



MCKV INSTITUTE OF ENGINEERING

NAAC Accredited "A" Grade Autonomous Institute under UGC Act 1956
Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal

243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India

Ph: +91 33 26549315/17 Fax +91 33 26549318 Web: www.mckvie.edu.in/

Curriculum for Undergraduate Degree (B.Tech.) in Information Technology (w.e.f. AY: 2020-21)

Part III: Detailed Curriculum

Eighth Semester

Course Name:	Mobile Computing		
Course Code:	PE-IT801A	Category:	Professional Elective Course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Computer Networking
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn the basics of mobile computing
2	To learn the different architectures of mobile computing
3	To build an application of mobile computing

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Personal Communications Services (PCS): PCS Architecture, Mobility management, Networks signaling. Global System for Mobile Communication (GSM) system overview: GSM Architecture, Mobility management, Network signaling.	5L
2	General Packet Radio Services (GPRS): GPRS Architecture, GPRS Network Nodes. Mobile Data Communication: WLANs (Wireless LANs) IEEE 802.11 standard, Mobile IP.	5L
3	Wireless Application Protocol (WAP): The Mobile Internet standard, WAP Gateway and Protocols, wireless mark up Languages (WML). Wireless Local Loop (WLL): Introduction to WLL Architecture, wireless Local Loop Technologies.	6L
4	Third Generation (3G) Mobile Services: Introduction to International Mobile Telecommunications 2000 (IMT 2000) vision, Wideband Code Division Multiple Access (W-CDMA), and CDMA 2000, Quality of services in 3G.	6L



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5	Global Mobile Satellite Systems: case studies of the IRIDIUM and GLOBALSTAR systems. Wireless Enterprise Networks: Introduction to Virtual Networks, Blue tooth technology, Blue tooth Protocols.	7L
6	Mobile Security: Threat and Security Issues in Mobile Computing: General Security Issues, Wireless Security Issues, Device Security Issues, Personnel security issues, How to handle security issues.	4L
7	Server-side programming in Java: Pervasive web application architecture, Device independent example application	7L
Total		40L

Course Outcomes:

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

1	Apply the basic concepts of Mobile computing
2	Apply the knowledge of various architecture in Mobile computing
3	Apply the concepts of protection and security mechanisms

Learning Resources:

1	“Pervasive Computing”, Burkhardt, Pearson
2	“Mobile Communication”, J. Schiller, Pearson
3	“Wireless and Mobile Networks Architectures”, Yi-Bing Lin & Imrich Chlamtac, John Wiley & Sons, 2001
4	“Mobile and Personal Communication systems and services”, Raj Pandya, Prentice Hall of India, 2001.

Course Name:	Cryptography and Network Security		
Course Code:	PE-IT801B	Category:	Professional Core Course
Semester:	Eighth	Credit:	3
L-T-P:	3 - 0 - 0	Pre-Requisites:	Computer Networks
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To familiarize the students with Cryptography: Concepts, Techniques & Algorithm.
2	To introduce the student about the major concepts involved in Internet Security Protocols & User Authentication.



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3	To familiarize the students with the Firewall.
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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction, Need for Security, Security approaches, Principles of Security, Types of attack	5L
2	Cryptography: Concepts & Techniques- Introduction, Plaintext & Cipher text, Substitution Techniques, Transposition Techniques, Encryption & Decryption, Symmetric & Asymmetric key Cryptography, Key Range & Key Size	7L
3	Symmetric Key Algorithm - Introduction, Algorithm types & Modes, Overview of Symmetric Key Cryptography, DES(Data Encryption Standard) algorithm, IDEA(International Data Encryption Algorithm) algorithm, RC5 (Rivest Cipher 5) algorithm.	7L
4	Asymmetric Key Algorithm, Digital Signature and RSA - Introduction, Overview of Asymmetric key Cryptography, RSA algorithm, Symmetric & Asymmetric key Cryptography together, Digital Signature, Basic concepts of Message Digest and Hash Function (Algorithms on Message Digest and Hash function not required).	8L
5	Internet Security Protocols, User Authentication - Basic Concepts, SSL protocol, Authentication Basics, Password, Authentication Token, Certificate based Authentication, Biometric Authentication.	6L
6	Electronic Mail Security - Basics of mail security, Pretty Good Privacy, S/MIME.	4L
7	Firewall - Introduction, Types of firewall, Firewall Configurations, DMZ Network	3L
Total		40L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe information security concepts and techniques.
2	Explain Cryptographic Algorithms.
3	Explain Internet Security Protocols & Firewall.



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Learning Resources:	
1	“Cryptography and Network Security”, William Stallings, 2nd Edition, Pearson Education Asia
2	“Network Security private communication in a public world”, C. Kaufman, R. Perlman and M. Speciner, Pearson
3	"Cryptography & Network Security", Atul Kahate, TMH.
4	“Network Security Essentials: Applications and Standards” by William Stallings, Pearson.
5	“Designing Network Security”, Merike Kaeo, 2nd Edition, Pearson Books
6	“Building Internet Firewalls”, Elizabeth D. Zwicky, Simon Cooper, D. Brent Chapman, 2nd Edition, Oreilly .
7	“Practical Unix & Internet Security”, Simson Garfinkel, Gene Spafford, Alan Schwartz, 3rd Edition, Oreilly
8	“Cryptography and Network Security”, V.K. Jain, Khanna Publishing House, 2017.

Course Name:	Natural Language Processing		
Course Code:	PE-IT801C	Category:	Professional Elective Course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	PE-IT501A (Theory of Computation)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To grasp the significance of natural language processing in solving real-world problems.
2	To map the appropriate processing technique to a problem and implement the technique.
3	To demonstrate required design skills for large collection sets.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Regular Expressions and Automata (Recap) - Introduction to NLP, Regular Expression, Finite State Automata Tokenization - Word Tokenization, Normalization, Sentence Segmentation, Named Entity	11L



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	Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance Morphology - Morphology – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer	
2	Language Modeling Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. Hidden Markov Models and POS Tagging Markov Chain, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based- and Machine Learning based approaches, Evaluation.	8L
3	Text Classification, Naïve Bayes’ Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic CFG, Dependency Parsing.	8L
4	Introduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity Information Retrieval Boolean Retrieval, Term document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback	9L
Total		36L

Course Outcomes:

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

1	Describe the fundamental concepts and techniques of natural language processing.
2	Distinguish among the various techniques of NLP, taking into account the assumptions, strengths, and weaknesses of each.
3	Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.
4	Analyze large volume text data generated from a range of real-world applications.



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Learning Resources:	
1	“Speech and Language Processing”, Jurafsky and Martin, Pearson Education.
2	“Foundation of Statistical Natural Language Processing”, Manning and Schutze, MIT Press.
3	“Multilingual Natural Language Processing Applications from Theory to Practice” : Bikel, Pearson.

Course Name:	Embedded System with IOT		
Course Code:	PE-IT801D	Category:	Professional Elective Courses
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Mobile computing, VLSI
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand fundamentals of IoT and embedded system including essence, basic design strategy and process modeling
2	To understand fundamentals of security in IoT, and to learn to implement secure infrastructure for IoT
3	To learn real world application scenarios of IoT along with its societal and economic impact using case studies

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	<p>Introduction to Embedded System and Internet of Things: Embedded Systems: Application Domain and Characteristic of Embedded System, Real time systems and Real-time scheduling, Processor basics and System-On-Chip, Introduction to ARM processor and its architecture.</p> <p>IoT: Definition and characteristics of IoT, Internet of Things: Vision, Emerging Trends, Economic Significance, Technical Building Blocks, Physical design of IoT, Things of IoT, IoT Protocols, Logical design of IoT, IoT functional blocks IoT communication models, IoT Communication APIs IoT enabling technologies, IoT levels and deployment templates, IoT Issues and Challenges, Applications</p>	5L



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2	Embedded IoT Platform Design Methodology: Purpose and requirement specification, Process specification, Domain model specification, information model specification, Service specifications, IoT level specification, Functional view specification, Operational view specification, Device and component integration, Application development.	5L
3	Pillars of Embedded IoT and Physical Devices: Horizontal, verticals and four pillars of IoT, M2M: The internet of devices, RFID: The internet of objects, WSN: The internet of transducer, SCADA: The internet of controllers, DCM: Device, Connect and Manage, Device: Things that talk, Connect: Pervasive Network, IoT Physical Devices and Endpoints: Basic building blocks of and IoT device. Exemplary device: <ul style="list-style-type: none"> ▪ Raspberry Pi, Raspberry Pi interfaces, ▪ Programming Raspberry Pi with Python, ▪ Beagle board and Other IoT Devices 	7L
4	IoT Protocols and Security: Protocol Standardization for IoT, M2M and WSN Protocols, SCADA and RFID Protocols, Issues with IoT Standardization, Unified Data Standards, Protocols – IEEE 802.15.4, BACNet Protocol, Modbus, KNX, Zigbee Architecture, Network layer, APS layer. IoT Security: Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling, Key elements of IoT Security: Identity establishment, Access control, Data and message security	7L
5	Web of Things and Cloud of Things: Web of Things versus Internet of Things, Two Pillars of the Web, Architecture Standardization for WoT, Platform Middleware for WoT, Unified Multitier WoT Architecture, WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing, Cloud Middleware, Cloud Standards – Cloud Providers and Systems, Mobile Cloud Computing, The Cloud of Things Architecture.	8L
6	IoT Physical Servers, Cloud Offerings and IoT Case Studies: Introduction to Cloud Storage Models, Communication API, WAMP: Autobahn for IoT, Xively Cloud for IoT, Python Web Application Framework: Django, Amazon Web Services for IoT, Skynet IoT Messaging, Platform. Case Studies: Home Intrusion Detection, Weather Monitoring System, Air Pollution Monitoring, Smart Irrigation.	8L
Total		40L



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Course Outcomes:

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

1	Implement an architectural design for IoT for specified requirement
2	Solve the given societal challenge using IoT
3	Choose between available technologies and devices for stated IoT challenge

Learning Resources:

1	Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", Pearson Education, Second Edition, 2014.
2	Adrian McEwen, Hakim Cassimally "Designing the Internet of Things", John Wiley and Sons, 2014.
3	Michael J. Pont, "Embedded C", Pearson Education, 2007.
4	Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
5	Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 2006.
6	IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
7	Andrew N Sloss, D. Symes, C. Wright, "Arm System Developers Guide", Morgan Kaufman/ Elsevier, 2006.
8	Arshdeep Bahga, Vijay Madiseti, "Internet of Things: A Hands-on Approach", VPT, 2014.

Course Name:	Image Processing		
Course Code:	PE-IT 801E	Category:	Professional Elective Course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	MATLAB programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To learn the basics of Image processing
2	To learn the principles of processing the different steps of Image processing
3	To build an application of Image processing



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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction: Background, Digital Image Representation, Fundamental steps in Image Processing, Elements of Digital Image Processing - Image Acquisition, Storage, Processing, Communication, Display.	3L
2	Digital Image Formation: A Simple Image Model, Geometric Model- Basic Transformation (Translation, Scaling, Rotation), Perspective Projection, Sampling & Quantization - Uniform & Non uniform.	4L
3	Mathematical Preliminaries: Neighbor of pixels, Connectivity, Relations, Equivalence & Transitive Closure; Distance Measures, Arithmetic/Logic Operations, Fourier Transformation, Properties of The Two Dimensional Fourier Transform, Discrete Fourier Transform, Discrete Cosine & Sine Transform.	9L
4	Image Enhancement: Spatial Domain Method, Frequency Domain Method, Contrast Enhancement -Linear & Nonlinear Stretching, Histogram Processing; Smoothing - Image Averaging, Mean Filter, Low-pass Filtering; Image Sharpening. High- pass Filtering, High-boost Filtering, Derivative Filtering, Homomorphic Filtering; Enhancement in the frequency domain - Low pass filtering, High pass filtering.	9L
5	Image Restoration: Degradation Model, Discrete Formulation, Algebraic Approach to Restoration - Unconstrained & Constrained; Constrained Least Square Restoration, Restoration by Homomorphic Filtering, Geometric Transformation - Spatial Transformation, Gray Level Interpolation.	8L
6	Image Segmentation: Point Detection, Line Detection, Edge detection, Combined detection, Edge Linking & Boundary Detection - Local Processing, Global Processing via The Hough Transform; Thresholding - Foundation, Simple Global Thresholding, Optimal Thresholding; Region Oriented Segmentation - Basic Formulation, Region Growing by Pixel Aggregation, Region Splitting & Merging	7L
Total		40L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the main concepts and key technologies of Image Processing
2	Apply different Image processing algorithms in Real Time cases.
3	Compare various Image Processing techniques.



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Learning Resources:	
1	Hearn, Baker – “Computer Graphics (C version 2nd Ed.)” – Pearson education
2	Z. Xiang, R. Plastock – “Schaum’s outlines Computer Graphics (2nd Ed.)” – TMH
3	D. F. Rogers, J. A. Adams – “Mathematical Elements for Computer Graphics (2nd Ed.)” –TMH

Course Name:	Augmented Reality and Virtual Reality		
Course Code:	PE-IT801F	Category:	Professional Elective Course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	PE-IT702A (Multimedia Technology) / PE-IT702E (Human Computer Interaction)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To explore the concepts of Virtual reality and appraise 3D virtual environment.
2	To learn the principles of range and maneuverability of atypical VR system.
3	To learn the role of AR with respect to VR to create a typical domain specific application.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality.	8L
2	Representation of the Virtual World: Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR. GHOST (General Haptics Open Software Toolkit) software development toolkit overview.	8L
3	Motion in Real and Virtual Worlds: Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking - Tracking 2D & 3D Orientation,	8L



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	Tracking Position and Orientation, Tracking Attached Bodies.	
4	Augmented Reality: Defining augmented reality, history of augmented reality, The Relationship Between Augmented Reality and Other Technologies - Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking Augmented Reality Software - Introduction, Major Software Components used to Create Content for the Augmented Reality Application.	8L
5	Mixed reality: Introduction to mixed reality, Applications of mixed reality, Input and Output in Mixed reality, Computer Vision and Mixed Reality, simultaneous localization and mapping (SLAM), variants of SLAM - dense tracking and mapping (DTAM), parallel tracking and mapping (PTAM) and semi-direct monocular visual odometry (SVO).	8L
Total		40L

Course Outcomes:

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

1	Define and describe a typical VR application
2	Define and describe the principles of VR and AR built systems.
3	Identify, examine and critically acclaim a software that reflects fundamental techniques for the design and deployment of VR experiences.

Learning Resources:

1	"Virtual Reality", Steven M. LaValle, Cambridge University Press, 2016.
2	"Understanding Virtual Reality: Interface, Application and Design", William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics). Morgan Kaufmann Publishers, San Francisco, CA, 2002
3	"Developing Virtual Reality Applications: Foundations of Effective Design", Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009
4	"Spatial Augmented Reality: Merging Real and Virtual Worlds", Oliver Bimber and Ramesh Raskar, 2005.



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Course Name:	Cyber Law & Ethics		
Course Code:	OE-CS801F	Category:	Open Elective Courses
Semester:	Eight	Credit:	3
L-T-P:	3-1-0	Pre-Requisites:	Basic Programming Skill & Cyber Awareness
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop an understanding of modern network architectures from a design and performance perspective.
2	To Implement cyber security solutions.
3	To be able to use cyber security, information assurance, and cyber/computer forensics software/tools

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction of Cybercrime: What is cybercrime? Forgery, Hacking & Ethical Hacking, Software Piracy, Computer Network intrusion. Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyber stalking, Introduction to Cyber Forensics	6L
2	Introduction to Cyber Security, Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyber warfare, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cyber security - Organizational implications.	8L
3	Cybercrime Mobile & Wireless devices: Security challenges posted by mobile devices, Cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Bluetooth; Different viruses on laptop	8L



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4	Hackers and Cyber Crimes: Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities Tools and Methods used in Cyber crime: Proxy servers, password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow	8L
5	Phishing & Identity Theft: Phishing methods, ID Theft; Online Identity method. Cybercrime & Cyber security: Legal aspects, Indian laws, IT act, Public key certificate Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000	8L
Total		38L

Course Outcomes:

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

1	Understand basic concepts of Cyber Security
2	Implement mechanism for access control & authentication
3	Describe Risk management concepts & Cyber Laws

Learning Resources:

1	"Cyber security" by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2	Information Security & Cyber Laws, Gupta & Gupta, Khanna Publishing House (AICTE Recommended - 2018).
3	"Information Security and Cyber Laws", Pankaj Agarwal
4	Enterprise Cyber Security -How to Build a Successful Cyber defense Program Against Advanced Threats, A-press by Donaldson, S.Siegel, S.Williams, C.K.Asam.
5	"Hacking the Hacker", by Roger Grimes, Wiley
6	"Cyber Law By Bare Act", Govt of India, IT Act 2000



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Course Name:	Bioinformatics		
Course Code:	OE-CS801D	Category:	Open Elective Courses
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic Knowledge of Biology & Database
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To exposed to the need for Bioinformatics technologies.
2	To be familiar with the modeling techniques..
3	To exposed to Pattern Matching and Visualization.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction: Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System.	8L
2	Introduction to Molecular Biology: Concepts of Cell, tissue, types of cell, components of cell, organelle. Functions of different organelles. Concepts of DNA: Basic Structure of DNA; Double Helix structure; Watson and crick model. Exons and Introns and Gene Concept. Concepts of RNA : Basic structure, Difference between RNA and DNA. Types of RNA. Concept of Protein: Basic components and structure. Introduction to Central Dogma: Transcription and Tranlation Introduction to Metabolic Pathways	12L
3	Sequence Databases: Introduction to Bioinformatics. Recent challenges in Bioinformatics. Protein Sequence Databases, DNA sequence databases. sequence database search programs like BLAST and FASTA. NCBI different modules: GenBank; OMIM, Taxonomy browser, PubMed.	12L
4	DNA Mapping and Assembly: Size of Human DNA, Copying DNA: Polymerase Chain Reaction (PCR), Hybridization and Microarrays, Cutting DNA into Fragments, Sequencing Short DNA Molecules, Mapping Long DNA Molecules. DeBruijn Graph. Sequence Alignment: Introduction, local and global alignment, pair wise and multiple alignment, Dynamic Programming Concept. Alignment algorithms: Needleman and Wunsch algorithm, Smith-Waterman.	6L
Total		38L



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Course Outcomes:

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

1	Develop models for biological data
2	Apply pattern matching techniques to bioinformatics data – protein data genomic data.
3	Apply micro array technology for genomic expression study

Learning Resources:

1	Bioinformatics Technologies by Yi-Ping Phoebe Chen (Ed). First Indian Reprint, Springer Verlag, 2007
2	Bio Informatics Computing by Bryan Bergeron, Pearson Education
3	Introduction to Bioinformatics by Arthur M Lesk Oxford University Press
4	Bioinformatics for Beginners by Supratim Chaudhury Elsevier.
5	Bioinformatics Algorithms: An Active Learning Approach, Volume 1 by Phillip Campeau Active Learning Publishers
6	Algorithms in Bioinformatics: A Practical Introduction by Wing-Kin Sung CRC Press



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Course Name:	Robotics		
Course Code:	OE-ME801D	Category:	Open Elective Courses
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Knowledge of Engg. Mechanics & Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the functions of the basic components of a Robot.
2	To study the use of various types of End of Effectors and Sensors.
3	To learn Robot safety issues and economics.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Introduction to Robotic Paradigm: Introduction - Overview of the Three Paradigms – social implications of robotics – history of robotics – tele operation – seven areas of AI – Hierarchical Paradigm – attributes – representative architectures – advantages and disadvantages – programming considerations.	8L
2	Robot Drive Systems and End Effectors: Pneumatic Drives-Hydraulic Drives-Mechanical Drives-Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors-Salient Features, Applications and Comparison of all these Drives, End Effectors. Grippers - Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.	10L
3	Sensors and Machine Vision: Requirements of a sensor, Principles and Applications of the following types of sensors- Position sensors – Piezo Electric Sensor, LVDT, Optical Encoders, pneumatic Position Sensors, Range Sensors Triangulations Principles, Structured, Lighting Approach, Time of Flight, Range Finders, Laser Range Meters, Touch Sensors , Analog Sensors, Wrist Sensors, Compliance Sensors, Slip Sensors, Camera, Frame Grabber, Sensing and Digitizing Image Data- Signal	10L



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	Conversion, Image Storage, Lighting Techniques, Image Processing and Analysis-Data Reduction, Segmentation, Feature Extraction, Object Recognition, Other Algorithms, Applications- Inspection, Identification.	
4	Implementation and Robot Economics: Implementation of Robots in Industries-Variou Steps; Safety Considerations for Robot Operations – Economic Analysis of Robot.	5L
5	Basic of Robot Programming: Robot programming Languages-VAL Programming-Motion Commands, Sensor Commands, End Effectors commands and simple Programs	5L
Total		38L

Course Outcomes:

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

1	Apply the basic engineering knowledge for the design of robotics
2	Apply programming techniques to Robotic Movement.
3	Understand the computation methodology with dynamics of Robots.

Learning Resources:

1	Introduction to AI Robotics by Robin R. Murphy. A Bradford Book, MIT Press.
2	Robotic Engineering-An Integrated Approach by R.D Klafter, T.A Chmielewski and Negin, Prentice Hal
3	Industrial Robotics -Technology Programming and Applications by M.P Groover, McGraw Hill
4	Robotics and Industrial Automation by R.K Rajput, S.Chand and Company.
5	Robotics Technology and Flexible Automation by S.R Deb Tata McGraw Hill Book Co
6	Robotics Control, Sensing, Vision and Intelligence by K.S Fu, R.C. Gonzalz and Lee McGraw Hill Book Co
7	Robotics and Image Processing by P.A Janakiraman Tata McGraw Hill



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Course Name:	Computational Biology		
Course Code:	OE-CS801E	Category:	Open Elective Course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know about the properties of DNA, RNA, and protein components etc., the relationships among these molecules.
2	To know how to convert a biological question into a computational problem that can be solved using computers.
3	To how to read and understand solutions to computational problems, which will be formalized as a series of tasks in form of an algorithm.

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Compositions of functions, Modeling basic life science scenarios (Implement basic functions, expressing basic operations as functions of time like cost functions, study variations etc.) In calculus - e.g. simple cases of drug concentration, energy consumption, Fick's law, Flow of blood, growth of bacteria, protein structures, estimates of inoculation, poiseuille's law, population growth recall rate of memory, respiration, spread of an epidemic, air and water pollution.	8L
2	Concepts of differentiation, anti-differentiation, differential equations, functions of several variables as needed to study population dynamics, biophysical models.	8L
3	Visualization: Graph Types in Biology - bar graphs, line graph, area graph, scatter plot, pie and 3-dimensional graphs and generation using simple programs like Excel / Octave / Matlab / python.	10L
4	Advanced use of computers like scientific libraries, scripting etc. Scope of cellular dynamics, Computational modeling in biology- Cartoons, Mechanisms, and Models, role of mathematics and role of computation, simple molecular switch. CUDA and computational biology – getting started with CUDA, memory, multiple GPUs.	10L



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Total	36L
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Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze the DNA content, identify protein binding patterns, compare sequences, and discover variation within genomes.
2	Formulate your own sequence analysis problem, implement a solution, and be able to present your findings
3	Formulate the types of biological questions which can be investigated using computers, and what limitations computational methods impose to get applied to biological domain.

Learning Resources:	
1	Alon, Uri. An Introduction to Systems Biology: Design Principles of Biological Circuits. Chapman and Hall/CRC, 2013. ISBN: 9781439837177.
2	Computational Cell Biology, Christopher Fall, Springer, 2000.
3	Mathematical models in biophysics, Riznichenko Galina Yur'evna, Book Online, Biophysical society.
4	Alon, Uri. An Introduction to Systems Biology: Design Principles of Biological Circuits. Chapman and Hall / CRC, 2013. ISBN: 9781439837177.

Course Name:	Introduction to Business Analytics		
Course Code:	OE-HU801F	Category:	Open Elective
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Basic concepts of Computer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To facilitate students with the basic concept of a Business Analytics.
2	To develop the ability to apply knowledge of Analytics for solution of Business problems.



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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Business Intelligence: Definitions and Examples in Business Intelligence, Need, Features and Use of Business Intelligence (BI) BI Component, Data Warehouse, Business Analytics, Business Performance Management o User Interface	6L
2	Business Analytics: Introduction to Business Analytics (BA) , Need, Components (Business Context, Technology, Data Science). Types (Descriptive, Predictive and Prescriptive). Business Intelligence versus Business Analytics, Transaction Processing v/s Analytic Processing , OLTP v/s OLAP , OLAP Operations , Data models for OLTP (ER model) and OLAP (Star & Snowflake Schema)	7L
3	Types of Digital Data: Definition, Sources, Storage and Characteristics of Structured, Unstructured and Semi Structured Data Warehouse: Definition, characteristics, framework Data lake Business Reporting, Visual Analytics: Definition, concepts , Different types of charts and graphs , Emergence of data visualization and visual analytics	7L
4	Data Mining: Concepts and applications, Data mining process. Text & Web Analytics: , Text analytics and text mining overview , Text mining applications , Web mining overview , Social media analytics , Sentiment analysis overview Big Data Analytics: Definition and characteristics of big data , Fundamentals of big data analytics	8L
5	Business Performance Management: Business performance management cycle , KPI, Dashboard Analytics in Business Support Functions: Sales & Marketing Analytics HR Analytics , Financial Analytics , Production and operations analytics , Analytics in Industries: Telecom, Retail, Healthcare, Financial Services	8L
Total		36L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Know the concept of domain knowledge of various technologies and its application to facilitates managerial decision /MIS.
2	Explain the concept of Enhance capabilities for innovative use of I.T.
3	Explain the concept of global platform for data retrieval/process among different business cultures of the world.
4	Know the of ethics and prevention of fraud through technology, theft of data etc.
5	Know the concept of Encourage cross functional collaboration to enhance efficiency and productivity.



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Learning Resources:

1	Ramesh Sharda, Dursun Delen, Efraim Turban, Business Intelligence: A Managerial Perspective on Analytics, Pearson
2	R.N.Prasad and Seema Acharya, Fundamentals of Business Analytics, Wiley
3	U. Dinesh Kumar, Business Analytics – The Science of Data Driven Decision Making, Wiley
4	Anil Maheshwari, Data Analytics, McGraw Hill
5	Jesper Thorlund & Gert H.N. Laursen, Business Analytics for Managers: Taking Business Intelligence Beyond, Wiley
6	Sahil Raj, Business Analytics, Cengage
7	James R. Evans, Business Analytics, Pearson
8	Weaving Analytics for Effective Decision Making - By Arindam Banerjee and Tanushri Banerjee
9	Business Analytics-Text and Cases: By Arindam Banerjee and Tanushri Banerjee

Course Name:	Economic Policies in India		
Course Code:	OE-HU801C	Category:	Management Science and Humanities
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To familiarize the students with the present features of the Indian Economy and Economic Planning.
2	To acquaint students with the major policy regimes of government to resolve problems in agriculture, industry and service sector of India.
3	To provide the students a basic knowledge of financial institutions and to acquaint them with major financial services in India.



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Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Economic Development and its Determinants: Approaches to economic development and its measurement – sustainable development; Role of State, market and other institutions; Indicators of development – PQLI, Human Development Index (HDI), gender development indices.	4L
2	Planning in India: Objectives and strategy of planning; Failures and achievements of Plans; Developing grass-root organizations for development – Panchayats, NGOs and pressure groups. Broad demographic features of Indian population; rural-urban migration; Urbanization and civic amenities; Poverty and Inequality	6L
3	Energy; social infrastructure – education and health; Environment; Regional imbalance; Issues and policies in financing infrastructure development. Institutional Structure – land reforms in India; Technological change in agriculture – pricing of agricultural inputs and output; industry; Agricultural finance policy; Agricultural Marketing and Warehousing; Issues Terms of trade between agriculture and in food security – policies for sustainable agriculture.	8L
4	Industrial policy; Public Sector enterprises and their performance; Problem of sick units in India; Privatization and disinvestment debate; Growth and pattern of industrialization; Small-scale sector; Productivity in industrial sector; Exit policy – issues in labor market reforms; approaches for employment generation. Public Finances Fiscal federalism – Centre-State financial relations; Finances of central government; Finances of state governments; Parallel economy; Problems relating to fiscal policy; Fiscal sector reforms in India.	8L
5	Money, Banking and Prices Analysis of price behavior in India; Financial sector reforms; Interest rate policy; Review of monetary policy of RBI; Money and capital markets; Working of SEBI in India.	4L
6	External Sector Structure and direction of foreign trade; Balance of payments; Issues in export-import policy and FEMA; Exchange rate policy; Foreign capital and MNCs in India; The progress of trade reforms in India. Economic Reforms Rationale of internal and external reforms; Globalization of Indian economy; WTO and its impact on the different sectors of the economy; Need for and issues in good governance; Issues in competition and safety nets in Indian economy.	6L
Total		36L



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Course Outcomes:

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

1	Understand the Demographic Features, Poverty and Inequality and evaluate the role of fiscal and monetary policies is bringing about economic stability.
2	Evaluate the role of financial institutions in India.
3	Analyse the role of different sectors in the economy.

Learning Resources:

1	Ahluwalia, I. J. and I. M. D Little (Eds.) (1999), India's Economic Reforms and Development (Essays in honour of Manmohan Singh), Oxford University Press, New Delhi.
2	Bardhan, P. K. (9th Edition) (1999), The Political Economy of Development in India, Oxford University Press, New Delhi.
3	Bawa, R. s. and P. S. Raikhy (Ed.) (1997), Structural Changes in Indian Economy, Guru Nanak Dev University Press, Amritsa
4	Brahmananda, P. R. and V. R. Panchmukhi (Eds.) (2001), Development Experience in the Indian Economy: Inter-State Perspectives, Book well, Delhi.
5	Chakravarty, S. (1987), Development Planning: The Indian Experience, Oxford University Press, New Delhi.
6	Dantwala, M. L. (1996), Dilemmas of Growth: The Indian Experience, Sage Publications, New Delhi.
7	Datt, R. (Ed.) (2001), Second Generation Economic Reforms in India, Deep & Deep Publications, New Delhi.
8	Government of India, Economic Survey (Annual), Ministry of Finance, New Delhi.
9	Jain, a. K. (1986), Economic Planning in India, Ashish Publishing House, New Delhi.

Course Name:	Operations Research and Optimizing Technique		
Course Code:	OE-M801A	Category:	Open Elective course
Semester:	Eighth	Credit:	3
L-T-P:	3-0-0	Pre-Requisites:	School mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05



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Course Objectives:	
1	To impart knowledge in concepts and tools of Operations Research
2	To understand mathematical models used in Operations Research
3	To apply these techniques constructively to make effective business decisions

Course Contents:		
Module No.	Description of Topic	Contact Hrs.
1	Solving Linear Programming Problems: Formulation, Solving LPP: Using Simultaneous Equations and Graphical Method; Simplex, Duality, Big-M method, Transportation & Assignment, Travelling Salesman problem.	11L
2	Game Theory: Introduction ; 2- person Zero – sum Game; Saddle Point ; Mini-Max and Maxi-Min Theorems (statement only); Games without saddle point ; Graphical Method ; Principle of Dominance	7L
3	Queuing Theory: Introduction; Basic Definitions and Notations; Axiomatic Derivation of the 7L Arrival & Departure (Poisson Queue). Pure Birth and Death Models; Poisson Queue Models: M/M/1: ∞ /FIFO and M/M/1: N/ FIFO	6L
4	Network Analysis: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).	6L
5	Non-Linear Programming: Integer Programming, Dynamic Programming.	6L
Total		36L

Course Outcomes:	
After completion of the course, students will be able to:	
1	Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained.
2	Determine optimal strategy for Minimization of Cost of shipping of products from source to Destination/ Maximization of profits of shipping products using various methods, Finding initial basic feasible and optimal solution of the Transportation problems
3	Optimize the allocation of resources to Demand points in the best possible way using various techniques and minimize the cost or time of completion of number of jobs by



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	number of persons
4	Analyse competitive real-world phenomena using concepts from game theory. Analyse pure and mixed strategy games
5	Formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems

Learning Resources:	
1	H. A. Taha, "Operations Research", Pearson
2	P. M. Karak – "Linear Programming and Theory of Games", ABS Publishing House
3	Ghosh and Chakraborty, "Linear Programming and Theory of Games", Central Book Agency
4	Ravindran, Philips and Solberg - "Operations Research", WILEY INDIA
5	Kanti Swaroop — "Operations Research", Sultan Chand & Sons
6	Rathindra P. Sen—"Operations Research: Algorithms and Applications", PHI
7	R. Panneerselvam - "Operations Research", PHI
8	A.M. Natarajan, P. Balasubramani and A. Tamilarasi - "Operations Research", Pearson
9	M. V. Durga Prasad – "Operations Research", CENGAGE Learning
10	J. K. Sharma - "Operations Research", Macmillan Publishing Company

Course Name:	Project-IV		
Course Code:	PW- IT881	Category:	Sessional Course
Semester:	Eighth	Credit:	6
L-T-P:	0-0-12	Pre-Requisites:	Knowledge of engineering, science and management subjects
Full Marks:	100		
Examination Scheme:	Semester Examination: 20		Continuous Assessment: 80

Course Objectives:	
1	In depth knowledge gain in the domain of the assigned topic.
2	To be able to finalize the approach to the problem of the assigned topic.
3	To be able to prepare an Action Plan for conducting the investigation, including team work.
4	To be able to do Detailed Analysis/Modelling/Simulation/Problem solving/Experiment as needed.
5	To perform Development of product/process, testing, results, conclusions and future scope analysis.



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Course Outcomes:

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

1	Prepare a report in the standard format.
2	Ready for Seminar Presentation before any standard body.
3	Prepare a paper for Conference presentation/Publication in Journals.