellectual Property Law, Oxford University Press, 3rd Edition, 2008

7 Duggal Pavan, Legal Framework on Electronic Commerce & Intellectual Property Rights, Universal Publishing House, 2014

8 Paul Torremans, Intellectual Property And Human Rights, Kluwer Law International, 2008

9 Steven D Anderman, Interface Between Intellectual Property Rights and Competition Policy, Cambridge University Press, 2007.

10 Philippe Cullet, Intellectual Property Protection and Sustainable Development, Lexis Nexis, 2005

Note: The paper setter will set the paper as per the question paper templates provide.