B.TECH. IV Semester-5	L	T	P	C
EC 501: Wireless Communication	3	0	2	4

Prerequisite
Electronics Communication and Digital Communication

Unit-1	12 hrs
The Cellular Concept - System Design Fundamentals: Introduction to Wireless Communication System: Overview of wireless Communication: History, Technical issues, brief of current wireless systems. Cellular system, Hexagonal geometry cell and concept of frequency reuse, Channel Assignment Strategies Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for Minimum Co-channel and adjacent interference, Handoff Strategies, Umbrella Cell Concept, Trunking and Grade of Service, Improving Coverage & amp; Capacity in Cellular System-cell splitting, Cell sectorization, Repeaters, Micro cell zone concept, Channel antenna system design considerations.	
Unit-2	**10 hrs**
Mobile Radio Propagation Model, Small Scale Fading Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread, upper bound Small scale, Multipath Measurement parameters of multipath channels, Types of small scale Fading, Rayleigh and Rician distribution, Statistical for models multipath fading channels.	
Unit-3	**8 hrs**
Multiple Access Techniques for Wireless Communications Introduction, Comparisons of multiple Access Strategies Time Division Multiple Access, Code Division Multiple Access, Frequency Division Multiple Access, Orthogonal Frequency Division Multiplexing.	
Unit-4	**12 hrs**
Wireless Systems and Recent trends in Wireless Communication GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA channels, Soft handoff, Recent developments from Third Generation (3G) to 5G wireless networks. LTE Advanced: Introduction to LTE Advanced, Carrier Aggregation, Multiple Antenna Techniques for LTE Advanced Relaying, Additional Features of LTE Release-10 and Future Directions, 5G Communications, mmWave Communications, Massive MIMO, Machine Type Communications (MTC)	

Recommended Books
1. Theodore S. Rappaport, Wireless Communication, Prentice hall.
2. Rajpandya, Mobile and personal Communication system and services, IEEE press (PHI).
3. Vijay Garg, Wireless Communications and Networking, Elsevier
4. T.G.Palanivelu, R. Nakkeeran , Wireless Mobile Communication, PHI.
5. Amitabha Ghosh, Rapeepat Ratasuk, "Essentials of LTE and LTE-A," Cambridge University Press, 2011.
6. Farooq Khan, "LTE for 4G Mobile Broadband: Air Interface Technologies and Performance", Cambridge University Press, 2009.

B.TECH. III Semester-5	L	T	P	C
EC 502: Nanoscale Device Engineering	3	0	0	3

Unit - 1	14 Hours
Introduction to Nanoscience and Nanotechnologies <u>Introduction to nanoscience and nanotechnologies</u>, <u>History of nanotechnologies</u>, <u>Fundamental 'nano-effects'</u>, <u>Material properties at nanoscale</u>: Electrical, Optical, Magnetic, Mechanical <u>Nanomaterials</u>: Biomimetic, Self-assembled, Nanostructured metals and alloys, Polymers, Semiconductors, Ceramic and glassy, Carbon-based, Composites, Nanocoatings <u>Characterization methods</u>: Microscopy, Spectroscopy methods, non-radiative and non-electron characterisation methods <u>Fabrication methods</u>: Top-down, Bottom-up	

Unit - 2	14 Hours
Fabrication Technology & SPICE Device Models <u>Introduction</u> <u>IC Fabrication Steps</u>: Silicon Wafers, Oxidation, Photolithography, Etching, Diffusion, Ion Implantation, Chemical Vapor Deposition, Metallization, Packaging <u>VLSI Processes</u>: Introduction, Twin-Well CMOS Process, Integrated Devices, MOSFETs, Resistors, Capacitors, pn Junction Diodes, BiCMOS Process, Lateral pnp Transistor, p-Base and Pinched-Base Resistors, SiGe BiCMOS Process <u>VLSI Layout</u>, <u>Beyond 20nm Technology</u> <u>Implications of Technology Scaling</u>: Issues in Deep-Submicron Design: Silicon Area, Scaling Implications, Velocity Saturation, Subthreshold Conduction, PVT Variations, Wiring: The Interconnect <u>SPICE Device Models</u>: The Diode Model, The Zener Diode Model, MOSFET Models, The BJT Model	

Unit - 3	14 Hours
Applications of Nanoscience and Nanotechnologies <u>Medicine and Healthcare</u>: Diagnosis, Imaging, Therapy, Regenerative medicine, Non-invasive brain-machine interfaces <u>Environment</u>: Remediation and mitigation, Pollution prevention, Environment sensing, Food packaging and monitoring <u>Energy</u>: Solar energy, Hydrogen society, Thermoelectricity, Rechargeable batteries <u>Information and Communication Technologies</u>: Integrated Circuits, Data Storage, Photonics, Displays, Information storage devices, Wireless sensing and communication	
Total Contact Time: 42 Hours	

Recommended Books
1. A. S. Sedra and K. C. Smith, "Microelectronic Circuits", Oxford University Press, 7th Edition.   2. Weste Neil H.E, Harris D. and Banerjee A., "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 4th Edition.   3. M. Lundstrom, J. Guo: Nanoscale Transistors   4. M.S. Dresselhaus, G. Dresselhaus, Ph. Avouris, "Carbon Nanotubes"   5. R. Murali, "Graphene Nanoelectronics: From Materials to Circuits"   6. Fahrner, W.R., Nanotechnology and Nanoelectronics, Springer.   7. Poole, C.P., Introduction to Nanotechnology, John Wiley & Sons.

B.TECH. III Semester-5	L	T	P	C
EC 503: Image Processing and Computer Vision	**3**	**0**	**2**	**4**

Unit - 1	**10 Hours**

Introduction: Digital Image, Image Processing Origins; Imaging in X-Rays, Ultraviolet, Visible Infrared, Visible, Microwave and Radio Bands; Fundamentals of Image Processing; Components of Image Processing Systems.

Digital Image Fundamentals: Visual Perception — Human Eye, Brightness Adaptation And Discrimination, Electromagnetic Spectrum; Image Sensing And Acquisition — Single, Strip And Array Sensors, Image Formation Models; Image Sampling And Quantization — Basic Concepts, Representation Of Image, Special And Gray Level Resolution, Aliasing, Zooming And Shrinking; Relationships Between Pixels — Nearest Neighbour, Adjacency, Connectivity, Regions, And Boundaries; Distance Measures; Image Operations On A Pixel Basis; Linear And Nonlinear Operations.

Unit - 2	**10 Hours**

Image Enhancement in Spatial Domain and Frequency Domain: Gray Level Transformations - Image Negatives, Log, Power-Law And Piecewise Linear Transformation Functions; Histogram Processing — Equalization, Matching; Enhancement Operations - Arithmetic, Logic, Subtraction And Averaging; Spatial Filtering — Linear And Order-Statistics For Smoothing, First And Second Derivatives/Gradients For Sharpening, 2-D Fourier Transform, Its Inverse And Properties; Discrete And Fast Fourier Transform; Convolution And Correlation Theorems; Filtering In Frequency Domain - Low Pass Smoothing, High Pass Sharpening, Homomorphic Filtering.

Unit - 3	**12 Hours**

Image Restoration: Image Degradation and Restoration Processes; Noise 'Models - Spatial Properties, Noise Probability Density Functions, Periodic Noise, Estimation of Noise Parameters; Restoration in The Presence of Noise and Mean Filters, Order-Statistics Filters, Adaptive Filters; Linear Position-Invariant Degradations and Estimation; Geometric Transformations - Spatial Transformation, Gray-Level Interpolation.

Morphological Image Processing: Preliminaries-Set Theory And Logic Operations In Binary Images; Basic Morphological Operations - Opening, Closing Operators, Dilation And Erosion; Morphological Algorithms - Boundary Extraction, Region Filling, Extraction Of Connected Components, Convex Hull, Thinning, Thickening, Skeletons; Extension Of Morphological Operations To Gray-Scale Images.

Unit - 4	**10 Hours**

Image Segmentation: Detection of Discontinuities — Point, Line and Edges; Edge Linking and Boundary Detection - Local Processing, Global Processing Using Hough Transform; Thresholding - Local, Global and Adaptive; Region-Based Segmentation - Region Growing, Region Splitting and Merging; Motion Detection.

Image Representation and Description: Representations - Chain Codes, Polygonal Approximations, Signatures, Boundary Segments, Skeletons; Boundary Descriptors - Shape Numbers, Statistical Moments; Regional Descriptors - Topological, Texture And Moments Of 2-D Functions.

Total Contact Time: 42 Hours

Recommended Books
1. Gonzalez R. C. and Woods R. E, "Digital Image Processing", Pearson Prentice Hall, 3n1 Ed., 2008.
2. Linda Shapiro and Stockman George, "Computer Vision", Prentice Hall, 15t Ed., 2001.
3. Forsyth D. and Ponce J., "Computer Vision - A Modern Approach", Prentice-Hall, 1st Ed., 2003.
4. Sonka M. Hlavac V., Boyle R., "Image Processing, Analysis and Machine Vision", Cengage Learning, 2r4 Indian Reprint, 2009.

5. Jain R., Kasturi R. and Schunk B., "Machine Vision", McGraw - Hill, 1st Ed., 1995.
6. Jain A. K., "Fundamentals Of Digital Image Processing", PHI, 1st Ed., 1989.
7. Ballard D. H. and Brown C. N., "Computer Vision", Prentice Hall, 1st Ed., 1982.

B.TECH. III Semester-5	L	T	P	C
CS 504: Cloud Computing & Big Data Infrastructure	**3**	**0**	**2**	**4**

Unit -1	8 Hours
Introduction to Cloud computing, Cloud computing: IaaS, PaaS, SaaS; Cloud computing: Current & future trends, Impact on scientific research Types of Cloud services providers: Google, Amazon, Microsoft Azure, IBM, Sales force	
Unit - 2	**8 Hours**
Virtualization for Cloud: Need for Virtualization, Pros and cons of virtualization, Types of virtualization; system VM, process VM, virtual machine monitor; Virtual machine properties, Interpretation and Binary translation, HLL VM – Hypervisors – Xen, VMWare, Hyper - V	
Unit - 3	**8 Hours**
Introduction to Big data. Big data and its importance, Drivers, Big data analytics, Big data applications. Algorithms, Matrix-Vector, Multiplication by Map Reduce. YARN, SQOOP, PIG	
Unit - 4	**8 Hours**
OpenStack – Cloud operating system, object storage (SWIFT). Introduction, distributed file system. Hadoop – Architecture, Hadoop distributed file system (HDFS) MapReduce – Programming model, Task scheduling algorithms, Data serialization	
Unit - 5	**10 Hours**
Apache Spark Java AWS SDK, S3 API, Relational Database Service, SimpleDB Service, NoSQL Databses, HIVE, MongoDB, HBase Elastic search, Qlik Sense, Superset. Building Interactive Visualization using Superset.	
Total Contact Time: 42 Hours	

Recommended Books
1. John Rittinghouse & James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013.
2. Dr. Kumar Saurabh, "Cloud Computing 2nd Kindle Edition", Wile India, 2012.
3. "Big Data, Black Book: Covers Hadoop, MapReduce, Hive, YARN, Pig, R and Data Visualization", Dreamtech Press, 1st Edition, 2016.
4. Arvind Sathi, "Big Data Analytics: Disruptive Technologies for Changing the Game", MC Press, 2012.
5. Tom White, "Hadoop: The Definitive Guide", O'Reilly Media, Third Edition, 2012.

B.TECH. V Semester-5	L	T	P	C
HM 505: Innovation and Entrepreneurship	2	0	0	2

Unit - 1	14 Hours
Concepts of Entrepreneurship: Scope of Entrepreneurship, Definitions of Entrepreneurship and Entrepreneur, Characteristics of an Entrepreneur, Entrepreneurial Development models and Theories, Entrepreneurs Vs Managers Classification of Entrepreneurs; Major types of Entrepreneurship – Techno Entrepreneurship, Women Entrepreneurship, Social Entrepreneurship, Intrapreneurship (Corporate entrepreneurship), Rural Entrepreneurship, Family Business etc.; Problems for Small Scale Enterprises and Industrial Sickness; Entrepreneurial Trait Tests; Entrepreneurial Environment – Political, Legal, Technological, Natural, Economic, Socio – Cultural etc. ; Motivation; Business Opportunity Identification *Project Planning*: Product Development – Stages in Product Development; Feasibility analysis – Technical, Market, Economic, Financial etc.; Project report; Project appraisal; Setting up an Industrial unit – procedure and formalities in setting up an Industrial unit; Business Plan Development	
Unit - 2	**14 Hours**
Innovation and Incubation: Innovation and Entrepreneurship, Creativity, Green Technology Innovations, Grassroots Innovations, Issues and Challenges in Commercialization of Technology Innovations, Introduction to Technology Business Incubations, Process of Technology Business Incubation *Sources of Information and Support for Entrepreneurship*: State level Institutions, Central Level institutions and other agencies *Protection of Innovation Through IPR*: Introduction to Intellectual Property Rights – IPR, Patents, Trademarks, Copy Rights	
Total Contact Time: 28 Hours	

Recommended Books
1. Desai Vasant, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, India, 6th Revised Edition, 2011
2. Charantimath P. M., Entrepreneurial Development and Small Business Enterprises, Pearson Education, 3rd Edition, 2018
3. Holt David H., Entrepreneurship: New Venture Creation, Pearson Education, 2016
4. Chandra P., Projects: Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill, 9th Edition, 2019
5. Banga T. R. &Shrama S.C., Industrial Organisation & Engineering Economics, Khanna Publishers, 25th Edition, 2015
6. Prasad L.M., Principles & Practice Of Management, Sultan Chand & Sons, 8th Edition,2015