Jaypee Institute of Information Technology

B. TECH BIOTECHNOLOGY

Course Descriptions

SEMESTER 6

Course Code	19B12HS611	**Semester : EVEN (specify Odd/Even)**	**Semester:** VI **Session** 2021-22 Month from: Feb-June
Course Name	Econometric Analysis		
Credits	3	**Contact Hours**	2-1-0

Faculty (Names)	**Coordinator(s)**	Manas Ranjan Behera
	Teacher(s) (Alphabetically)	Manas Ranjan Behera

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-2.1	*Demonstrate* the key concepts from basic statistics to understand the properties of a set of data.	Understanding Level - C2
C304-2.2	*Apply* Ordinary Least Square method to undertake econometric studies.	Apply Level - C3
C304-2.3	*Examine* whether the residuals from an OLS regression are well-behaved.	Analyze Level - C4
C304-2.4	*Evaluate* different model selection criteria for forecasting.	Evaluation Level - C5
C304-2.5	*Create* models for prediction from a given set of data.	Creation Level - C6

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the m**
1.	Statistical Inference	Point and interval estimation; ;The Z distribution ;The Null and Alternate hypotheses ;The chi-square distribution; The F distribution; The t distribution	3
2.	Regression Analysis	Two variable regression model; The concept of the PRF; Classical assumptions of regression; Derivation of the OLS estimators and their variance; Properties of OLS estimators under classical assumptions; Gauss-Markov Theorem; Tests of Hypothesis, confidence intervals for OLS estimators; Measures of goodness of fit: R square and its limitations; Adjusted R square and its limitations	7
3.	Econometric Model Specification	Identification: Structural and reduced form; Omitted Variables and Bias; Misspecification and Ramsay RESET; Specification test; Endogeneity and Bias	5

4.	Failure of Classical Assumptions	Multi-collinearity and its implications; Auto-correlation: Consequences and Durbin-Watson test ;Heteroskedasticity: Consequences and the Goldfeld -Quandt test	2
5.	Forecasting	Forecasting with a)moving averages b) linear trend c) exponential trend CAGR; Forecasting with linear regression; Classical time series decomposition; Measures of forecast performance: Mean square error and root mean square error; Limitations of econometric forecasts	5
6.	Time Series Analysis	Univariate Time Series Models: Lag Operator, ARMA , ARIMA models, Autoregressive Distributed Lag Relationship	3
7.	Linear Programming	Linear programming; Dual of a linear programming problem; Simplex method Transportation	3
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz+Project+Viva -Voce)
Total	**100**

Project based Learning: Students have to form a group (maximum 5 students in each group) and have to do an econometric analysis on the topic assigned. Students will use the different statistical methods using quantitative data to develop theories or test existing hypothesis. Students will also be encouraged to forecast future economic trends.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Gujarati, D.N. (2002), Basic Econometric (4th ed.), New York: McGraw Hill.
2.	Greene, W.H. (2003), Econometric Analysis, New Jersey: Prentice Hall.
3.	Madala, G.S. (1992), Introduction to Econometrics (2nd ed.), New York: Macmillan.
4.	Wooldridge,J (2010),Econometric Analysis of Cross Section and Panel Data(2nd ed.), Cambridge, The MIT Press.
5.	Stock, J. H., and M. W. Watson. (2015). Introduction to Econometrics, (Third Update), Global Edition. Pearson Education Limited.

Course Code	15B11BT611	**Semester** Even	**Semester VI Session** 2021- 2022 **Month from** January- June
Course Name	Comparative & Functional Genomics		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	1. Prof. Vibha Rani
	Teacher(s) (Alphabetically)	1. Dr. Chakresh Kumar Jain

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the fundamental concepts of functional genomics, transcriptomics and proteomics	Understand (C2)
CO2	Apply advanced techniques for improved diagnostics and therapeutics	Apply (C3)
CO3	Categorize different bioinformatics tools related to genomics and proteomics	Apply (C3)
CO4	Integrate and infer the bioinformatics data obtained through genomics studies	Analyze (C4)

Pre-requisite
[10B11BT511]- Introduction to Bioinformatics

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Genes and Genomes	Basics structure of gene and organization in prokaryotic to eukaryotic, features of genome structure and complexity, evolutionary conservation, type of model organism, their structure number of genes sequencing status, type of maps genetic linkage maps, physical maps, techniques used to map their significance relation with human genome	3

2.	Whole Genome Sequencing Technologies	Human genome project fact sheet, techniques used for sequencing (shot gun sequencing), mapping techniques (BAC, YAC), genome assembly problems	2
3.	Genome Annotation i.e. Mining Genomic Sequence Data	Sequential annotation, structural annotations, prediction of gene and their elements like ORF finder, promoter region, LDA method, functional genomics, Dijkstra's algorithm, application in functional correlation	3

4.	Haplotyping: Concepts and Applications	Basics of haplotyping and its application in disease	2
5.	Pharmacogenomics: Concepts and Applications in Healthcare	Basics of phylogenomic, methods used and application, Basics of pharmecogenomics and relation with disease, personalized medicine	4
6.	SNP Technologies: Platforms & Analysis	SNP structure, techniques, prevalence and application in population genetics	3
7.	Gene Silencing Mechanisms	RNAi, noncoding RNAs, Structure and biogenesis difference between SiRNA, MiRNAs, protein involve in RISC, prediction rule set, CRISPER	3
8.	Gene Cloning and Expression Platforms	Introduction: Gateway technology; Microarrays; SAGE; GIS	3
9.	DNA Protein Interactions	General; CHIP assay, EMSA; Library screening; DNA foot-printing; south western analysis; one hybrid assay	5
10.	Phage display	introduction; peptide display; antibody display; phage and phagemid system	4
11.	Protein-protein Interactions	Ribosome display; tandem affinity purification; Yeast two hybrid system, GST pull Down	4
12.	Quantitative proteomics	MALDI-TOF; LC-MS-MS, ICAT method; 2-D technology; Biomarkers; protein arrays	6
Total number of Lectures			**42**

Evaluation Criteria

Components Maximum Marks

T1 20

T2 20

End Semester Examination 35

TA 25 (Assignment-1&2, Home Assignment, Quiz and case studies)

Total 100

Project based learning: Each student was given insights to understand the concepts of drug discovery using genomics, transcriptomics and proteomics tools. To make subject application based, the students were given case studies of COVID-19 to understand and analyze latest applications of the CFG concepts. At the end of the course, students were asked to design their own hypothesis and proposal in the improvement of existing diagnostics and therapeutics against human pathologies.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	A. M. Lesk. *Introduction to Genomics*. United Kingdom (UK): Oxford University Press, 2007.
2.	T.A. Brown. Genomes-3. United Kingdom (UK): Oxford University Press, 2007.
3.	D. C. Liebler and J. R. Yates. *Introduction to Proteomics*. New York, USA: Humana Press, 2002.
4.	Protein-Protein Interactions, Methods and Applications, Editors: Meyerkord, Cheryl L., Fu, Haian (Eds.), 2015
5.	N. C. Jones and P. A. Pevzner. *Introduction to Bioinformatics Algorithms (Computational Molecular Biology)*. Massachusetts, USA: MIT Press, 2004.
6.	DNA-Protein Interactions, Principles and Protocols, Editors: Leblanc, Benoît P., Rodrigue, Sebastien (Eds.), 2015

Course Code	15B17BT671	**Semester: EVEN**	**Semester Session 2021-22** Month from Jan **to June**
Course Name	**Comparative and Functional Genomics Lab**		
Credits	1	**Contact Hours**	3
Faculty (Names)	**Coordinator(s)**	Prof. Vibha Rani	
	Teacher(s) (Alphabetically)		

COURSE OUTCOMES		**COGNITIVE LEVELS**
C374.1	Explain the basic concept of genes and genome using various databases	Understand Level (C2)
C374.2	Compare and analyze functional genomic and proteomic data using computational tools	Analyze Level (C4)
C374.3	Utilize the acquired knowledge of gene expression technologies	Analyze Level (C3)
C374.4	Apply and analyze cloning and expression of gene of interest	Analyze Level (C4)

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1-4	Basic skills of transcriptomics	RNAase free water preparation and DEPC treatment of labware	**CO2**
		RNA isolation from plant tissues	**CO2**
		Quality assessment of isolated RNA	**CO4**
		Primer designing for quantitative RT-PCR	**CO2**
5-9	Basic skills of proteomics	Induction and expression of recombinant proteins	**CO2**
		SDS-PAGE analysis of differential expression of recombinant proteins	**CO4**
		SDS-PAGE analysis of differential	**CO4**
		Gel densitometry using ImageJ	**CO4**
		Western blotting for expressed protein confirmation	**CO2**
10-12	Analysis of molecular interactions	To interpret the protein- protein interaction using STRING	**CO 3**
		Visualization of molecular interaction network and identification of crucial gene(s) using Cytoscape	**CO 1**
		Identification of clusters/Modules in a network	**CO3**

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Exam	20
End Term Exam	20
Day to Day	60
Total	**100**

Project Based Learning: Students are given independent/group project based computational experiments on analysing protein-protein interactions, or identification of crucial genes, and hubs and nodes in networks of various diseases.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Keith Wilson, John Walker. ―Principles and Techniques of Practical Biochemistry‖. Cambridge University Press, 2000
2.	https://vlab.amrita.edu/?sub=3&brch=187&sim=1331&cnt=1 (Western blotting) https://vlab.amrita.edu/?sub=3&brch=186&sim=718&cnt=1 (RNA isolation) https://www.youtube.com/watch?v=OWcMYWaYYIU (RNA isolation)
3	http://vlab.amrita.edu/index.php?sub=3&brch=273&sim=1501&cnt=1 (Primer designing)
4	http://vlab.amrita.edu/?sub=3&brch=186&sim=319&cnt=1(Polyacrylamide gel electrophoresis) https://vlab.amrita.edu/index.php?sub=3&brch=276&sim=1483&cnt=1(nIntegrating Biological Networks and Microarray Expression data)
5	Design of experiments, principle and the expected outcome and related literature will be provided to the student

Subject Code	15B19BT691	**Semester : ODD (specify Odd/Even)**	**Semester : VI Session : Month from : Jan to July**
Subject Name	**Minor 2**		
Credits	**4**	**Contact Hours**	

Faculty (Names) **Coordinator(s)** 1. Prof. Rachana

Teacher(s) (Alphabetically)

COURSE OUTCOMES		Cognitive level
C351.1	Outline the specific biotechnological problem and explain the related scientific approaches	C2
C351.2	Summarize the literature related to the specified topic	C2
C351.3	Analyze and demonstrate team effort in presentation and data analysis	C4
C351.4	Organize the data and develop scientific report writing skills	C3

PBL based learning: Minor project is methodically designed for the students so that they can learn to do literature review with a rationale behind, could identify a problem identification and formulate with a planning, to implicate to solve it in a methodological way and present in the form of power point presentations along with a report submission.

Course Code	16B1NBT633	**Semester Even (specify Odd/Even)**	**Semester 6th Session** Month from January	
Course Name	Instrumentation Techniques in Biotechnology			
Credits	**4**	**Contact Hours**	**4**	
Faculty (Names)	**Coordinator(s)**	Dr. Priyadarshini		
	Teacher(s) (Alphabetically)	Dr. Priyadarshini		

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain the principles, practices and instrumentation	Apply Level (C2)
CO2	Apply understanding of the principles, practices and instrumentation	Apply Level (C3)
CO3	Compare and contrast techniques of different instruments for their strength, limitations and creative use for problem-solving.	Apply Level (C4)
CO4	Assess sample preparation method(s) and problem solving	Apply Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic laboratory Instruments	Background of instrumentation, Principle, working and applications of centrifugation, pH meter and other basic instruments	5
2.	Microscopy techniques	Principle, working and applications of simple microscope, electron microscopy (SEM & TEM), confocal, fluorescence and phase contrast microscopy.	7
3.	Spectroscopy techniques	Principle, working and applications of UV, Visible, IR, NMR, Fluorescence, circular dichroism, Atomic Absorption spectroscopy, Surface plasmon resonance, Nuclear magnetic resonance, X-ray diffraction.	7
4.	Mass spectrometry techniques	a) Introduction to Ionisation, Mass analysers, Detectors b) Structural information by tandem mass spectrometry c) Analysing protein complexes d) Computing and database analysis	7
5.	Radioisotopic techniques	a) Principles & application of radioisotope b) The nature of radioactivity c) Detection and measurement of radioactivity	6

		d) Other practical aspects of counting of radioactivity and analysis of data e) Safety aspects	
6.	Flow cytometry	a) Principles of the Flow Cytometer b) Principles of Fluorescence c) Data Analysis d) Controls in Flow Cytometry e) Optimizing your Experiments	5
7.	Live imaging techniques.	a) Issues of maintaining cell viability during imaging b) Types of techniques and microscopy used for live-cell imaging c) Applications of Live Cell Imaging	5
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, Assignment2)
Total	**100**

Project based learning: Each student in a group of 5-6 will select a instrument which are being used in biotechnology research area and will explain about the principle and working methodology of it. Theywill also be asked to takethe recent research paper and explain the instrument used in that particular research. This will help them to select a instrument for a particular experiment.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	I. D. Campbell, Biological spectroscopy (Benjamin/Cummings Pub. Co, Menlo Park, Calif, 1984), Biophysical techniques series
2.	K. Wilson, J. M. Walker, Eds., Principles and techniques of biochemistry and molecular biology (Cambridge University Press, Cambridge, UK: New York, 7th ed., 2009).
3.	D. B. Williams, C. B. Carter, Transmission electron microscopy a textbook for materials science (Springer, New York, 2009; http://dx.doi.org/10.1007/978-0-387-76501-3).
4.	R. M. Silverstein, Spectrometric identification of organic compounds (John Wiley & Sons, Hoboken, NJ, 7th ed., 2005)
5.	Darzynkiewicz, Z., Crissman, H.A. and Robinson, J.P. (eds.) (2001) Cytometry. 3rd edition. Part A and B. Methods in Cell Biology, Volume 63 and 64, Academic Press, San Diego, USA. (ISBN 0-12-203053-2 (Part A); 0-12-203054-0 (Part B)).

Course Code	16B1NBT631	**Semester** EVEN **(specify**	**Semester** VI **Session 2021-2022** **Month from** JANUARY - MAY

		Odd/Even)	
Course Name	BIOECONOMICS		
Credits	4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**	DR. ASHWANI MATHUR
	Teacher(s) (Alphabetically)	DR. ASHWANI MATHUR

COURSE OUTCOMES		**COGNITIVE LEVELS**
C330-2.1	Relate and summarize biological products as economic resources	Understanding (Level 2)
C330-2.2	Demonstrate understanding of economic pronciples for biological resources and develop the concept of sustainability	Understanding (Level 2)
C330-2.3	Make use of neoclassic economic theories and bioeconomic principles to find a robust solution to biotechnological and sustainability issues	Applying (Level 3)
C330-2.4	Apply the knowledge of bioeconomic principles and SWOT analysis technique for developing sustainabile solution and profit maximization from fisheries and agricultural sectors	Applying (Level 3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to bioeconomics	Bio-economics- Concept, Development of Economics and Bioscience (Concept of resource economics for scarcity of biological resources), Evolution and Development of Economics and Biology (Charles Darwin and the evolutionary paradigm)	4
2.	Bioeconomics and thermodynamics	Thermodynamic analysis and thermo economics, Exergy cost, Exergetic efficiency**,** 1st and 2nd Laws of Thermodynamics applied to economics, economic processes and elasticity, entropy and utility, Concept of excergy in waste – Waste to value	5
3.	Bioeconomics and sustainability	Development of resource efficient bioeconomy, Social and economic challenges for bioeconomy, Concept of Market and Market failures, Reasons for market failures, Externalities Concept and understanding of ecological and carbon footprint	5
4	Total Economic Value of Bioresources	Understanding of total economic value (TEV) of a resource, Application of the concept of TEV to renewable and non renewable resources, Understanding of the principles behind use and non-use value, Introduction to Option and Quasi-option value	5
5.	Market and Non-market valuation methods	Understanding of different Market and Non-market valuation methods, Revealed preference and stated preference methods for estimating use and non use value,	6

		Market cost method. Application of different methods to different conditions	
6	Life Cycle Assessment and Impact Assessment	Life cycle assessment (LCA)– rationale and utility, Principles behind designing LCA, Understanding of Impact Assessment and its use in development of sustainability solutions	5
7.	SWOT analysis of Bioeconomy	Rationale and criteria for SWOT analysis of Bioeconomies and their suggested use in Bio-entrepreneurial planning	2
8	Generic bioeconomic mathematical models	Bioeconomic Models- Dynamic resource harvesting model, Dynamic optimization model, Demand-limited bionomic equilibrium, Growth and aging- The cohert model and multi cohort models	5
9	Ecological bioeconomics and bioeconomy for agriculture and fisheries	Forestry model, Inherent characteristic of fish stocks, The multi-cohert model for fisheries	3
10	Business plan writing using Bioeconomic analysis	Introduction to business plan, Role of Biotechnology entrepreneurship,	3
Total number of Lectures			43

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Class Test-1 / MCQ / Business Plan writing)
Total	100

PBL component:

Students will learn the role of use and non-use value in estimating total cost and learn to estimate TEV using recent data from various Government portals. Students will learn the concept of Kuznet curve and use data of different states of India to plot the curve and analyze its importance. The course content will help student in understanding the bioeconomic factors in policy making

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Clark, C.W. Mathematical bioeconomics, John Wiley & Sons, USA, 2010
2.	Asafu-Adjaye, J. Environmental Economics for Non-Economists, World Scientific Publishing Co. Pvt. Ltd., London, 2000
3.	Viaggi, D. The bioeconomy : delivering sustainable green growth, CAB International publishers, U.K, 2018

4.	Tukker, A. Life cycle assessment as a tool in environmental impact assessment, Environmental Impact Assessment Review, 20 (2000), 435–456
5.	Satpute,M.S., Lamdande, A.G., Kadam, V.D. and Garud, S.R. Life cycle assessment of food. Internat. J. Agric. Engg., 6(2), (2013), 558-563.
6.	Glasson, J., Therivel R., Chadwick, A. Introduction to Environmental Impact Assessment, 3rd edition, Routledge, Taylor & Francis Group, 2013
7.	Muthu, S.S. The Handbook of Carbon Footprint, CRC Press, Taylor & Francis Group, 2016

Course Code	16B1NBT 634 ELECTIV E	**Semester** EVEN	**Semester VI Semester Session** 2021-2022 **Month from** January to June
Course Name	Genetic Disorder and Personalized Medicine		
Credits	4	**Contact Hours**	4
Faculty (Names)	**Coordinator(s)**	Prof. Sujata Mohanty	
	Teacher(s) (Alphabetically)	Prof. Sujata Mohanty	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C330-1.1	Apply knowledge of genetic principles to understand disease etiology, clinical features and mode of inheritance	Apply Level (C3)
C330-1.2	Explain and interpret different molecular diagnoses and genetic test results	Understand Level (C2)
C330-1.3	Analyze the role of population and quantitative genetics for genetic disorders	Analyze Level (C4)
C330-1.4	Develop the concept of Personalized Medicine and integrate information from HGP databases	Apply Level (C3)
C330-1.5	Assess the genetic counseling process and its impact from a cultural, ethical and psychosocial perspective	Evaluate Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Genetic Disorder and Principles of their Inheritance	Introduction to Medical Genetics, Genetic Disorder and Concern, Clinical Features, Genetic Principles to Understand Disease Etiology, and Mode of Inheritance, Pedigree analysis and carrier screening	08
2.	Genetic Screening and DNA Banking	Preventive Genetics; DNA Banking and Clinical DNA Testing, Cytogenetic, Molecular and Biochemical Common as well as Modern Technology based Genetic Tests and their Results Interpretation	08
3.	Population and Quantitative Genetics	Application of population genetics in genetic risk calculation within Family/Population, heritability factor estimation	06

4.	Case studies	Case studies; Epigenetics, Uniparental disomy, Mosaicism, Inborn errors of metabolism, cancer genetics etc.,	06
5.	Human Genome Projects	Human Genome Projects and Outcomes: Initial Reference Genome, 100,000, Encode, Gencode and the future prospects, Integration of genomic information in Biomedical Sciences, Related Databases	06
6.	Concept of Personalized Medicine	Personalized Medicine, Study of Genetic resources (OMIM, Gene tests, Gene clinics etc.)	04
7.	Genetic counseling	The Genetic Counseling Process and Its Impact from a Cultural, Ethical and Psychosocial Perspective	04
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment 1, Class Test, assignment 2)
Total	**100**

PBL: Students after learning the modes of inheritance, will do small projects on various case studies with regards to appropriate genetics screening, carrier screening, % of transmission risk and also will make the family pedigree chart. In addition, students will do projects on comparative genomics using the available genomic information of biomarkers associated with genetic disorders and can understand the concept of Personalised Medicine. Human Genome projects on rare genetic disorders will provide students to explore more on population or lineage specific genetic diseases.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	A.J.F. Griffiths, S.R. Wessler, R.C. Lewontin, S.B. Carroll, *Introduction to Genetic Analysis* ,9th Ed, WH Freeman, 2015
2.	C. Szalai (Eds), *Genetics and Genomics*, 1st Edition, Tipotex, 2014
3.	S. Gersen, M. B. Keagle (Eds), *The Principles of Clinical Cytogenetics*, Humana Press, 2010

4.	M.R. Speicher, A.G. Motulsky, and S.E. Antonarakis (Eds)*Vogel and Motulsky's Human Genetics*. Berlin Heidelberg: Springer, 2010
5.	E.S. Tobias, M. Connor, M.F. Smith, *Essential Medical Genetics*, 7th Ed, John Wiley & Sons
6.	*Genetic disorder and related databases* e.g. *Indian Genetic Disease Database (http://www.igdd.iicb.res.in/IGDD/home.aspx),* *Rare Disorder by Ministry of health and family welfare (https://mohfw.gov.in/diseasealerts/rare-diseases), Clinical genomic databases (https://research.nhgri.nih.gov/CGD/)*
7.	Current research articles relevant to this subject will be provided as study materials and discussed in the class.

Semester & Session	VI Semester	Credits	4	Contact Hours L T P	4 4 - -

Faculty (Names)	Coordinator(s)	Vibha Gupta
	Teacher(s) (Alphabetically)	1. Vibha Gupta

Course Name: Anti-Microbial Resistance

COURSE OUTCOMES		COGNITIVE LEVELS
S. No.	**Course Outcomes**	**Cognitive levels**
C331-1.1	Explain the importance of antimicrobials and emerging resistance	**C2**
C331-1.2	Describe the biological mechanisms of antibiotic resistance	**C2**
C331-1.3	Analyze antimicrobial susceptibility tests	**C4**
C331-1.4	Support Antibiotic stewardship	**C5**

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Course overview	Basic overview of antibiotic resistance; Importance of optimizing antimicrobial usage for maintaining cost-effective therapies	2
2.	Antimicrobial Classes	Discovery and History of antibiotics, importance of antibiotics, Different classes of antimicrobials (bacterial, Viral & fungal) and their mode of action	6
3.	**Mechanisms of Resistance**	Molecular mechanisms of Resistance; Emergence and spread of resistance; Microbial resistance – a global issue	6
4.	Techniques for detection of resistance	Antimicrobial susceptibility tests; methods for detecting antimicrobial resistance; Obtaining good results; interpretation of antimicrobial susceptibility results; genomic analysis tools to detect resistance genes	10
5.	New antimicrobial approaches	Alternative therapies to antibiotics – phage therapy, probiotics, vaccines, etc.	7
6.	Antimicrobial Stewardship	Roles and responsibilities of different stakeholders in antimicrobial stewardship (including physician, pharmacist, microbiologist, hospital administrators); Case studies - Antimicrobial stewardship strategies	10

		by WHO, ICMR etc.	
Total number of Contact hours			**41**

Evaluation Criteria

Components	**Maximum marks**
T1	20
T2	20
End term	35
TA	25
Total	**100**

Project based Learning: Students in groups of 4 to 5 will be engaged in a project - Awareness Program Against Antimicrobial Resistance (APAAR) under which they (i) will collect and analyze data on Antibiotic knowledge and usage by all so as to be able to analyze the present AMR scenario in India and (ii) will carry out a survey to understand current prescription behavior of doctors (iii)will try to understand the cost involved in treatment of drug resistant versus drug sensitive infection taking examples of commonly prevalent diseases such as TB, Typhoid, Pneumonia etc

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Kateryna Kon and Mahendra Rai "Antibiotic Resistance: Mechanisms and New Antimicrobial Approaches" Academic press 2016
2.	CARD - Comprehensive Antibiotic Resistance Database (https://card.mcmaster.ca/) site for information on publicly available resistance genes and related information.
3.	Research papers and Reports provided as per the course content.

Course Code	16B1NPH636	**Semester: Even**	**Semester: VI Session** 2021-2022 **Month from:** January to June
Course Name	**Medical & Industrial Applications of Nuclear Radiation**		
Credits	4	**Contact Hours**	4
aculty (Names)	**Coordinator(s)**	Dr. Papia Chowdhury	
	Teacher(s) (Alphabetically)	Dr. Papia Chowdhury & Dr. Manoj Tripathi	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C302-11.1	Define nuclear structure, properties and reactions; Nuclear magnetic resonance process.	Remembering (C1)
C302-11.2	Explain models of different nuclear imaging techniques; CNO cycle; principle of radioactive decays.	Understanding (C2)
C302-11.3	Apply knowledge of nuclear reaction mechanisms in atomic devices, dosimetry, radiotracers, medical imaging, SPECT, PET, tomography etc.	Applying (C3)
C302-11.4	Analyze different radiocarbon dating mechanisms and processes.	Analyzing (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Nucleus, Radioactivity & Dating	Structure of matter**;** Nucleus:Nuclear Size, Structure and forces; Binding energy and Nuclear stability, mass defect;Nuclear reaction: Fission, Fusion, chain reaction. Nuclear fusion in stars, Formation of basic elements: proton- proton chain, CNO cycle, Hydrostatic equilibrium; Applications: atom bomb, hydrogen bomb, nuclear power plants, Nuclear reactor problems, precautions. **ii)**Radioactive decay, kinetics of radioactive decay, Types of radioactive decay and their measurement, Half life, decay constant, Population of states, Production of radionuclides. Radioactive dating, Radiocarbon dating: Formation, mechanism of dating, carbon cycle, radiocarbon clock and applications, advantages, disadvantages, precautions; Other dating techniques, protein dating, accuracy in dating;	**17**

2.	Radiation and matter interactions	Dosimetry and applications: Interaction of Radiation of matter: Biological effects of radiations; dosimetry, working principles, Tools and radiotherapy, Doses, Radioisotopes, Radiotracers;	09
3.	NMR and MRI	Nuclear Magnetic Resonance: General Introduction to Magnetic Resonance, Reference Frame; RF Pulses, Larmor precision, Basic principles of NMR & ESR Spectroscopy, Nuclear shielding, Chemical shifts; Couplings, Nuclear Imaging; 1D,2D, 3D Images, Application of NMR in medical industry as MRI, working MRI, Types of differen MRI, Applications of NMR in quantum computation;	09
4.	Nuclear Medicine and Nuclear Imaging	Nuclear Medicine and Nuclear imaging techniques, preclinical imaging, detector designing, photon counting, Medical imaging using β+γ coincidences, SPECT AND PET: Radiation tomography, applications;	05
		Total number of Lectures	**40**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 [2 Quiz (10 M), Attendance (10 M) and Cass performance (5 M)]
Total	**100**

PBL: Different groups of students with 5-6 students in each group may be formed and these groups may be given to complete a task like identifying common applications to nuclear science, recent developments in medical applications, etc. These problem domains (elemental and content analysis, materials modification, radiation gauging, solid/liquid Interface, and heart imaging) may be also chosen based on their potential interest to students. Students may be given a task of presenting the working of devices like MRI, PET scan, X-rays and other imaging techniques. Within each of these problem domains, the students will learn to work in a team. It will improve their analytical skills and the students will learn to achieve their common goal through mutual discussion and sharing of knowledge, information & understanding.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Basic Sciences of Nuclear Medicine; Magdy M K halil, Springer
2.	Physics and Radibiology of Nuclear Medicine; Gopal B Saha, Springer

3.	A. Beiser, Concepts of Modern Physics, Mc Graw Hill International.
4.	Radionuclide Techniques in Medicine, JM McAlister (Cambridge University Press, 1979).
5.	Nuclear Physics; S.N.Ghosal

Course Code	19B12HS612	Semester: Even	**Semester VI** **Session** 2021 -2022 **Month from** Jan 2021 to June 2021
Course Name	Social Media and Society		
Credits	3	**Contact Hours**	2-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Shirin Alavi	
	Teacher(s) (Alphabetically)	Dr. Shirin Alavi	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-1.1	Infer the implications of digital change, and the concept of social media and e-marketing in the context of the changing marketing landscape	Apply Level(C3)
C304-1.2	Elaborate the implications of cyber branding and digitization on online marketing mix decisions	Create Level (C6)
C304-1.3	Develop specific models related to social media and social media analytics	Create Level (C6)
C304-1.4	Evaluate concepts related to Search Engine Marketing, Customer Centric Web Business models and Web Chain Analysis	Evaluate Level(C5)
C304-1.5	Illustrate the new age marketing practices	Understand Level (C2)

Modu le No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction, Individuals Online and Rules for engagement for social media	What is social media marketing, the importance of social media for influencing target audience, Patterns of internet usage, Internet user demographics, The Behavioural Internet, E-Marketing, The Virtual world, the changing Marketing Landscape, E -	4

		Marketing-Strengths and Applications, Online Marketing Domains, Digital Marketing Optimization, The Need for Digital Engagement	
2.	The Online Marketing Mix	The Online Marketing Mix, Consumer Segmentation, Consumer Traits, Consumers and Online Shopping Issues, E-Product, E-Place, E-Price, E-Promotion, Website Characteristics affecting online purchase decision.	3
3.	The Online Consumer and Social Media	The Digital Ecosystem, Online Consumer Behavior, Cultural Implications of key web characteristics, Models of website visits, Web 2.0 and Marketing, The collaborative web, Network evolution, Network science, Marketing with networks, Metcalfe's law, Netnography, Social Media Model by McKinsey, Social Media Tools-Blogs, Wikis, Online Communities, Facebook, Twitter, You Tube, Flickr, Microblogging.	4
4.	Online Branding and Traffic Building	Cyber branding, Online brand presence and enhancement, The Digital Brand Ecosystem, Brand Experience, Brand Customer Centricity, Brands and Emotions, The Diamond Water paradox, Internet Traffic Plan, Search Marketing Methods, Internet Cookies and Traffic Building, Traffic Volume and quality, Traffic Building Goals, Search Engine Marketing, Keyword Advertising, Keyword value, Internet Marketing Metrics, Websites and Internet Marketing.	4
5.	Web Business Models, Social Media Strategy, Social Media Marketing Plan	The value of a Customer Contact, Customer Centric Business Management, Web Chain of Events, Customer Value Analysis and the Internet, Business Models, Revenue Benefits, Value Uncertainty, Purchase Importance, Define a social media plan, explain the social Media marketing planning cycle, list the 8C's of strategy development.	4
6.	Market Influence analytics in a Digital Ecosystem	Engagement Marketing through Content Management, Online Campaign Management, Consumer Segmentation, Targeting, and Positioning using Online Tools, Market Influence Analytics in a Digital Ecosystem, The Digital Ecosystem, Knowledge as a value proposition, CGM and Consumer behavior, The value of the power of influence, Amplifying Social Media Campaigns.	4

7.	The Contemporary Digital Revolution and its impact on society	Online Communities and Co-creation, The fundamentals of online community management strategies, The World of Facebook, The Future of Social media Marketing—Gamification and Apps, Game based marketing The world of Apps, Apps and the Indian Diaspora	3
8.	Integrating Mobile into Social Media Marketing	Types of Mobile Marketing, Progression of the mobile as a Marketing channel, some Indian mobile marketing campaigns, Impact of Social Media on government, the economy, development, and education	2
		Total number of Lectures	**28**

Project Based Learning: The project is to be done in a group size of 4 -5 members. Students were asked to identify one brand/company on social media. Read the information available on social media and browse through campaigns. Study the consumer engagement and comments. Write their opinion about it. Analyze the same with a social media tool and compare the results. Also identify and elucidate the strategies used by the brand in the context of online branding. This helped the students to understand concepts of cyber branding and social media analytics and enhanced their employability skills in an organization.

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Viva and Attendance)
Total	**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Digital Marketing, Chaffey, D., & Ellis-Chadwick, F, Seventh Edition, Pearson (U.K) 2019.
2.	Digital Marketing, Seema Gupta, First Edition, Mc Graw Hill Education (India) Private Limited ,2018
3.	Social Media Marketing A Strategic Approach, Melissa Barker, Donald Barker, Second Edition Cengage Learning ,2017.
4.	Internet Marketing: A Practical Approach in the Indian Context, Maity, Moutusy, First Edition Oxford University Press, 2017.

5.	Fundamentals of Digital Marketing, Puneet Singh Bhatia, Second Edition, Pearson,2017.
6.	Digital Marketing, Vandana Ahuja, First Edition, Oxford University Press, 2015
7.	Social Media Marketing, Liana "Li" Evans, First Edition, Pearson, 2011.

Course Code	18B12HS611	**Semester EVEN** (specify Odd/Even)	**Semester VI Session** 2021-2022 **Month from: Jan - June**
Course Name	Marketing Management		
Credits	**3**	**Contact Hours**	**(2-1-0)**
Faculty (Names)	**Coordinator(s)**	Dr Swati Sharma	
	Teacher(s) (Alphabetically)	Dr Praveen Sharma, Dr Swati Sharma	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-7.1	To illustrate the fundamentals of marketing, marketing environment and market research	Understanding Level (C2)
C304-7.2	To model the dynamics of marketing mix	Applying Level (C3)
C304-7.3	To demonstrate the implications of current trends in social media marketing and emerging marketing trends.	Understanding Level (C2)
C304-7.4	To appraise the importance of marketing ethics and social responsibility	Evaluating(C5)
C-304-7.5	To conduct environmental analysis, design business portfolios and develop marketing strategies for businesses to gain competitive advantage.	Creating (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Understanding New Age Marketing**	Defining Marketing For 21st Century The importance of marketing and marketing's role in business and society. Introduction to Digital Marketing. Online Communication Tools. The Social Media-Conversations, Community and Content.	5

		Affiliate Marketing and Mobile Engagement. The Digital Campaigns	
2	**Marketing Environment and Market Research and insights**	Internal and external forces impacting marketers. Marketing and Customer Value. Gathering Information and Scanning the environment. Company's Micro and Macro Environment Responding to the Marketing Environment	3
3	**Strategic Planning and the marketing Process**	Explore the impact of social forces on marketing actions. Describe how technological change affects marketing. Designing the business Portfolio Discuss the Strategic Planning Process and Strategic Marketing Process.	5
4	**Consumer and Business Buyer Behaviour**	Consumer Markets and consumer buyer behaviour. The buying decision process. Business Markets and business buyer behaviour. Discuss the modern ethical standards.	5
5	**Branding**	Brand Image, Identity and Association. Product brands and Branding decisions. Product line and mix decisions. Consumer Brand Knowledge. New Product Development and Product life cycle strategies.	4
6	**Pricing products: Pricing considerations and strategies**	Factors to consider when setting prices. New product pricing strategies. Product mix pricing strategies. Price adjustments and changes.	4
7	**The New Age Social Marketing**	Ethics and social responsibility in marketing. Ethical behavior in business. Ethical decision making. Social forces affecting marketing. Impact of culture on marketing. Discuss modern ethical standards. Importance of marketing in CSR and business sustainability.	2
		Total number of Lectures	**28**

Evaluation Criteria

Components	Maximum Marks
T 1	20
T 2	20
	35

Project Based Learning: Students will be assessed on a Project report. The students will present a business plan for a prospective business idea focusing on its marketing strategies applying all the concepts taught in the course

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Kotler, Philip and Gary Armstrong, Principles of Marketing, 10th Edition, New Delhi, Pearson Education, 2004.
2.	Darymple, Douglas J., and Leonard J. Parsons, Marketing Management: Text and Cases, 7th Edition, John Wiley & Sons (Asia) Pte. Ltd., 2002.
3.	Kotler, Philip., and Kevin Lane Keller, Marketing Management, 12th Edition, New Delhi, Pearson Education, 2006.
4.	Winer, Russell S., Marketing Management, 2nd Edition, Prentice Hall,2003.
5.	Hollensen, S. (2019). Marketing management: A relationship approach. Pearson Education.

Subject Code	**16B1NHS632**	**Semester: EVEN**	**Semester 6th Session 2021-2022 Month from Jan to June**
Subject Name	**COGNITIVE PSYCHOLOGY**		
Credits	**3**	**Contact Hours**	**2-1-0**
Faculty (Names)	**Coordinator(s)**	**Dr. Badri Bajaj**	
	Teacher(s) (Alphabetically)	**Dr. Badri Bajaj**	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-4.1	Understand and apply the concepts of cognitive psychology in everyday life	Applying Level (C3)
C304-4.2	Analyze the different models of various cognitive processes	Analyzing Level (C4)
C304-4.3	Evaluate cognitive psychology issues and recommend possible solutions	Evaluating Level (C5)
C304-4.4	Evaluate interventions/solutions for self-development through cognitive processes	Evaluating Level (C5)

Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	Introduction to Cognitive Psychology	Historical Background: Emergence of modern cognitive Psychology; Approaches: Information Processing and PDP Model; Research Methods	**3**
3.	Perceptual Processes	Perceptual learning and development; perception of shape, space, and movement.	**4**
3.	Attention	Selective Attention and Divided Attention: Meaning, Definition, and Theories.	**4**
4.	Memory	Short Term Memory	**3**
5.	Imagery	Properties of mental images; Representation of images and cognitive maps.	**3**

6.	Language	Structure of language and its acquisition, speech perception, factors affecting comprehension.	**4**

7.	Thinking and Problem Solving	Types of thinking; Classification of problems; Problems solving approaches, Problems space theory by Newell and Simon, Creativity	**4**
8.	Decision Making	Logical reasoning types and errors i Concept formation and categorization; Judgment and decision making	**3**
Total number of Hours			**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Project, Assignment, Oral Questions)
Total	**100**

Project based learning: Students in a group will choose a research topic from the syllabi of cognitive psychology. Students will cover the following points to prepare project reports: Understanding of concept, related theories and perspectives; Describe the relevance of the chosen concept for personal growth; Discuss the application of chosen topic for your professional life; Elaborate the relevance of the topic at group level and societal level. Discussions on these practical aspects will enhance students' understanding & application of concepts of cognitive psychology in everyday life.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Ronald T. Kellogg, Fundamentals of Cognitive Psychology, 2nd Ed., Sage Publishing, 2012
2.	Robert Solso, Otto Maclin, M. Kimberly Maclin, Cognitive Psychology, 8th Ed., Pearson Education, 2013
3.	Kathleen M. Galotti, Cognitive Psychology, 5th Ed., Sage Publishing, 2014
4.	Michael W. Eysenck, Mark T. Keane, Cognitive Psychology: A Student's Handbook , 7th Ed, Psychology Press, 2015

5.	Robert Sternberg, Karin Sternberg, Cognitive Psychology, 6th Ed, Wadsworth/Cengage Learning, 2011
6.	Edward E. Smith, Stephen M. Kosslyn, Cognitive Psychology: Mind and Brain, Ist Ed, Pearson Education India; 2015

Course Code	**20B16CS322**	**Semester Even**	**Semester VI** **Session** 2021 - 2022 **Month from** Feb to Jun
Course Name	**Java Programming**		
Credits	Audit	**Contact Hours**	1-0-2

Faculty (Names)	**Coordinator(s)**	Dr. Shruti Jaiswal, Ms. Shradha Porwal
	Teacher(s) (Alphabetically)	Dr. Amarjeet Prajapati, Kashav Ajmera, Mr. Prantik Biswas, Dr. Raghu, Ms. Shradha Porwal, Dr. Shruti Jaiswal,

COURSE OUTCOMES At the completion of the course, Students will be able to		**COGNITIVE LEVELS**
C305-8.1	Write basic Java programs using Java constructs – loops, switch-case and arrays.	Understand Level (C2)
C305-8.2	Define all basic concepts related to OOP concepts	Remember Level (C1)
C305-8.3	Develop java programs using Java collection framework	Apply Level (C3)
C305-8.4	Create or design an application based on Java programming constructs	Create Level (C6)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Overview of OOA (Object Oriented Analysis) and Java basics	Classes, Objects, OOPs concept using JAVA, Packages and Interfaces.	**3**
2.	JVM Internals	Memory management, Garbage Collection	**1**
3.	String Handling	Using String and StringBuilder class. String Immutability(toString())	**2**
4.	Exception Handling in JAVA	Fundamentals, Exception types, Java built-in exceptions, Custom Exceptions, Chained Exceptions.	**2**
5.	Collections Framework	Collection Overview, List, Map (hashCode& Equals), Set, Queue & other collections	**4**
6.	Multithreading in Java	Multithreading overview and requirement, Thread state diagram, Java multithreading implementation (Thread/Runnable), Challenges in multithreading/Mutual Exclusion, Java handling of mutual exclusion (synchronization), Communication between threads (wait/notify)	**2**
		Total number of Lectures	**14**
Evaluation Criteria			

Components	Maximum Marks
Mid Tern Evaluation	30
End Semester Examination	40
TA	30 (Attendance = 07, Quizzes = 08, Internal assessment = 07, Assignments in PBL mode = 08.)
Total	**100**

Project based learning: Assignments on different topics are given to each student. They utilize the java concepts and try to solve different problems given as assignments. The course emphasized on the Skill development of students in Java Programming. Topics like inheritance, classes, exception handling, multithreading, collection frameworks, etc. are taught to enhance the programming skills of the students for making them ready for employability in software development companies.

Recommended Reading material:	
Text Books	
1.	Schildt, H. (2014). *Java: the complete reference*. McGraw-Hill Education Group.
2.	Bloch, J. (2016). *Effective java*. Pearson Education India.
Reference Books	
1.	Sierra, K., & Bates, B. (2005). Head First Java: A Brain-Friendly Guide. " O'Reilly Media, Inc.".
2.	Mughal, K. A., & Rasmussen, R. W. (2003). A programmer's guide to Java certification: a comprehensive primer. Addison-Wesley Professional.

Course Code	16B1NHS631	**Semester Even**	**Semester 6th Session** 2021 -2022 **Month from January 2021to June 2021**
Course Name	PROJECT MANAGEMENT		
Credits	3	**Contact Hours**	2-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Swati Sharma, Dr. Deepak Verma	
	Teacher(s) (Alphabetically)	Dr. Deepak Verma	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-5.1	Apply the basic concepts of project management such as features, objectives, life cycle, model and management, in a given context	Apply Level (C3)
C304-5.2	Analyze projects and their associated risks by understanding the various theoretical frameworks, non-numerical and numerical models in order to make correct selection decisions	Analyze Level (C4)
C304-5.3	Evaluate the stages of project management and identify and determine correct techniques for planning and scheduling	Evaluate Level (C5)
C304-5.4	Evaluate management processes for budgeting, controlling and terminating projects in order to achieve overall project success	Evaluate Level (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Project Management: Introduction	Characteristics of project; Life Cycle of Project; Project Model; Project Management as discipline; Contemporary aspects of Project Management	4
2.	Project Selection	Theoretical Models; Non-numeric models; Numeric Models; Financial Models; Project Portfolio process, Significance and applicability of Monte Carlo simulation	6
3.	Project Organization, Manager and Planning	Pure Project organization; Functional Organizations; Mixed organizations; Matrix organizations; Role, Attitudes and Skills of Project Manager, Project Coordination, Systems Integration, Work Breakdown Structure, Linear Responsibility Charts.	4
4.	Risk Management	Theoretical Aspects of risk, Risk Management process, Numeric Techniques, Hillier model,Sensitivity Analysis,	4

		Certainty Equivalent approach and Risk adjusted discount rates, Game theory.	
5.	Project Scheduling and Resource Allocation	Theoretical aspects-Importance, Focus Area-PERT/CPM, AOA and AON charts, Probability Analysis, Gantt Charts, Crashing of Projects- Time and Cost tradeoff, Basics-Resource Leveling and Loading.	6
6.	Budgeting, Control and Project Termination	Estimating Project Budgets, Improving the process of cost estimation, Basics, Importance, Purpose of control, Types of Control, Desirable features of Control, Control Systems, Critical Ratio Method, Control of creative activities, Control of change and scope creep, Why Termination, Types of termination, typical termination activities.	4
Total number of Lectures			**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Project, Oral Questions)
Total	**100**

Project Based Learning: Students are supposed to form a group (Maximum 5 students in each group) and identify a real-life project. They are supposed to do the in-depth study of this project and assess it in terms and Time, cost, performance and client satisfaction. They are supposed to do the detailed study of project planning, organizing, scheduling, leading and controlling. They must highlight the various tools and techniques which are used in their chosen project. The project provides understanding to students that how organizations are managing their projects and what is the relevance and appropriate usage of the concepts, tools and techniques that they are studying in this subject. The fundamentals of Project management are very important in today's corporate world and certainly this subject enhances student's employability in every sector.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Meredith, Mantel, Project Management-A Managerial Approach, 10th Edition, Wiley Publications,2017
2.	Timmothy Kloppenborg, Contemporary Project Management, 5th[t] Edition, Cengage Learning, 2017
3.	Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling,12th Edition, Wiley Publications,2017
4.	Wysocki, R. K., Effective Project Management: Traditional, Agile, Extreme, Hybrid, 8th Edition, Wiley Publications,2018

5.	Vohra, N. D., Quantitative Techniques in Management, 5th Edition, Tata McGraw Hill Publishing Company, 2017

Course Code	20B12HS311	**Semester** Even **(Specify Odd/Even)**	**Semester Session** 2021-2022 **Month from** Jan - July
Course Name	Global Politics		
Credits	3(2-1-0)	**Contact Hours**	**3**
Faculty (Names)	**Coordinator(s)**	Dr. Chandrima Chaudhuri	
	Teacher(s) (Alphabetically)	Dr. Chandrima Chaudhuri	

CO Code	**COURSE OUTCOMES**	**COGNITIVE LEVELS**
C304-9.1	Demonstrate an understanding of the meaning and nature of globalization by addressing its political, economic, cultural and technological dimensions	Understanding (C2)
C304-9.2	Analyzing the significance of contemporary global issues	Analyze (C4)
C304-9.3	Analyze how the global politics shapes domestic politics	Analyze (C4)
C304-9.4	Demonstrate an understanding of the working of the global economy, its anchors and resistances offered by global social movements	Understanding (C2)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Globalization: Conceptions and Perspectives	Political Dimension of globalization and Culture Technological Dimensions Debates on territoriality and sovereignty	6

2.	Global Economy	Its Significance and Anchors of Global Political Economy: IMF- history and India's benefit from its membership of IMF WTO- History and India's experience with WTO and reform proposals World Bank- history and role of world Bank in India Rise of TNCs and role of TNCs in globalization Global resistances (Global Social Movement and NGOs)-their nature and characteristics , prominent movements and their impact	8
3.	Contemporary Global Issues-I	Ecological Issues: historical overview of international environmental agreements-UNSCD, Paris agreement, climate change- Copenhagen summit to post Copenhagen summit policies of India, climate change and global initiatives global commons debate Proliferation of Nuclear Weapons-history of nuclear proliferation, threat of proliferation with increase in globalization	8
4.	Contemporary Global Issues-II	International Terrorism: globalization and global terrorism, impact of terrorism on globalization, role of non-state actors and state terrorism; the US and war on terrorism Migration and Human Security- globalization, violent extremism and migration; new global regime	6
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Attendance, Quiz, Project)
Total	**100**

Project Based learning: Each student would form a group of 3-4 students and to make projects on issues such as climate change, terrorism and proliferation of nuclear weapons. This project would help the students in having a better idea about the contemporary global issues and how with the revolution in information and technology as a result of globalization has impacted the world. This would improve their research skills and enhance their knowledge about the impact of globalization on various sectors

of the economy.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	C. Hay, Ed. *New Directions in Political Science: Responding to the Challenges of an Interdependent World.* New York, USA: Palgrave Macmillan Education, 2010
2.	D.Held & A. McGrew, *Globalization/Anti-globalization: Beyond the Great Divide*. Cambridge, UK: Polity Press, 2007
3.	F. Halliday, "Terrorism in Historical Perspective"., *Open Democracy*. 22 April, 2004 [Online] Available: http://www.opendemocracy.net/conflict/article_1865.jsp
4.	J. Baylis and S. Smith, Ed.*The Globalization of World Politics: An Introduction to International Relations*. Oxford, UK: Oxford University Press, 2017
5.	L.Gordon and S. Halperin, "Effective Resistance to Corporate Globalization" in *Contesting Global Governance,* R.O'Brien, A.M. Goetz, J.C. Scholte & M.Williams. Cambridge, UK: Cambridge University Press,2000

Course Code	18B12MA611	**Semester** Even	**Semester** VI **Session** 2021-2022 **Month from** January to June	
Course Name	Operations Research			
Credits	4		**Contact Hours**	3-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Neha Sighal		
	Teacher(s) (Alphabetically)	Prof. Pato Kumari Dr. Amita Bhagat		

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C302-3.1	construct mathematical models for optimization problems and solve linear programming problems (LPP) using graphical and simplex method.	Applying Level (C3)
C302-3.2	apply two-phase, Big-M and dual simplex method for linear programming problems.	Applying Level (C3)
C302-3.3	make use of sensitivity analysis to linear programming problems.	Applying Level (C3)
C302-3.4	solve transportation, assignment and travelling salesman problems.	Applying Level (C3)
C302-3.5	apply cutting plane and branch & bound techniques to integer programming problems.	Applying Level (C3)
C302-3.6	examine optimality conditions and solve multivariable nonlinear problems.	Analyzing Level (C4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Preliminaries	Introduction, Operations Research Models, Phases and Scope of O.R. Studies.	3
2.	Linear Programming Problems (LPP)	Convex Sets, Formulation of LPP, Graphical Solutions, Simplex Method, Big-M Method, Two Phase Method, Special Cases in Simplex Method.	8
3.	Duality and Sensitivity Analysis	Primal-Dual Relationship, Duality, Dual Simplex Method, Sensitivity Analysis.	8

4.	Transportation Problems	Introduction, Matrix Form, Applications, Basic Feasible Solution- North West Corner Rule, Least Cost Method, Vogel's Approximation Method. Degeneracy, Resolution on Degeneracy, Optimal Solution, Maximization TP Model.	5
5.	Assignment Problems	Definition, Hungarian Method, Traveling Salesmen Problems.	4
6.	Integer Linear Programming Problems	Pure and Mixed Integer Linear Programming Problems, Cutting Plane Method, Branch and Bound Method.	6
7.	Non Linear Programming	Introduction to NLP, convex functions and graphical solution, Unconstrained Problem, Constrained Problems - Lagrange Method for equality constraints, Kuhn-Tucker Conditions for inequality constraints, Quadratic Programming - Wolfe's Method	8
Total number of Lectures			**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, Tutorials)
Total	**100**

Project based learning: Each student in a group of 4-5 will collect literature on transportation, assignment and integer programming problem to solve some practical problems. To make the subject application based, the students analyze the optimized way to deal with afore mentioned topics.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Taha, H. A. - Operations Research - An Introduction, Pearson Education, 2005.
2.	Hadley, G. - Linear Programming, Massachusetts: Addison-Wesley, 1962.
3.	Hiller, F.S. and Lieberman, G. J. - Introduction to Operations Research, San Francisco, 1995.
4.	Wagner, H. M. - Principles of Operations Research with Applications to Managerial Decision, PHI, 1975.
5.	Vohra, N. D., Quantitative Techniques in Management, Second Edition, TMH, 2003.
6.	Taha, H. A. - Operations Research - An Introduction, Pearson Education, 2005.

Detailed Syllabus

Course Code	**16B1NHS 531**	**Semester : Even (specify Odd/Even)**	**Semester : VI Session: 2021 - 2022** Month from: Feb- June 2021
Course Name	**Sociology of Youth**		
Credits	**3**	**Contact Hours**	**(3-0-0)**

Faculty (Names)	**Coordinator(s)**	**Prof Alka Sharma**
	Teacher(s) (Alphabetically)	**Prof Alka Sharma** **Shikha Kumari**

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-13.1	Demonstrate an understanding of Youth and youth culture in sociological perspectives	Understanding (C 2)
C304-13.2	Explain the ethical, cultural& social issues concerning Youth	Evaluating(C 5)
C304-13.3	Examine the relative importance of structure and agency in shaping young people's experiences and life opportunities	Analyzing(C 4)
C304-13.4	Evaluate youth experience in a context of social change	Evaluating(C 5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Youth	Meaning and characteristics of youth, demographic profile of youth in India, Challenges faced by Youth, Youth's roles and responsibilities in society	4
2.	Youth Culture	Concept of Youth Culture, role of Popular culture in shaping youth culture,	4
3.	Perspectives on Youth Culture	Functionalist, Conflict, Interactionist and Feminist Perspective on Youth Culture, Youth and Gender	5
4.	Youth and Identity	Social divisions: sexuality, urban and rural youth, social identities: subcultural, digital, Experiences of youth to negotiate identities in contemporary societies	8
5.	Socialization of	Concept and processs of socialization, Internalization	9

	Youth	of norms, types of socialization, conditions of learning, internalized objects, theories of socialization, stages of socialization, adult socialization, agents of socialization, role of culture in socialization, socialization and cultural differences, importance of socialization, Failure of the socialization process	
6.	Problems of Youth	Role and Value conflicts, Generation Gap, Career decisions and Unemployment, Emotional adjustment, Coping with pressures of living, Unequal Gender norms, Crime (Social Strain theories),	8
7.	Changing perceptive of Youth and Youth Culture in 21st century	involvement of youth in major decision making institutions, Post-modernity and Youth, Youth Unrest	4
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20 (Project based)
T2	20
End Semester Examination	35
TA	25 (Presentation, Assignment, attendance, Quiz and Participation in Tutorial)
Total	**100**

PBL- Each student will identify the variables shaping their identity and aspirations. In what ways do they do this? (Another way to think about this question: How do these social forces or institution provide you with the chance to pursue your goals? How do they limit your life chances?)

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Tyyskä, V. *Youth and Society: The long and winding road*, 2nd Ed., Canadian Scholars' Press, Inc. (2008).
2.	White, Rob, Johanna Wyn and Patrizia Albanese. *Youth & Society: Exploring the Social Dynamics of Youth Experience.* Don Mills, ON: Oxford University Press, 2011.
3.	Bansal, P. *Youth in contemporary India: Images of identity and social change*. Springer Science & Business Media, 2012.
4.	Furlong, Andy. *Youth studies: An introduction*. Routledge, 2012.
5.	Blossfeld, Hans-Peter, et al., eds. *Globalization, uncertainty and youth in society: The losers in a globalizing world*. Routledge, 2006.

6.	Ruhela, Satya Pal, ed. Sociology of the teaching profession in India. National Council of Educational Research and Training, 1970.
7.	Frith, S. "The sociology of youth. Themes and perspectives in sociology." Ormskirk, Lancashire: Causeway Books , 1984.

Course Code	21B12HS311	**Semester: EVEN (specify Odd/Even)**	**Semester: VI Session:2021-2022** Month from: Jan-June
Course Name	Development Issues and Rural Engineering		
Credits	03	Contact Hours	2-1-0
Faculty (Names)	**Coordinator(s)**	Dr. Amandeep Kaur	
	Teacher(s) (Alphabetically)	Dr. Amandeep Kaur (amandeep.kaur@mail.jiit.ac.in)	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C304-10.1	Understand the concept, philosophy and determinants of rural development	Understanding Level- (C2)
C304-10.2	Assess public policies related to rural development	Analyze Level – (C4)
C304-10.3	Explain the role of local self-governance in planning and development of rural areas.	Understanding Level- (C2)
C304-10.4	Analyze the impact of recent policy changes and schemes on rural development.	Analyze Level – (C4)
C304-10.5	Evaluate the issue and challenges of through possible determinants of rural development.	Evaluation Level- (C5)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Rural Development: An Introduction	Rural Development Philosophy, Concepts, Principles, Traditional and Modern Concept of Development, Trends and Pattern of micro as well as macro indicators of Rural Development.	4
2.	Public Policies and Rural Development	Policies related to Employment Generation, Poverty Reduction, Skill Development and, Infrastructure such as MGNGEGA, DDUGKY, Atam Nirbhar Bharat rojgar yojna and schemes related to MSMEs etc.	6

3.	Rural Development Administration and Panchayat Raj Institutions	Rural Development administration: Panchayat Raj System (73rd Amendment Act), functions of Panchayat Raj System, Financial Distribution of Resources in Rural India through Panchayat Raj System, merits and demerits of Panchayat system, Ways to strengthen the existing system by overcoming the flaws.	6
4.	Rural Development Issues and Challenges	Issues and challenges of Rural development: Employment in line with sectoral distribution (GDP and Employment), Poverty and Migration Issue, Rural and Urban Consumption and Production Linkages.	7
5.	Recent Advancements and changes	Recent packages and schemes implemented in Rural India, Budget Allocation for Rural Development - 2019-20 and 2020-21: For Employment Generation, poverty reduction, infrastructure and MSMEs.	5
		Total number of Lectures	**28**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Assignment, Quiz, Project)
Total	**100**

Project-based Learning: Students are required to collect the data related to different indicators of rural development (related to agriculture, health and education infrastructure, literacy levels, population density, poverty, employment etc.). They also need to check the compatibility of data (data mining and data refining process) and then analyse the contribution of these indicators in rural development of particular state/country as whole. Moreover, they are required to analyse the extent of progress and failure of programmes/schemes implemented in rural areas for poverty reduction, employment generation and MSMEs. Collecting information and analysing the data related to development indicators and policies will upgrade students' knowledge regarding the development issues and strengthen their skills to tackle multiple data handling and measuring issues.

Recommended Reading material:

1.	**Singh, Katar.** Rural Development: Principles, Policies and Management *(3e).*2009
2.	**Coke, P., Marsden, T. and Mooney, P.** Handbook of Rural Studies. Sage Publications, 2006
3.	**Todaro, M.P**., **Stephen C. Smith,** Economic Development, Pearson Education, 2017

3.	**Ahuja, H. L.**, Development Economics, S Chand publishing, 2016
4.	**Musgrave, R. A., Musgrave, P. B.,** Public Finance in Theory and Practice, McGraw Hill Education,2017

Course Code	**20B16CS326**	**Semester** Even	**Semester VI Session** 2021 -2022 Month from Feb to Jun
Course Name	Front End Programming		
Credits	3	**Contact Hours**	1-0-2

Faculty (Names)	**Coordinator(s)**	Mr. Janardan Verma (J62), Dr. Shailesh Kumar(J128)
	Teacher(s) (Alphabetically)	Janardan Verma, Kapil Madan, Kritika Rani, Mahendra Gurve, Shailesh Kumar

COURSE OUTCOMES		**COGNITIVE LEVELS**
C305-11.1	Demonstrate new technologies by applying foundation paradigms	Understanding [Level 2]
C305-11.2	Build strong foundations for basic front end tools & technologies thereby making them understand the application development lifecycle.	Apply [Level 3]
C305-11.3	Develop elegant and responsive Front-end by leveraging latest technologies	Apply [Level 3]
C305-11.4	Explain activity creation and Android UI designing	Understanding [Level 2]
C305-11.5	Develop an integrated mobile application to solve any complex real time problem	Create [Level 6]

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Object Oriented Programming Concepts	Objects, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism	1
2.	Introduction to basic front-end techniques	HTML 5, CSS 3, Javascript, jquery, bootstrap	3
3.	Java Fundamentals	Decision Making, Loop Control, Operators, Array, String, Overloading, Inheritance, Encapsulation, Polymorphism, Abstraction	2
4.	Advanced Front-End Programming Concepts	Storing and retrieving data, Python Programming Concepts, Python for developing Android Application.	2

5.	Designing Android Application	Android development lifecycle, Learning UI and layout, controller, component, Directives, Services & views.	3
6.	Android with Database	Data base Application Development	2
7.	Privacy & Security Issues	Security Issues with Android Platform	1
Total number of Lectures			**14**

Evaluation Criteria

Components	**Maximum Marks**
Mid Semester Examination	30
End Semester Examination	40
TA	30 (**Attendance-10, Assignments/ Class Test/ Quiz/ LAB Record - 05, Project -15**)
Total	**100**

Project based learning: In this subject student will learn the latest front-end technology. After completing the subject, each student in a group of 3-4 will be able to create a mobile application.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

Reference Books:

1.	Schildt, H. (2014). Java: The Complete Reference. McGraw-Hill Education Group.
2.	Mughal, K. A., & Rasmussen, R. W. (2016). A Programmer's Guide to Java SE 8 Oracle Certified Associate (OCA). Addison-Wesley Professional.
3.	Gaddis, T., Bhattacharjee, A. K., & Mukherjee, S. (2015). Starting out with Java: early objects. Pearson.

Text Books:

4.	Duckett, J. (2014). Web Design with HTML, CSS, JavaScript and jQuery Set. Wiley Publishing.
5.	Shenoy, A., & Sossou, U. (2014). Learning Bootstrap. Packt Publishing Ltd.
6.	Lee, W. M. (2012). Beginning android for application Development. John Wiley & Sons.
7.	Hardy, B., & Phillips, B. (2013). Android Programming: The Big Nerd Ranch Guide. Addison-Wesley Professional.

Course Code	**15B11BT414**	**Semester** Even	**Semester** VI **Session** **Month from** January to June
Course Name	Immunology		
Credits	4	**Contact Hours**	6
Faculty (Names)	**Coordinator(s)**	Prof. Rachana	
	Teacher(s) (Alphabetically)	Dr Rachna, Dr Shalini Mani	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO216.1	Differentiate between innate & adaptive immunity and explain the role of cells as well organs of immune system.	Understand level (C2)
CO216.2	Compare different antigens, immunogens, antibodies as well as their interactions and regulations	Understand level(C2)
CO216.3	Identify the inappropriate immune response in autoimmunity, hypersensitivity, immunodeficiency and infectious disease.	Apply level (C3)
CO216.4	Analyze different techniques based on antigen-antibody interactions and their use in diagnostics and therapeutics.	Analyze level (C4)
CO216.5	Apply the concepts of immunology in vaccine designing and production of monoclonal antibodies	Apply level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Basic immunology	Historical perspectives, Cells and organs of the immune system	3
2.	Types of immunity	innate and acquired immunity	3
3.	Antigens	Immunogenicity, antigenicity, epitopes, haptens, mitogens	2
4.	Immunoglobins : structure and function	Basic structure and fine structure of Igs, immunoglobin classes, hybridoma technology, antibody engineering	4
5.	Antigen-antibody interactions	Theory, cross reactivity, precipitation reactions, agglutination reactions, RIA, ELISA, Western blotting, immunofluorescence	4

6.	B cell and T cell receptor	Organization and expression of immunoglobulin genes : Generation of antibody diversity, class switching, T cell receptor complex, TCR coupled signaling pathways, co-stimulatory signals	**5**
7.	Major histocpmatibilit y complex (MHC) and HLA	General organization and inheritance of MHC, structure of MHC class I and II molecules, peptide binding by MHC molecules, MHC and susceptibility to disease, Tissue and organ transplantation	**3**
8	Regulation of immune response and immunological tolerance	Cytosolic and endocytic pathway, Responses in humoral and cell mediated branch and immunological tolerance	2
9	Immune effector mechanisms	Complement system, Cytokines	3
10	Autoimmunity	Types of autoimmune diseases	2
11	Hypersensitivit y reactions	Type I, II, II and IV, hypersensitivity reactions	2
12	Vaccines	Types, active and passive immunization	3
13	Immune response to infectious diseases and tumor immunity	Viral, bacterial, protozoan diseases, parasitic infections	4
14	Immunodeficie ncy diseases	Primary and secondary immunodeficiency diseases, Acquired immunodeficiency syndrome (AIDS)	2
Total number of Lectures			**42**

Evaluation Criteria	**Maximum Marks**
Components	20
T1 T2	20
End Semester Examination TA	35
Total	25 (assignment, class test, quiz, case study)

PBL based learning: Students will be asked to search and identify relevant topics in the area of Immunology and the topics will be taken up in groups of 3 – 4 students and will be discussed/presented in the class. This

will train students to search the database and take decision to choose and explore application based topics and share/present with their peers.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	***Immunology (3rd edition),*** *Janus Kuby, W.H. Freeman and company*
2.	**Essentials of Immunogy** Ivan- roit; 6th edition (1988); Blackwell Publ
3.	**Antibodies A laboratory Manual** Harlow and David Lane, Old spring Harbor Laboratory
4.	**Immunology – A Short Course**, Richard Coico, *et al*. 5th Ed., Wiley – Liss, 2003.
5.	**Immunology, 4th Ed** Richard Hyde. Lippincott Wilkins & Wilkins, 2000.
6.	**Microbiology & Immunology Online.** Richard Hunt. Univ South Carolina, School of Medicine, http://pathmicro.med.sc.edu/book/immunol-sta.htm

Course Code	21B13BT311	**Semester** Even	**B.TechSemester** VI **Session** 2022 -2023 Month from **January- June**
Course Name	Biorisk and Biosecurity		
Credits	**Value Added Course**	**Contact Hours (per week)**	2

Faculty (Names)	**Coordinator(s)**	Ashwani Mathur
	Teacher(s) (Alphabetically)	Dr. Ashwani Mathur

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Compare and classify the potential Biorisk agents	**Understand Level (C2)**
CO2	Identify various hazards associated with biological agents	**Apply Level (C3)**
CO3	Explain the importance of biosafety and biosecurity in laboratories and industries	**Understand Level (C2)**
CO4	Examine Biosafety measures and Biosecurity surveillance	**Analyze Level (C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Biorisk	Introduction to risk associated with biological materials, potential hazardous organisms and samples. Understand biological agent and associated biohazards	6
2.	Hazard identification	Human microbiota, pathogen and virulence factors, zoonotic agents of research animals, Hazards of plant pathogen, pathogens to human health, laboratory associated infections, nosocomial infections	6
3.	Risk assessment of biological Hazards	Assessment of the risks associated with hazardous agents- bacterial pathogens, viral, mycotic agents and biological toxins, molecular agents,	6
4.	Introduction to Biosafety and Biosecurity	Understanding biosafety, Safety in laboratories, biosafety in large scale production, Biosafety in pharmaceutical industry, biosafety guidelines for different containment level, Bioterrorism and Bioaccident, Introduction to biosecurity	6

	Elements of Biosecurity	Primary barriers and equipment for biosecurity, Biosecurity Surveillance strategies, Biosecurity surveillance in food and agriculture sector	6
		Total number of Lectures	**30**

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Examination	30
End Semester Examination	40
TA	30 (Assignments / Quiz / Reports/ Class Test)
Total	**100**

Project based Learning: The students will learn about potential biorisk associated with biological material, along with risk analysis approach. The knowledge of elements of security and safety measures associated with the risks, will help students being an intellectual resource for Institutions and organizations dealing with biological agents and organisms their working with them following good laboratory practices. The students will be submitting the assignment where potential risk situation (case studies) will be discussed with them and they will be advised to explore a solution in context to risk and plan a safety and security strategy.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	Dawn P. Wooley, Karen B. Byers, Biological Safety: Principles and Practices- 3rd Edition, Wiley Publishers, **2020** [ISBN: 9781555819637]

Mathematical Modelling in Biotechnology (21B12MA311)

Course Description

Course Code	21B12MA311	**Semester** - Even	**Semester** VI **Session** 2021-22 **Month from** Jan 2022 - Jun 2022		
Course Name	**Mathematical Modelling in Biotechnology**				
Credits	3	**Contact Hours**	3-0-0		
Faculty (Names)	**Coordinator(s)**	Dr. Yogesh Gupta			
	Teacher(s) (Alphabetically)	Dr. Yogesh Gupta			

COURSE OUTCOMES		**COGNITIVE LEVELS**
After pursuing the above mentioned course, the students will be able to:		
C302-12.1	explain basic concepts of mathematical modelling in Biotechnology.	Understanding Level (C2)
C302-12.2	apply difference equations in mathematical modelling.	Applying Level (C3)
C302-12.3	make use of ordinary differential equations in mathematical modelling.	Applying Level (C3)
C302-12.4	construct and solve mathematical models using system of differential equations.	Applying Level (C3)
C302-12.5	apply partial differential equations and numerical methods to solve various models.	Applying Level (C3)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Mathematical Modelling	Classification of mathematical models. Procedure, merits and challenges of mathematical modelling. Applications of algebra, geometry, calculus etc. in mathematical modelling.	6
2.	Mathematical Modelling through Difference Equations	Basic theory and methods for difference equations, Homogeneous and non-homogeneous difference equations, Difference equations in discrete models of population dynamics and genetics, Discrete Prey-Predator models.	8
3.	Mathematical Modelling through Ordinary Differential Equations	Formation of differential equations, Methods of ordinary differential equations, First order and higher order ODEs, Eigen values and eigen vectors, Stability and bifurcation, Applications in continuous models such as Growth models, Decay models, Newton's Law of Cooling, Population dynamics, Continuous Prey-Predator models and other models.	11
4.	Applications of System of Differential Equations	Methods for system of simultaneous ordinary differential equations, Applications in Mathematical models of infectious diseases, The Kermack-McKendrick model, Epidemic models- SI, SIR, SIRS, SIRD etc.	8
5.	Applications of Partial	Basic concepts, methods and applications of partial differential equations, Numerical methods in	9

	Differential Equations and Numerical Methods in Mathematical Modelling	modelling, Euler method, Runge-Kutta method, some applications in Biotechnological processes.	
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (Quiz , Assignments, PBL etc.)
Total	**100**

Project based learning: Each student in a group of 4-5 will apply the concepts ofdifferential equations, system of differential equations and numerical methods in mathematical models of biosciences applications such as epidemic modeling, human physiology etc.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)

1.	**J. N. Kapur,**Mathematical Modeling, New Age International 2005.
2.	**L. Edsberg,** Introduction to Computation and Modeling for Differential Equations, John Wiley and Sons 2008.
3.	**D. S. Jones**, Differential Equations and Mathematical Biology, Chapman & Hall/CRC Mathematical Biology and Medicine Series 2005.
4.	**S. Banerjee,** Mathematical Modeling: Models, Analysis and Applications, CRC Press 2014.
5.	**Ching-Shan Chou, Avner_Friedman,** Introduction to Mathematical Biology, Springer International Publishing Switzerland 2016.

Course Code	**21B13HS311**	**Semester Even (specify Odd/Even)**	**Semester VI Session 2021 - 2022** **Month from Jan 2021-June 2021**
Course Name	**Poverty, Inequality and Human Development**		
Credits	**2**	**Contact Hours**	**1-0-2**
Faculty (Names)	**Coordinator(s)**	Dr Akarsh Arora	
	Teacher(s) (Alphabetically)	Dr Akarsh Arora	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C305-13.1	Understand the concepts and dimensions of Poverty, Inequality and Human Development	Understand (Level 2)
C305-13.2	Evaluate different approaches to measure Poverty, Inequality and Human Development	Evaluate (Level 5)
C305-13.3	Apply an analytical framework to understand the factual or proximate causes or determinants of Poverty and Inequality	Apply (Level 3)
C305-13.4	Analyze the role of public policy and affirmative action to tackle Poverty and Inequality and strengthen Human Development.	Analyze (Level 4)

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Concepts and Dimensions	Concepts and Dimensions of Poverty, Inequality and Human Development	3
2.	Measurement	Measurement of Poverty and Inequality: Steps and Axioms. Steps to calculate Human Development	4
3.	Data Sources	Census Data, Unit level Household Data, Geospatial Data, Satellite Image Data	2

4.	Determinants	Determinants/ Factors: Demographics, Household, Individual, and Macroeconomic variables Introduction to Stata, Regression- Linear and Binary models	3
5.	Public Policies and Affirmative Actions	Review of different public policies of GOI to eradicate poverty. Role of education and health care policies to strengthen human development	2
Total number of Lectures			**14**

Module No.	**Title of the Module**	**List of Experiments/Activities**	**CO**
1.	Concepts and Dimensions	Practical sessions on different dimensions of poverty and inequality.	CO1, CO2
2.	Measurement	Practical sessions on STATA software to measure poverty, inequality, and human development.	CO1, CO2
3.	Data Sources	Practical sessions on key survey issues and problems while collecting data on poverty, inequality and human development.	CO2, CO3
4.	Determinants	Practical sessions on STATA software to find and interpret the determinants of poverty using regression analysis.	CO2, CO3
5.	Public Policies and Affirmative Actions	Practical sessions on the impact of different Government of India policies and programmes on poverty, inequality and human development.	CO3, CO4

Evaluation Criteria

Components	**Maximum Marks**
Mid Term	30 (Project)
End Term	40 (Written)
TA	30 (Class Mock Activities, Assignment, Quiz)
Total	**100**

Project based Learning: Students, in groups of 2-3, are required to submit a detailed report on the measurement of poverty and inequality for the selected Indian state. Students are expected to follow official poverty estimation reports in India and measure poverty in a genuine sense based on the existing poverty methodology. They also need to check the data's compatibility, process the data after cleaning for various issues and analyse poverty and inequality at aggregated and disaggregated levels. Furthermore, they need to support findings/ arguments based on previous research studies. Measurement, interpretation and empirical-based argumentation in this sense will upgrade students' knowledge regarding economic development issues and strengthen their skills to tackle extensive and multiple data sets and develop their

core competencies in respect of social data science.	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	A. V. Banerjee and E. Duflo, *Poor Economics: A Radical Rethinking of the Way to Fight Global Poverty*. New York: Public Affairs, 2011
2.	J. Haughton and S. R. Khandker, *Handbook on Poverty and Inequality*. Washington, DC: The World Bank, 2009.
3.	A. Tarozzi and A. Deaton, "*Using census and survey data to estimate poverty and inequality for small areas*," The review of economics and statistics, vol. 91, no. 4, pp. 773-792, 2009.
4.	D. Ray, *Development Economics*, 19 ed. New Delhi, India: Oxford University Press, 2012
5.	A. Sen, *On Economic Inequality*. Oxford: Clarenson Press, 1997.
6.	S. Alkire and M. E. Santos, "*Acute Multidimensional Poverty: A New Index for Developing Countries*," OPHI WORKING PAPER. 2017.

Course Code	19B13BT311	**Semester** Even **(specify Odd/Even)**	**Semester** VI **Session 2021-22** Month from **Jan-June**
Course Name	Nanoscience in Food Technology		
Credits	2	**Contact Hours**	2

Faculty (Names)	**Coordinator(s)**	Prof. Sudha Srivastava
	Teacher(s) (Alphabetically)	Prof. Sudha Srivastava

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain properties of nanoparticles and nanoemulsions	**Understand Level (C2)**
CO2	Outline food processing, packaging and preservation	**Understand Level (C2)**
CO3	Apply nanotechnology concepts to improve food quality, texture, and shelf life	**Apply Level (C3)**
CO4	Analyze food quality degradation and pathogens detection, using nanosensors	**Analyze Level (C4)**

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	Introduction to Nanomaterials	Introduction to nanomaterials, nanoemulsions, method of synthesis and identification of nanoemulsions	5
2.	Food Packaging and Preservation	Introduction to food processing, packaging and preservation. Modified atmosphere packaging, active packaging and intelligent packaging.	6
3.	Application of nanotechnology in Food and agriculture	Microemulsions for delivery of nutraceuticals, edible films and coating for food, Polymer nanocomposites, effect of nanomaterials on mechanical, thermal and barrier properties of polymers. Application of nanotechnology for pesticide delivery, nutrient uptake etc. Nanomaterials in Food- Health and Safety Issues	7
4.	Biosensors for monitoring food quality	Time temperature indicators, pathogen detection using biosensors, Pesticide detection using biosensor.	6
		Total number of Lectures	**24**

Evaluation Criteria	
Components	**Maximum Marks**
Mid Term	30
End Term	40
TA	30 (Assignment, Presentations, Project based Evaluation **)**
Total	**100**

PBL: Students will choose any application of nanotechnology in food science and give a report/presentation in a group or individually. If possible they can visit some food industry and write a report on that.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Vellaichamy Chelladurai, Digvir S. Jayas, 2018 Nanoscience and Nanotechnology in Foods and Beverages CRC Press, ISBN 9781498760638
2.	Recent Research papers

Course Code	21B12CS311	**Semester odd (specify Odd/Even)**	**Semester VI Session** 2021 -2022 **Month from** Jan21 to May21
Course Name	Software Development Principles and Practices		
Credits	**3**	**Contact Hours**	**3-0-0**
Faculty (Names)	**Coordinator(s)**	Aparajita Nanda	
	Teacher(s) (Alphabetically)	NA	

COURSE OUTCOMES		**COGNITIVE LEVELS**
CO1	Explain software engineering principles and software process models for project development.	Understand Level (Level 1)
CO2	Analyze software requirements and document software requirements specification.	Analyze Level (Level 4)
CO3	Design and develop the system models for software development.	Apply Level (Level 3)
CO4	Apply risk management principles and processes to determine risk and its mitigation plans.	Apply Level (Level 3)
CO5	Assess softwaíe quality using vaíious metíics	Evaluate Level Level 5

Module No.	**Title of the Module**	**Topics in the Module**	**No. of Lectures for the module**
1.	**Introduction to Software Engineering**	Introduction to software engineering principles, Software process models(build and fix model, waterfall model, Incremental process model, Evolutionary- Prototype and Spiral models. Introduction to Agile Methodologies , Project planning, and Project Scheduling.	7

2.	**Requirement Engineering**	Balancing Development Needs with Organizational Expectations, Writing Requirements and Requirements Specifications, Quality Assurance of Requirements, Types of requirement, Prioritizing Requirements, SRS.	7
3.	**Software Design**	Use case diagram, State diagram, Activity Diagram, Class Diagram, Sequence diagram, Collaboration diagram, Deployment Diagram, Component Diagram and Package diagram. Design Modularity: Coupling Cohesion.	8
4.	**Risk Assessment and management**	Task Analysis, Accident Theory, Accident Investigation and Reporting, Accident Statistics, Safety Inspection Procedures, Disaster Planning, Risk Management Systems, Analysis of risk at various stages of SDLC, Tools and techniques	5
5.	**Software Metrics**	Size-Oriented Metric, Functional Point metric, Function- oriented Metric, Halstead's Software Metric, Information Flow Metric, Objectoriented Metric, Class-Oriented Metric, COCOMO Model.	6
6.	**Software Testing and Debugging**	White-Box Testing, Basis Path Testing, Control Structure Testing: Condition Testing, Data Flow Testing, Loop Testing, Black-Box Testing: Equivalence class partitioning, Boundary Value Analysis, Decision table testing, Cause effect graphing, Mutation Testing and regression Testing. Debugging and its types.	9
		Total number of Lectures	**42**

Evaluation Criteria

Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25 (**Attendance-05, Assignments/Quiz/Mini Project-20**)
Total	**100**

Project based learning: Each student in a group of 4-5 will choose an application or problem Software Development Principles to understand the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment. To make subject application based, the students demonstrate an understanding of current theories, models, and techniques that provide a basis for the software lifecycle. Expose students to current technologies and issues that provide ability to use the techniques and tools necessary for engineering practice and employability into software industries.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Roger S. Pressman and Bruce R Maxim, "Software Engineering: A practitioner approach", 8th Edition-McGraw-Hill - ISBN: 978-0-07-802212-8
2.	Sommerville , "Software Engineering" , Seventh Edition - Addison Wesley
Other Reference books	
3.	GRADYBOOCH**,** JAMES RUMBAUGH**,** IVAR JACOBSON, The Unified Modeling Language User Guide, Addison Wesley, Reading, Massachusetts.
4.	Richard Thayer , "Software Engineering Project Management", Second Edition - Wiley-IEEE Comp Society Press.
5.	B. Bezier, "Software Testing Techniques", Second Edition- International Thomson Computer Press.
6.	Pankaj Jalote, "An Integrated Approach to Software Engineering" Third addition , Springer Press

Detailed Syllabus Lab-wise Breakup

Course Code	15B17BT474	**Semester** Even	**Semester** 6 **Session** 2021 -2022 **Month from** January to June
Course Name	Immunology Lab		
Credits	1	**Contact Hours**	2
Faculty (Names)	**Coordinator(s)**	Dr Sonam Chawla	
	Teacher(s) (Alphabetically)	Ms. Manisha Singh, Prof Rachna, Prof. Sudha Srivastava	

COURSE OUTCOMES		**COGNITIVE LEVELS**
C276.1	Understand and learn skills for purification of antibody for experimental procedures.	C2
C276.2	Demonstrate relationship between different antigens using basic immunological techniques.	C2
C276.3	Apply immunological techniques for quantifying antigen/ antibody in the given sample.	C3
C276.4	Apply basic knowledge and skills of immunological principles and techniques for diagnostic assays.	C3

Module No.	**Title of the Module**	**List of Experiments**	**CO**
1.	Purification of antibody	Ammonium sulphate precipitation of crude immunoglobulins from serum.	C276.1
2.	Purification of	Desalting of crude precipitated immunoglobulin by dialysis.	C276.1
3.	Purification of antibody	Chromatographic separation of immunoglobulin using DEAE-cellulose columns.	C276.1
4.	Purification of	Quantification of amount of immunoglobulin at different	C276.1

	antibody	steps of its purification.	
5.	Quantification of antigen/ antibody concentration	Quantification of antibody concentration using Precipitin assay.	C276.3
6.	Quantification of antigen/ antibody concentration	Quantification of antibody concentration using Single Radial Immuno Assay (SRID)/Mancini‟s test.	C276.3
7.	Demonstrate relationship between different antigens	Demonstrating relationship among the antigens using Ouchterlony Double Diffusion Assay (ODD).	C276.2
8.	Demonstrate relationship between different antigens	Analysing antigens from their complex mixture (serum) using Immunoelectrophoresis.	C276.2
9.	Principles of	Demonstrate the presence of antigen in the given sample by using latex agglutination assay.	C276.4
10.	Principles of	Detecting presence of antigen using DOT-BLOT ELISA, the basic principle behind pregnancy and other diagnostic kits.	C276.4
11.	Principles of	Demonstrating the principle and functioning of pregnancy kit.	C276.4
12.	Principles of	Determining the presence and concentration of antibody/antigen in the sample using ELISA, the basic technique behind various diagnostic tests.	C276.4

PBL based learning: The experiments for this course are designed in a way that the students will learn from the scratch to purify the antibodies from crude serum and will learn to use them for different applications such as detecting and identifying antigens in unknown samples. Students also learn latest techniques like ELISA which are used diagnosing pregnancy and HIV etc.

Evaluation Criteria

Components	**Maximum Marks**
Lab Record	15
Performance based test	15

Mid term viva voce	20	
End term viva voce	20	
Day to day evaluation		20
Attendance		10
Total		**100**

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	J.A Owen, J.Punt, S. A. Stanford, P. P Jones, Janus Kuby Immunology (7^{th} edition), W.H. Freeman and company, 2009
2.	Harlow and D.Lane, Edward A. Greenfield Ed, Antibodies: A laboratory Manual, 2^{nd} edition Old spring Harbor Laboratory, 2014