

**BACHELOR OF TECHNOLOGY (IGDTUW)**  
**(Electronics & Communication Engineering)**  
**(Teaching and Examination Scheme)**

**THIRD SEMESTER**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BAS 201	Numerical Methods	4	-	4	Basic Science
2	BEC 203	Signal & Systems	4	-	4	Departmental Core
3	BEC 205	Network Analysis and Synthesis	4	-	4	Departmental Core
4	BEC 207	Analog Electronics – I	4	-	4	Departmental Core
5	BIT 209	Object Oriented Programming	4	-	4	Engineering Science
<b>PRACTICAL/VIVA VOCE</b>						
1	BAS 251	Numerical Methods Lab	0	2	1	Basic Science
2	BEC 253	Signal & Systems Lab	0	2	1	Departmental Core
3	BEC 255	Network Analysis and Synthesis Lab	0	2	1	Departmental Core
4	BEC 257	Analog Electronics – I Lab	0	2	1	Departmental Core
5	BIT 259	Object Oriented Programming (using C++ & JAVA) Lab	0	2	1	Engineering Science
		<b>TOTAL</b>	<b>20</b>	<b>10</b>	<b>25</b>	

**FOURTH SEMESTER**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BEC 202	Analog Electronics – II	4	-	4	Departmental Core
2	BEC 204	Digital Circuits & Systems	4	-	4	Departmental Core
3	BEC 206	Communication Systems	4	-	4	Departmental Core
4	**BCS 208	Data Structures Using C++	4	-	4	Departmental Core
5	BEC 210	Transmission Lines and Antennas	4	-	4	Departmental Core
<b>PRACTICAL/VIVA VOCE</b>						
1	BEC 252	Analog Electronics – II Lab	0	2	1	Departmental Core
2	BEC 254	Digital Circuits & Systems Lab.	0	2	1	Departmental Core
3	BEC 256	Communication Systems Lab.	0	2	1	Departmental Core
4	BEC 258	Mini Project	0	2	1	Departmental Core
5	**BCS 260	Data Structure Using C++ Lab	0	2	1	Departmental Core
		<b>TOTAL</b>	<b>20</b>	<b>10</b>	<b>25</b>	

**\*\*Proposed to be included w.e.f. January 2016 in place of Probability and Stochastic Processes/Simulation Lab**

**BACHELOR OF TECHNOLOGY (IGDTUW)**  
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**FIFTH SEMESTER EXAMINATION**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BEC 301	Digital Systems Design & VHDL	4	-	4	Departmental Core
2	BEC 303	Advanced Communication Systems	4	-	4	Departmental Core
3	BCS 305	Microprocessors & Microcontrollers	4	-	4	Engineering Science
4	BEC 307	Control Engineering	4	-	4	Departmental Core
5	BEC 309	Electronic Measurement & Instrumentation	4	-	4	Departmental Core
6	BAS 311	Human Values & Professional Ethics	3	-	3	Humanities & Social Sciences
<b>PRACTICAL/VIVA VOCE</b>						
1	BEC 351	Digital Systems Design Lab	0	2	1	Departmental Core
2	BEC 353	Advanced Communication Systems Lab	0	2	1	Departmental Core
3	BCS 355	Microprocessors & Microcontrollers Lab	0	2	1	Engineering Science
4	BEC 357	Control Engineering Lab	0	2	1	Departmental Core
5	BEC 359	Electronic Measurement & Instrumentation Lab	0	2	1	Departmental Core
<b>TOTAL</b>			<b>23</b>	<b>10</b>	<b>28</b>	

**BACHELOR OF TECHNOLOGY (IGDTUW)**  
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**SIXTH SEMESTER EXAMINATION**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BEC 302	Microwave & Radar Engineering	4	-	4	Departmental Core
2	BEC 304	Information Theory & Coding	4	-	4	Departmental Core
3	BEC 306	VLSI Design	4	-	4	Departmental Core
4	**BIT 308	Data Communication & Networking	4	-	4	Departmental Core
5	BEC 310	Digital Signal Processing and its applications	4	-	4	Departmental Core
6	BAS 312	Engineering Economics	3	-	3	Humanities & Social Sciences
<b>PRACTICAL/VIVA VOCE</b>						
1	BEC 352	Microwave & Radar Engineering Lab	0	2	1	Departmental Core
2	BEC 354	Information Theory & Coding Lab	0	2	1	Departmental Core
3	BEC 356	VLSI Design Lab	0	2	1	Departmental Core
4	**BIT 358	Data Communication & Networking Lab	0	2	1	Departmental Core
5	BEC 360	Digital Signal Processing and its applications Lab	0	2	1	Departmental Core
		<b>TOTAL</b>	<b>23</b>	<b>10</b>	<b>28</b>	

**NOTE:** 4-6 weeks training will be held after sixth semester. However, Viva-Voce will be conducted in the seventh semester.

**\*\* Proposed to be included w.e.f. January 2016 in place of Fundamentals of Operating Systems/ Fundamentals of Operating Systems Lab**

**BACHELOR OF TECHNOLOGY (IGDTUW)**  
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**SEVENTH SEMESTER EXAMINATION**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BEC 401	Wireless Communication	4	-	4	Departmental Core
2	BEC 405	Optical Communication	4	-	4	Departmental Core
<b>ELECTIVES- I (Choose Any One)</b>						
1.	BCS 403	Mobile Computing	4	-	4	Departmental Elective
2.	BEC 411	VLSI Technology				
3.	BCS 409	Soft Computing				
4.	BMA 407	Non Conventional Energy Resources				
5.	BEC 413	Open Elective “New and Emerging Technologies in Electronics Engineering.”				
6.	BIT 421	Cloud Computing & applications				
7.	BEC-423	Advanced Antenna Technology				
<b>ELECTIVES-II (Choose Any One)</b>						
1	BMA 417	Process Improvement Techniques	3	-	3	Humanities & Social Sciences/ Department of IT & MAE
2	BAS 419	Financial Accounting				
3	BIT 415	Cyber Security Awareness				
<b>PRACTICAL/VIVA VOCE</b>						
1	BEC 451	Wireless Communication Lab	0	2	1	Departmental Core
2	BEC 453	Optical Communication Lab	0	2	1	Departmental Core
3	BEC 455	Practical based on Elective-I	0	2	1	Departmental Elective
4	BEC 457	*Minor Project	0	8	4	Departmental Core
5	BEC 459	Practical Training	-	-	2	Departmental Core
6	BAS 461	Disaster Management	0	2	1	Humanities & Social Sciences
<b>TOTAL</b>			<b>15</b>	<b>16</b>	<b>25</b>	

\*The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports.

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**EIGHTH SEMESTER EXAMINATION**

Sl. No.	Paper Code	Paper Title	L	P	Credits	Course Category
<b>THEORY PAPERS</b>						
1	BCS 402	Embedded Systems Design	4	-	4	Departmental Core
2	BEC 404	Mobile Communication	4	-	4	Departmental Core
<b>ELECTIVES-I (Choose Any One)</b>						
1	BEC 406	Power Electronics	4		4	Departmental Elective
2	BEC 408	Advanced VLSI Design				
3	BEC 410	Digital Image Processing				
4.	BCS 412	Wireless Sensor Networks				
5.	BEC 414	Open Elective “New and Emerging Technologies in Communications & Signal Processing”				
<b>ELECTIVES_II (Choose any one)</b>						
1	BAS 420	Business Entrepreneurship	3	-	3	Humanities & Social Sciences
2	BAS 422	Organizational Behavior				
<b>PRACTICAL/VIVA VOCE</b>						
1	BCS 452	Embedded System Design Lab	0	2	1	Departmental Core
2	BEC 454	Mobile Communication Lab	0	2	1	Departmental Core
3	BEC 456	*Major Project	0	12	8	Departmental Core
<b>TOTAL</b>			<b>15</b>	<b>16</b>	<b>25</b>	
<b>GRAND TOTAL</b>					<b>212</b>	

\*The student will submit a synopsis at the beginning of the semester for approval from the departmental committee in a specified format. The student will have to present the progress of the work through seminars and progress reports.

**NOTE:**

- 1. The total number of the credits of the B.Tech. Programme = 212**
- 2. Each student shall be required to appear for examinations in all courses. However, for the award of the degree a student shall be required to earn the minimum of 204 credits.**

**Paper Code: BEC 401**

**L P C**

**Paper Title: Wireless Communication**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Cellular Concepts - System Design Fundamentals:** Cellular concept, Channel reuse, handoff strategies, dynamic resource allocation interference and system capacity, improving capacity and coverage of cellular systems.

**Second and third generation network standards:** GSM standardization, architecture and function Partitioning. GSM radio aspects, security aspects, protocol model, call flow sequences, evolution to 2.5G mobile radio networks, Introduction to 3G/4G Network, IS-95 service and radio aspects, key features of IS-95 CDMA systems- ECWDMA, UMTS physical layer, UMTS network architecture, CDMA 2000 physical layer. **[10H]**

**UNIT II**

**Radio Wave Propagation:** Free space propagation model, basic propagation mechanisms- reflection, ground reflection model diffraction, scattering, practical link budget design, outdoor and indoor propagation models.

**Small scale fading and multipath:** Small scale multipath propagation, Impulse response model of a multipath channel - small scale multipath measurements, parameters of mobile multipath channels, Types of small scale fading. **[10H]**

**UNIT III**

**Capacity of Wireless Channels:** Capacity of Flat Fading Channel, Channel Distribution Information known, Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity with Receiver diversity, Capacity comparisons, Capacity of Frequency Selective Fading channels.

**Performance of digital modulation over wireless channels:** Error probability of BPSK, FSK, MSK, GMSK, QPSK, M-ary PSK, M-ary QAM and M-ary FSK on AWGN channels, Fading,

Outage Probability, Average Probability of Error, Combined Outage and Average Error Probability. [10H]

#### **UNIT IV**

**Performance Estimation and Evaluation:** Estimation of Performance Measures, Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasi Analytical Estimation.

**Next Generation Wireless Network:** Evolution of Public Mobile Services, First Wave of Mobile Data Services: Text-Based Instant Messaging, Second Wave of Mobile Data Services: Low-Speed Mobile Internet Services, Current Wave of Mobile Data Services: High-Speed and Multimedia Mobile Internet Services. IP-Based Wireless Networks - 3GPP, 3GPP2. [10H]

#### **Text Books:**

1. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2010.
2. T. S. Rappaport, "Wireless Communications," Pearson Education.
3. William C. Y. Lee, "Wireless and Cellular Telecommunications," Third edition, McGraw-Hill, 2006.

#### **References Books:**

1. S. Raj Pandya, "Mobile and Personal Communication Systems and Services," Prentice Hall of India, 2002.
2. Raymond Steele, ed. "Mobile Radio Communications," IEEE Press, New York, 1992.
3. V. K. Garg and J. E. Wilkes, "Wireless and personal Communication Systems," PHI, 1996.
4. A. J. Viterbi, "CDMA: Principles of Spread Spectrum Communications," Addison Wesley Wireless Communication Series, New York, 1995.

**Paper Code: BEC 405**

**L P C**

**Paper Title: Optical Communication**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction:** Introduction to Telecommunications and Fiber Optics, The Evolution of Fiber Optic Systems, Basic Optical Laws and Definitions, Propagation of light inside fiber, Critical-Angle, Numerical- Aperture, Acceptance-Angle, Cut-off wavelength, V-Number, Modes, Single and Multi-Mode Fibers, Fiber Types, Waveguide Equations, Step-Index Fiber Structure, Graded-Index Fiber Structure, Splicing Techniques and Connectors, Elements of an Optical Fiber Transmission Link, Advantages of Fiber Optics. **[10H]**

**UNIT II**

**Transmission Characteristics and Attenuation in Optical Fibers:** Introduction, Attenuation, Absorption Losses, Scattering Losses, Bending Losses, Core and Cladding Losses, Total combined Losses. Dispersion, Material Dispersion, Waveguide Dispersion, Intermodal Distortion.

**Optical Sources and Detectors:** Laser, Light-Emitting Diodes (LEDs), LED Structures, Characteristics of LEDs, Laser Diodes, Comparison between LED and Laser Diode. Physical Principles of Photodiodes, PIN Photodetector, Avalanche Photodiodes (APD), Comparison of Photodetectors. Optical Receiver. **[10H]**

**UNIT III**

**Optical Fiber Communication System:** ISDN, ATM, Ethernet, Digital Optical Fiber Communication System-First Generation, System, Second Generation System, Future System.

**Data Communication Networks-** Network Topologies, Access network, LAN, MAN, WAN. Optical WDM Networks. **[10H]**

**UNIT IV**

**Advanced Multiplexing Strategies-** Optical TDM, Sub carrier Multiplexing. Architec-



tures: SONET/SDH Frame and its architecture.

**Applications**-Military Applications, Civil, Consumer & Industrial Applications.

**[10H]**

**Text Books:**

1. John M. Senior, "Optical Fiber Communications," Pearson, 3<sup>rd</sup> Edition, 2011.
2. M. N. Bandyopadhyay, "Optical Communication and Networks," 1<sup>st</sup> Edition, PHI, 2014.
3. J. Gowar, "Optical communication systems," PHI, 1987.
4. Gerd Keiser, "Optical Fiber Communication," McGraw-Hill, 2<sup>nd</sup> Edition, 2010.

**References Books:**

1. M. K. Raina, "Optical Fiber Communication System," Satya Prakashan, 6<sup>th</sup> Edition, 2012.
2. S.E. Miller and A.G. Chynoweth, "Optical fibres telecommunications," Academic Press, 1979.
3. G. Agrawal, "Fiber Optic Communication Systems," John Wiley and sons, New York, 1992.

**Paper Code: BCS 403**

**L P C**

**Paper Title: Mobile Computing**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction:** Mobile Computing, Motivations, concepts, and challenges of mobile computing, Architecture of Mobile Computing. Mobile computing environments, challenges and applications. Various Communication Radio Technologies, Security and Privacy issues. **[10H]**

**UNIT II**

**Wireless System and Standards:** Cellular concept, frequency allocation. Global System for Mobile Communication GSM architecture and its interfacing, call routing in GSM, location management, HLR-VLR, Mobility Management, Handoffs, Introduction to LAN Protocols. **[10H]**

**UNIT III**

**Data Management:** Introduction, GPRS and Packet Data Network, GPRS Network architecture, operation and Data Services, Applications and Limitations of GPRS. CDMA and 3G: Introduction, Spread spectrum technology, CDMA versus GSM, 3G Network. Introduction to Dynamic routing algorithms. **[10H]**

**UNIT IV**

**Emerging Technologies:** Bluetooth technology, protocols and interfacing, Voice over IP and its Application. IPV6, Mobile IP. Location Based Services, Context aware Computing, data broadcasting and file management, CODA file system, QoS issues in mobile Computing. **[10H]**

**Text Books:**

1. Asoke K Telukder, Roopa R Yavagal, "Mobile Computing," TMH, 2011.
2. Raj Kamal, "Mobile Computing," Oxford University Press, 2007.
3. Yi-Bing Lin & Imrich Chlamtac, "Wireless and Mobile Networks Architectures," John Wiley

& Sons, 2001.

**References Books:**

1. Reza Behravanfar, "Mobile Computing Principles: Designing and Developing Mobile Applications with UML and XML," Cambridge University Press, October 2004.
2. Frank Adelstein, Sandeep K.S. Gupta, Golden G. Richard III, and Loren Schwiebert, "Fundamentals of Mobile and Pervasive Computing," McGraw-Hill Professional, 2005.
3. Hansmann, Merk, Nicklous, and Stober, "Principles of Mobile Computing," Springer, 2<sup>nd</sup> Edition, 2003.

**Paper Code: BEC 411**

**L P C**

**Paper Title: VLSI Technology**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Crystal Growth**, crystal structure, crystal defects, raw materials and purification, electronic grade silicon, Czochralski and float-zone crystal growth methods, Wafer preparation and specifications, Fabrication Facilities and Environment - pure water system, clean room and personnel, wafer manufacturing clean rooms, wafer cleaning and gettering, Basic concepts, manufacturing methods and equipment, Measurement methods. **[10H]**

**UNIT II**

**Oxidation** - Thermal, Dry & Wet, High Pressure and Plasma Oxidation, Lithography - Optical Lithography, Photomask, Photo resist and Process, Electron Lithography, X-ray Lithography, Ion Beam Lithography. Etching - Wet Chemical Etching, Reactive etching, Impurity Doping - Diffusion Ion Implantation, Metallization - desired Properties, Applications, Ohmic contacts, Choices and Problems. **[10H]**

**UNIT III**

**Integrated Elements:** Isolation of circuit elements, Bipolar Technology: NPN Transistors, PNP Transistors, Integrated Diodes, Semiconductor Resistors, Capacitors and Inductors, MOS Technology: NMOS and CMOS IC Technology. Wafer sort, Device Separation, Die Bonding, Wire Bonding, Package Types and Considerations, Testing of ICs. **[10H]**

**UNIT IV**

**Problem of raising the scale of integration** - Causes of IC failures - Electron static Discharge Damage and Alpha Particle Induced soft errors, Yield and Reliability, Antenna effect, Design Rule, Methods of reliability evaluation, Non silicon Technology (GaAs ICs), Future trends. **[10H]**

### **Text Books:**

1. Sorab Ghandhi, "VLSI Fabrication Principles," 2<sup>nd</sup> Edition, John Wiley and Sons, 2008.
2. S. M. Sze, "VLSI Technology," 2<sup>nd</sup> Edition, McGraw-Hill, 2002.
3. James D. Plummer, M.D. Deal and P.B. Griffin, "Silicon VLSI Technology, Fundamentals, Practice and Modeling," 1st Edition, Pearson Education, 2007.

### **References Books:**

1. Stephen A. Campbell, "Fabrication Engineering at the Micro- and Nanoscale," Oxford University Press, 2008.
2. Richard C. Jaeger, "Introduction to Microelectronic Fabrication," 2<sup>nd</sup> Edition, PHI, 2002.
3. Gary S. May, Simon M. Sze, "Fundamentals of Semiconductor Fabrication," Wiley, 2004.

**Paper Code: BCS 409**  
**Paper Title: Soft Computing**

**L P C**  
**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction of soft computing:** soft computing vs. hard computing, various types of soft computing techniques, applications of soft computing. **Concept Of Uncertainty:** Presence of uncertainty in real world problems, handling uncertain knowledge, degree of belief, degree of disbelief, uncertainty and rational decisions, decision theory, utility theory, concept of independent events, Bayes rule, Using Bayes rule for combining events. **[10H]**

**UNIT II**

**Rough Sets:** Definition, Upper and Lower Approximations, Boundary Region, Decision Tables and Decision Algorithms. **Properties of Rough Sets, Fuzzy sets and fuzzy logic:** Introduction to fuzzy logic, classical and fuzzy sets, overview of fuzzy sets, membership function, fuzzy rule generation, operations on fuzzy sets: compliment, intersection, union, combinations on operations, aggregation operation. **[10H]**

**UNIT III**

**Neural Networks:** Overview of biological neurons, Mathematical model of Neuron, Perceptron and Multi Layer Perceptron, Learning in Artificial Neural Networks; Supervised, Unsupervised and Competitive Learning paradigms; Learning rules and Functions, Back propagation algorithm, RBF networks , Hopfield networks Associative Memories, Self Organizing Maps, Applications of Artificial Neural Networks. **[10H]**

**UNIT IV**

**Nature Inspired Algorithms:** Introduction, Evolutionary algorithms - Genetic Algorithm: History, terminology, biological background, creation of offspring, working principles of genetic algorithms, fitness function, Roulette wheel selection, Boltzmann selection, cross over mutation,

inversion, deletion, and duplication, generation cycle , Swarm Optimization - Particle Swarm Optimization and Ant Colony Optimization. [10H]

**Text Books:**

1. Deepa, Shivandan, and Das, "Principles of Soft Computing," John Wiley, 2<sup>nd</sup> Edition.
2. Chandrasekharan, "Fuzzy, Neural and Genetic Algorithm," PHI.
3. T. J. Ross, "Fuzzy Logic with Engineering Applications," John Wiley, 2<sup>nd</sup> Edition, 2004.

**References Books:**

1. Paul P. Wang, "Fuzzy Logic: A spectrum of Theoretical and Practical Issues," Pearson Education, 2004.
2. Lotfi Asker Zadeh, George J. Kirl, Bo yuan, "Fuzzy Sets, Fuzzy logic, and Fuzzy Systems," 2005.
3. Foundations of Fuzzy logic and Soft Computing, 12<sup>th</sup> International Fuzzy conference proceeding, 2005.
4. Xin-She Yang, "Nature-Inspired Metaheuristic Algorithms," 2<sup>nd</sup> Edition, Luniver Press, 2010.

**Paper Code: BMA 407**

**L P C**

**Paper Title: Non-Conventional Energy Resources**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction to various sources of energy;** Solar thermal, Photovoltaic, hydro power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy.

**Solar Radiations:** Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, Measurement of solar radiations, Declination angle, Surface azimuth angle, Hour angle, Zenith angle, Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.

**Solar Energy:** Solar thermal power and its conversion, solar collectors, flat plate, performance analysis of flat plate collector, solar concentrating collectors, types of concentrating collectors, thermal analysis of solar collectors. Solar thermal energy storage, different systems and their applications, water heating, space heating & cooling, solar distillation, solar pumping, solar cooking, greenhouses, solar power plants. **[10H]**

**UNIT II**

**Solar Photovoltaic System:** Photovoltaic effect, efficiency of solar cells, semiconductor materials for solar cells, solar photovoltaic system, standards of solar photovoltaic system, applications of PV system, PV hybrid system.

**Biogas:** Photosynthesis, bio gas production aerobic and anaerobic bio-conversion process, properties of biogas (composition and calorific value), storage and enrichment, community biogas plants, problems involved in bio gas production, bio gas applications, Biomass: generation, characterization, use as energy source, biomass conversion techniques, biomass co-generation, fuel properties, biomass resource development in India. **[10H]**

**UNIT III**

**Wind Energy:** Properties of wind, availability of wind energy in India, wind velocity, wind



machine fundamentals, types of wind machines and their characteristics, horizontal and vertical axis wind mills, elementary design principles, selection of a wind mill, wind energy farms, economic issues, and recent development.

**Tidal and Wave Power:** Tides and waves as sources of energy, fundamentals of tidal power, use of tidal energy, limitations of tidal energy conversion systems. [10H]

#### **UNIT IV**

**Geothermal Energy:** Structure of earth's interior, geothermal sites, geothermal resources, hot springs, steam system, types of geothermal station with schematic representation, site selection for geothermal power plants, problems associated with geothermal conversion.

**Ocean Energy:** Principle of ocean thermal energy conversion, wave energy conversion machines, power plants based on ocean energy, problems associated with ocean thermal energy conversion systems, thermoelectric OTEC. [10H]

#### **Text Books:**

1. G.D Rai, "Non-Conventional Energy Sources," Khanna Publishers, 2011.
2. G.N. Tiwari and M.K. Ghosal, "Renewable Energy Resources: Basic Principles and Applications," Alpha Science International, 2005.
3. John Twiddeu and Tony Weir, Renewal Energy Resources Routledge Publishers, 3<sup>rd</sup> edition, 2015.

#### **References Books:**

1. D.P. Kothari, K.C. Singal and Rakesh Ranjan, "Renewable Energy Resources and Emerging Technologies," Prentice Hall India Pvt. Ltd, 2011.
2. Ashok V. Desai, "Nonconventional Energy," New Age International Publishers Ltd, 1990.
3. Manfred Kleemann, Michael Meliss, Ranjan Kaul and Kaushik Ghosh, "Renewable Energy Sources and Conversion Technology," Tata Mc Graw Hill, 1990.

**Paper Code: BEC 413**

**L P C**

**Paper Title: New and Emerging Technologies in Electronics Engineering**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Organic electronics:** Organic Materials Science, comparison with inorganic materials, charge transport, Device Physics and Applications, Organic LEDs (OLEDs), thin film transistors, flat panels, foldable displays, Viewing angle, brightness, comparison between OLED and LCD, OLEDs in automobile applications and portable devices such as mobile phones, digital video cameras, DVD players and PDAs, Types of OLEDs. **[10H]**

**UNIT II**

**Spintronics:** Progress in Theory, Materials, and Devices, Spin transport in metals and insulators, Spin-motive force in the presence of spin-orbit interaction, spin Hall effect, topological phases engendered by spin-orbit interactions, spin-transfer torques, spin-motive forces. Fundamentals of quantum spin transport and correlations in diverse phases of matter and nanoscale systems to highly nonlinear out-of-equilibrium phenomena involving the interplay of electronic, nuclear, optic, and mechanical spin/angular momentum degrees of freedom. **[10H]**

**UNIT III**

**Quantum electronics:** Physics and quantum devices, nonlinear optical phenomena and the quantum nature of light, Quantization of the electromagnetic field; Number states; Coherent states and their properties; Squeezed states of light and their properties; Application of optical parametric processes to generate squeezed states of light; Entangled states and their properties; Generation of entangled states; Quantum eraser, Ghost interference effects; Applications in quantum information science. **[10H]**

**UNIT IV**

**Emerging Non-CMOS Devices & Technologies:** Novel non-CMOS materials, processes and

devices, (nanotubes, nanowires and nanoparticles, including carbon, graphene, metal oxides) for electronic, applications. Applications of Nanotubes, Nanowires, and Graphene: Nanowire Growth as a Means for the Monolithic Integration of III-V Compound Semiconductors on Si, Transport Studies in Graphene Field Effect Transistors. [10H]

**References:**

1. NPTEL Lectures
2. <https://tem.msae.wisc.edu/research/spintronics-materials-and-devices/>
3. <http://www.journals.elsevier.com/organic-electronics/>
4. Rainer Waser, "Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel Devices," John Wiley & Sons, 2005
5. A Yariv, "Quantum Electronics," John Wiley, NY, 1989.

**Note:-** BEC 413 is offered as an Open Elective and the contents may be revised from time to time depending upon recent trends.

**Paper Code: BIT 421**

**L P C**

**Paper Title: Cloud Computing and Applications**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**The Evolution of Cloud Computing**, Why Cloud Computing Matters, Advantages and Disadvantages of Cloud Computing, Characteristics of Cloud Computing, Cloud Models Service Models Deployment Models, Understanding Services and Applications by type, IaaS, PaaS, SaaS.

**[10H]**

**UNIT II**

**Infrastructure as a service:** Introduction, Storage as a service, Amazon Storage Services, Compute as a service: Amazon Elastic Compute Cloud (EC2), Multi tenancy, Load Balancing, PaaS Windows Azure, Google App Engine, Software As a Service Salesforce.com, Google App Engine, Social Computing Services Case Study: Face Book, Social Media Website, Picassa, Twitter, Google Doc.

**[10H]**

**UNIT III**

**Addressing Cloud Cloud Challenges**, Scaling Computation, scale out versus scale up, Amadhl's Law, Scaling Cloud application with a reverse Proxy, Hybrid cloud and Cloud Bursting: Open Nebula, Design of a scalable cloud platform: Eucalyptus, Scaling Storage, Cap Theorem, Implementing Weak Consistency, Multi Tenancy Multi tenancy levels tenants and Users, Resource sharing, Cloud Security Issues Risk management.

**[10H]**

**UNIT IV**

**Cloud Technology**, Server virtualization, Hypervisor Based Virtualization, Technique for Hypervisors, Hardware Support, VMware Virtualization Software, Storage Virtualization, Grid computing, Utility computing, autonomic computing, Cloud based Services and applications, Cloud Computing for Energy systems, Cloud computing for Mobile Communication, Cloud

computing for Manufacturing Industry, Cloud computing for Education.

[10H]

**Text Books:**

1. A. Velte, T. J. Velte, Robert Elsenpeter, “ Cloud Computing , A practical approach,” TMH
2. Dinkar Sitaram, Geeta Manjunath, “Moving to the Cloud,” Syngress.
3. Arshdeep Bahga Vijay Madiseti, “Cloud Computing: A Hands-On Approach,” CreateSpace Independent Publishing Platform, 2013.

**References Books:**

1. John W. Rittinghouse and Ames F. Ransome, “Cloud Computing Implementation, Management and Security,” CRC Press, Taylor & Francis Group, Boca Raton London New York. 2010.
2. Barrie Sosinsky, “Cloud Computing Bible,” Wiley-India, 2010.
3. Thomas Erl., “Cloud Computing: Concepts, Technology and Architecture,” Pearson.

**Paper Code: BEC 423**

**L P C**

**Paper Title: Advanced Antenna Technology**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Review of Antenna Basic and Radiation Concepts:** Electromagnetic waves and modes, Physical concept of radiation, Radiation pattern, near-and far-field regions, Maxwell's Eqn, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions, Biological Interaction of Radiation. **[10H]**

**UNIT II**

**Radiation from Wires and Loops:** Infinitesimal dipole, finite-length dipole, dipole for mobile comm., small circular loop of wire antennas and line source.

**Aperture and Reflector Antennas:** Image Theory, Huygens' principle, radiation from infinite ground plane, rectangular and circular apertures, design considerations, Babinet's principle, Antenna radiation, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabol-ic reflector and cassegrain antennas. **[10H]**

**UNIT III**

**Analysis and synthesis of Antenna Array:** Review of Antenna Array Basics, Linear arrays, circular and planar arrays, Effect of Mutual Coupling, Phased array antenna, scan principles, Linear array Sythesis: Fourier series method, Woodward-Lawson sampling method, Dolph-Chebyshev method, Taylor synthesis, O-E-stem synthesis, Optimization of directivity and signal-to-noise ratio.

**Broadband and Frequency Independent Antennas:** Log-periodic and Yagi antennas, frequency independent antennas, broadcast antennas, Helical antenna: Normal mode and axial mode helix. Fractal and Meta material Antennas.

**Multiple-input multiple-output (MIMO) systems** - Multiple Element antenna, Spatial mul-

time-division multiplexing, block diagram of MIMO system, system information, Channel state information, Capacity in non-fading and flat fading channels, Tradeoffs between Diversity, Beam forming gain and spatial multiplexing. [10H]

#### **UNIT IV**

**Microstrip Antennas:** Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas: cavity and transmission line models, Microstrip arrays. Antenna on Chip.

**Basic Concepts of Smart Antennas:** Concept and benefits of smart antennas, Fixed weight beamforming basics, Adaptive beamforming. Applications of Antenna in defense, Mobile Communication and medical, recent development in Antenna. [10H]

#### **Text Books:**

1. Fusco, "Foundations of Antenna Theory & Techniques," 1<sup>st</sup> Ed, Pearson, 2007.
2. R. L. Yadava, "Antenna and wave Propagation," 2<sup>nd</sup> Edition, PHI, 2003.
3. C. A. Balanis, "Antenna Theory and Design," 3<sup>rd</sup> Ed., John Wiley & Sons, 2005.
4. W. L. Stutzman, and G. A. Thiele, "Antenna Theory and Design," 2<sup>nd</sup> Ed., John Wiley & Sons, 1998.

#### **References Books:**

1. G. S. N. Raju, "Antennas & Wave Propagation," 1<sup>st</sup> Ed, Pearson, 2004.
2. R. E. Collin, "Antennas and Radio Wave Propagation," McGraw-Hill., 1985.
3. F. B. Gross, "Smart Antennas for Wireless Communications," McGraw-Hill., 2005
4. R. S. Elliot, "Antenna Theory and Design," Revised edition, Wiley-IEEE Press., 2003.
5. T. A. Milligan, "Modern Antenna Design," 2<sup>nd</sup> Ed. 2005, John Wiley & Sons.

**Paper Code: BMA 417**

**L P C**

**Paper Title: Process Improvement Techniques**

**3 0 3**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Principles of Management:** approaches to management thoughts, scientific management, functions of management

**Organization:** Organization structure and organization design, The Process View of Organizations - Service and manufacturing processes - Nature of service processes, process structure in services, Process structure in Manufacturing , Value Chain - Core and support processes, adding value with processes **[08H]**

**UNIT II**

**Productivity,** Value analysis and Value Engineering Concept, Procedure, Application and role in Productivity. Process Improvement Techniques: Total Quality Management(TQM), Basic Concept of Total Quality (TQ), Statistical Process Control, Programmes; Quality Improvement Teams; Marketing Aspect of T.Q.; Total Quality of Services; Total Quality and Safety; Six Sigma. **[07H]**

**UNIT III**

**Benchmarking:** Process and Benefits, Enterprise Resource Planning(ERP), Business Reengineering, Simulating business process - Application, simulation process, discrete event simulation, computer simulation. **[08H]**

**UNIT IV**

**Constraint Management** - theory of constraints, process layout - designing flexible flow layouts; Lean Systems - Toyota production system, characteristics of lean systems, continuous improvement, Kanban system Value stream mapping, JIT, Process Synchronization and Improvement. **[07H]**



### **Text Books:**

1. Manuel Laguna, and Johan Marklund, "Business Process Modelling, Simulation and Design," Pearson Education, 2011.
2. Poornima M.Charantimath, "Total Quality Management," Pearson Education, 1<sup>st</sup> Indian Reprint 2003.
3. Shankar R., "Industrial Engineering and Management," Galgotia Publication, 2002.
4. K. Mathur, and D. Solow, "Management Science," Prentice Hall, 1994.

### **References Books:**

1. Ravi Anupindi, Sunil Chopra, Sudhakar Deshmukh, Jan A. Van Mieghem, and Eitan Zemel, "Managing Business Process Flows: Principles of Operations Management," Pearson Education, 2006.
2. Douglas C. Montgomery, "Introduction to Statistical Quality Control," Wiley Student Edition, Wiley India Pvt. Limited, 2008.
3. James R. Evans and William M. Lindsay, "The Management and Control of Quality," 6<sup>th</sup> Edition, Thomson, 2005.

**Paper Code: BAS 419**  
**Paper Title: Financial Accounting**

**L P C**  
**3 0 3**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction to Accounting**, concept and objectives of accounting and bookkeeping, conventions and principles, Accounting Equation, International Accounting principles and standards, Matching of Indian Accounting Standards with International Accounting Standards, debit and credit entries, double entry principle, journal and journal entries; accounting of sole proprietorship. **[08H]**

**UNIT II**

**Ledger posting** and trial balance, preparation of final accounts, Profit & Loss Account, Profit & Loss Appropriation account and Balance Sheet, Policies related with depreciation, inventory and intangible assets like copyright, trademark, patents and goodwill **[07H]**

**UNIT III**

**Analysis of financial statement:** Ratio Analysis- solvency ratios, profitability ratios, activity ratios, liquidity ratios, Funds Flow Statement: Meaning, Concept of Gross and Net Working Capital, Preparation of Schedule of Changes in Working Capital, Preparation of Funds Flow Statement and its analysis **[08H]**

**UNIT IV**

**Cash Flow Statement:** Various cash and non-cash transactions, flow of cash, preparation of Cash Flow Statement and its uses. **[07H]**

**Text Books:**

1. Maheshwari & Maheshwari, "An Introduction to Accountancy," Vikas Publishing House, 2009.
2. S. N. Maheshwari, "Principles of Management Accounting," 11<sup>th</sup> Edition, Sultan Chand &

Sons, 2001

3. V. K. Gupta & R. L. Gupta, "Financial Accounting," Sultan Chand & Sons, 2014.
4. T. P. Ghosh, "Financial Accounting for Managers," Taxman, 2009.

**References Books:**

1. Narayanswami, "Financial Accounting: A Managerial Perspective," PHI, 2014.
2. Ramchandran & Kakani, "Financial Accounting for Management," TMH, 2011.
3. Ashish K. Bhattacharya, "Financial Accounting for Managers," PHI, New Delhi, 2006.

**Paper Code: BIT 415**

**L P C**

**Paper Title: Cyber Security Awareness**

**3 0 3**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Concept of Information**, Information as an asset, Information Security Concepts, Computer and Internet Security, Security Services, Security goals, Security attacks, Threats, Vulnerabilities, Malicious Software, Virus, Trojan, Worms, Spywares. **[07H]**

**UNIT II**

**Device Security:** Securing PC, Securing Smart Phone, Securing Laptops/Tabs, Securing Pen drives, Physical Security, Wi-fi security, Email Security, Browser security, Email Architecture, Email Tracing, Secure download, Secure Apps, Spam mails, Identity theft **[07H]**

**UNIT III**

**New and emerging IT Technologies**, Cloud Technologies and cloud security, Security issues of Smart Phones, digital tablets and smart Devices, Social Networking Safety and Privacy issues on Social Network sites. Identity Theft, Password Hacking, Spamming, Social network Account Attack, Hacking of social network account using password cracking. **[08H]**

**UNIT IV**

**Cyber Crime**, Types of Cyber crime, Cyber Attacks methodology, Hacking, Phishing, credit card fraud, Malware, Threats to Critical infrastructure, software Piracy and legal issues, M-commerce e.g. mobile wallet, mobile payment m-banking and security issues, Indian IT ACT, 2000 and its amendments 2008 & 2011, Mobile law in India, Legal issues pertaining to Device, Mobile Apps and Social Media. **[08H]**

**Text Books:**

1. William Stallings, "Network security essentials : Applications and Standards," Pearson Ed-

- ucation, 5<sup>th</sup> Edition, 2013
2. Pavan Duggal., “Law Relating to iPads, Tablets, Smartphones & Smart Devices,” Universal Law Publishing & Co, 2013.

**Reference Books:**

1. Mark Rhodes-Ousley, “Information Security: The Complete Reference,” McGraw-Hill, 2<sup>nd</sup> Edition, 2013.
2. Mark Ciampa, “Security Awareness: Applying Practical Security in Your World,” Cengage Learning, 4<sup>th</sup> Edition, 2014.
3. <http://www.sans.org/security-resources/>

**Paper Code: BAS 461**  
**Paper Title: Disaster Management**

**L P C**  
**0 2 1**

**Objective:-** The Course will focus on the areas of disaster management preparedness, the relationship of different disaster management activities with mock drills and use of ICT for managing disaster.

### **UNIT I**

**Concepts and Definitions of disaster-** hazard, vulnerability, resilience, risks, Difference between accidents and disasters Categories of disasters- Natural disasters- earthquake, cyclone, flood, tsunami, fire, and Man-made disasters- technological, armed conflict and civil strife, Nuclear and gas leakage disasters, Factors affecting Vulnerabilities, differential impacts, Impact of Development projects such as dams. Strategic Planning for Disaster Preparedness, Recovery and Management of Disasters. **[12H]**

### **UNIT II**

**Technology disasters,** Business Continuity Planning and Recovery, Disaster Policy of India (Salient Features). Use of ICT, mobile technology, alarms etc. for managing disaster. **[08H]**

### **Text Books:**

1. Alexander David, "Introduction in Confronting Catastrophe," Oxford University Press, 2000.
2. Anu Kapur *et al.*, "Disasters in India: Studies in Grim Reality," Rawat Publishers, 2005.
3. Anil K Gupta, and Sreeja S. Nair, "Environmental Knowledge for Disaster Risk Management," NIDM, 2011.

### **References Books:**

1. J. Andharia, "Vulnerability in Disaster Discourse," JTCDM, Tata Institute of Social Sciences Working Paper no. 8, 2008.
2. Govt. of India: Disaster Management Act 2005, Government of India, New Delhi.

**Paper Code: BCS 402**

**L P C**

**Paper Title: Embedded System Design**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction:** Embedded system and general purpose computers, Embedded system components, Embedded System Design Process, Classification of an embedded system, Examples of an embedded system, Applications of an embedded system, Processor Selection for embedded systems and its issues, Embedded controllers, Memory selection, Programming language/tool selection, IDE selection. **[10H]**

**UNIT II**

**Implementation Platforms and Its Programming:** The ARM programmers model, ARM development tools, ARM instruction set: Software interrupt (SWI) Interrupt Service Routines-Writing simple assembly language programs for ARM, 3-stage pipeline ARM organization Comparison between ARM and Atom processors. Introduction to Reconfigurable platforms( SoC, FPGA). **[10H]**

**UNIT III**

**RTOS:** Operating system service, RTOS architecture, Process management, Timer and Event function, Memory management, Device , File and I/O subsystem management, Interrupt routine in RTOS environment and handling of interrupt service calls, Watch dog timer, Real time clock, Customizing OS for Embedded system, Introduction to Embedded C. Case study of Mbed OS and RT Linux. **[10H]**

**UNIT IV**

**Advanced Processors for Embedded Systems:** Intel architecture for Embedded System and IoT (Intel Atom architecture, Intel Galileo) Interfacing, Programming of Peripherals such as LCD, Sensors (Temperature, Humidity, PIR etc), Buzzer and Bluetooth. Introduction to H/W and S/W

co-design.

[10H]

**Text Books:**

1. William Hohl, "ARM Assembly Language: Fundamentals and Techniques," CRC Press, 2<sup>nd</sup> Edition.
2. Steve Heath, "Embedded Systems Design," Newnes(Elsevier) publications, 2<sup>nd</sup> Edition.
3. Manoel Ramon, "Intel Galileo Gen 2 and Intel Edison for Beginners: A Hands-on Introduction," A press Open.

**References Books:**

1. Dr.K.V.K.K.Prasad, "Embedded/Real Time Systems: Concepts, Design and Programming," DreamTech press, Black Book, 2005.
2. Wayne Wolf, "Computer as Components: Principles of Embedded Computer System Design," Princeton University.
3. Arnold S. Berger, "Embedded System Design: An introduction to Processes Tools and Techniques," Viva CMP Books.



**Paper Code: BEC 404**

**L P C**

**Paper Title: Mobile Communication**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction to broadband wireless:** Evolution of Broadband Wireless; Fixed Broadband Wireless and Mobile Broadband Wireless; WiMAX, 3G, 4G & Wi-Fi Systems; Spectrum Options for Broadband Wireless; Technical Challenges for Broadband Wireless- Wireless Radio Channel: Path loss and Shadowing; Spectrum Scarcity, Quality of Service, Mobility, Portability, Security, Supporting IP in Wireless. Orthogonal Frequency Division Multiplexing, Multicarrier Modulation- OFDM; Introduction to Multiple Antenna Techniques limit. **[10H]**

**UNIT II**

**Spectrum Sensing:** Overview, Classification, Matched filter, Waveform based sensing, Cyclostationary based sensing, Energy detector based sensing, Radio Identifier, Cooperative sensing, other sensing methods, Design Challenges associated with CR- Hardware requirements- Hidden primary user problem- detecting spread spectrum primary users- sensing duration and frequency- security, Optimum Detection and error probability for synchronous and asynchronous channels, Rayleigh fading, Optimum non-coherent multiuser detection, Decorrelating detector in synchronous and asynchronous channel. **[10H]**

**UNIT III**

**LTE System Overview,** The Evolution from UMTS to LTE; Requirements and Targets for LTE; LTE Radio Access, Transmission Scheme, Spectrum Flexibility, Channel Dependent Scheduling and Rate Adaptation, Inter-Cell Interference Combining, Multi-Antenna Transmission. Technologies for LTE; Network Architecture - Overall Architecture Overview, Protocol Architecture. **[10H]**

**UNIT IV**

**LTE Advanced** - Introduction, Requirements, Main Features, Backward Compatibility, Deployment Aspects, UE Categories for LTE Advanced. Pillars of 5G, 5G Architecture, Internet of things and context awareness, Mobility- a clean state approach, small cells for 5G, Mobile cloud technology and services for future communications, Cognitive radios for 5G, Security for 5G communication, Green flexible RF for 5G. **[10H]**

**Text Books:**

1. Jeffrey G. Andrews, Arunabha Ghosh, and Rias Muhamed, “Fundamentals of WiMAX: Understanding Broadband Wireless Networking,” Pearson Education, 2007.
2. Yan Zhang and Hsiao-Hwa Chen, “Mobile WiMAX: Toward broadband wireless metropolitan area networks,” Auerbach Publications, 2007.
3. Moray Rumney, “LTE and Evolution to 4G Wireless: Design and Measurement Challenges,” Agilent Technologies, 2008.

**References Books:**

1. Stefania Sesia, Issam Toufik, Matthew Baker, “LTE - The UMTS Long Term Evolution: From Theory to Practice,” John Wiley & Sons, 2<sup>nd</sup> Edition, 2011.
2. Jochen Schiller, “Mobile Communications,” Pearson Education, 2<sup>nd</sup> Edition.
3. Luis M. Correia, “Mobile Broadband Multimedia Networks: Techniques, Models and Tools for 4G,” Elseiver, 2006.

**Paper Code: BEC 406**

**L P C**

**Paper Title: Power Electronics**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Power Electronic Devices:** Construction, Principle of operation, Static and dynamic characteristics of Power diodes, SCR, TRIAC, GTO, power BJT, power MOSFET and IGBT, Safe operating Area, Protection circuits- series and parallel connections. **[10H]**

**UNIT II**

**AC TO DC Converters:** Single phase and three phase controlled rectifiers (half and full converters) with R, RL and RLE load, Estimation of RMS load voltage, RMS load current and input power factor, effect of source inductance and firing circuits, Single phase and three phase dual converters. **[10H]**

**UNIT III**

**DC TO DC Converters:** Principle of step up and step down operation, single quadrant DC chopper with R, RL and RLE load, Time ratio control, Estimation of average load voltage and load current for continuous current operation- two quadrant and four quadrant DC choppers, Voltage, current and load-commutated choppers. **[10H]**

**UNIT IV**

**DC TO AC Converters & AC TO AC Converters:** Inverters- Types- Voltage source and current source inverters, single phase bridge inverters, three phase bridge inverters, PWM inverters, Series inverter control of AC output voltage, Harmonic reduction, AC voltage regulator, step up and step down cycloconverter, three phase to single phase cycloconverter and three phase to three phase cycloconverter. **[10H]**

**Text Books:**

1. M. H. Rashid, "Power Electronics - Circuits Devices and Applications," 4<sup>th</sup> Edition, Pearson Education, 2014.
2. P. C. Sen, "Power Electronics," Tata Mc Graw Hill Education, 12<sup>th</sup> Edition, 2011.
3. P. S. Bhimbra, "Power Electronics," Khanna publishers, 2012.

**References Books:**

1. M. D. Singh and Kanchandani, "Power Electronics," Tata McGraw-Hill & Hill Publication Company Ltd New Delhi-2002.
2. Joseph Vithayathil, "Power Electronics," McGraw Hill series in Electrical and Computer Engineering, USA , 1995.
3. G. K. Dubey, S.R. Doradia, A. Joshi, and R.M. Sinha, "Thyristorised Power Controllers," Wiley Eastern Limited, 1986.
4. W. Lander, "Power Electronics," McGraw Hill and Company, Third Edition, 1993.
5. Umanand Loganathan, "Power Electronics," Wiley India Pvt. Limited, 2009.

**Paper Code: BEC 408**

**L P C**

**Paper Title: Advanced VLSI Design**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Small signal & large signal models:** Small signal & large signal models of MOS & BJT transistor, MOS & BJT transistor Amplifiers: single transistor Amplifiers stages: Common Emitter, Common base, Common Collector, Common Drain, Common Gate & Common Source Amplifiers, Frequency response of amplifiers. Multiple transistor amplifier stages: CC-CE, CC-CC, & Darlington configuration, Cascode configuration, Active Cascode, Differential amplifiers: Differential pair & DC transfer characteristics. **[10H]**

**UNIT II**

**Current Mirrors,** Active Loads & References, current mirrors, simple current mirror, Cascode current mirrors Widlar current mirror, Wilson Current mirror, Active loads, Analysis of differential amplifier with active load, supply and temperature independent biasing techniques. **[10H]**

**UNIT III**

**Operational Amplifier:** applications of operational Amplifier, theory and Design; Definition of Performance Characteristics; Design of two stage MOS Operational amplifier, two stage MOS operational amplifier with cascodes, MOS telescopic-cascode operational amplifiers, MOS folded-cascode operational amplifiers, Bipolar operational amplifiers, Frequency response & compensation. **[10H]**

**UNIT IV**

**Voltage controlled oscillator,** Comparators, Source follower, Phase locked techniques; Phase Locked Loops (PLL), closed loop analysis of PLL. Digital-to-Analog (D/A) and Analog-to-Digital (A/D) Converters, OTA Amplifiers, Switched Capacitor Filters. **[10H]**

### **Text Books:**

1. P. R. Gray, P. J. Hurrt, S.H. Lweic, and RoG. Meyer, "Analysis and Design of Analog Integrated Circuits," John Wiley and Sons, 2001.
2. P. E. Allen, D. R. Holberg, "CMOS Analog Circuit Design," Oxford University Press, 2002.
3. B. Razavi, "Design of Analog CMOS Integrated Circuits," TMH, 2002.

### **References Books:**

1. R. J. Baker, H.W. Li, and D. E. Boyce, "CMOS Circuit Design, Layout and Simulation," PHI.
2. Ken Martin, "Digital Integrated Circuit Design," Oxford University Press.
3. Yanyiiis Tsividis and Colin Mcandrew, "The MOS Transistor," Oxford University Press, 2013.
4. Geiger, Allen, and Strader "VLSI Design Techniques for Analog and Digital Circuits," Tata McGraw-Hill, 1990.

**Paper Code: BEC 410**

**L P C**

**Paper Title: Digital Image Processing**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction:** Light, Brightness adaption and discrimination, Pixels, coordinate conventions, Imaging Geometry, Perspective Projection, Spatial Domain Filtering, Image Sensing and Acquisition, sampling and quantization, Basic Relationships between Pixels.

**Image Enhancement:** Gray level transformation, Histogram Processing, Enhancement using arithmetic and logical operator, Spatial filtering, contrast intensification, smoothing and sharpening spatial filters, spatial filter enhancements. **[10H]**

**UNIT II**

**Filtering in the Frequency domain:** Introduction to Hotelling Transform, Fourier Transforms and properties, FFT (Decimation in Frequency and Decimation in Time Techniques), Convolution, Correlation, 2-D sampling, Frequency domain filtering, correspondence between filtering in spatial and frequency domain, smoothing and sharpening frequency domain filters, Homomorphic filtering.

**Image Restoration:** Basic Framework, Interactive Restoration, Image deformation and geometric transformations, Image morphing, Restoration techniques, Noise characterization, Noise restoration filters, Adaptive filters, Linear, Position invariant degradations, Constrained Least Squares Filtering, Geometric Mean Filter, Geometric Transformations, Restoration by Singular value decomposition **[10H]**

**UNIT III**

**Image Compression:** Encoder-Decoder model, Types of redundancies, Lossy and Lossless compression, Entropy of an information source, Shannon's 1st Theorem, Introduction to different codings - Huffman Coding, Arithmetic Coding, LZW coding, Transform Coding, Sub-image size selection, blocking artifacts, DCT implementation using FFT, Run length coding, Symbol-based

coding, Bit-plane encoding, Bit-allocation, Zonal Coding, Threshold Coding, JPEG, Lossless predictive coding, Lossy predictive coding, Motion Compensation, Introduction to Wavelet based Image Compression. [10H]

#### **UNIT IV**

**Image Segmentation:** Boundary detection based techniques, Point, line detection, Edge detection, Edge linking, contour detection, local and regional processing, Hough transform, Thresholding, Iterative thresholding, Otsu's method, Moving averages, Multivariable thresholding, Region-based segmentation, Watershed algorithm, Use of motion in segmentation.

**Morphological Image Processing:** Basics, SE, Erosion, Dilation, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Hole filling, Connected components, convex hull, thinning, thickening, skeletons, pruning, Erosion, Reconstruction by dilation & erosion [10H]

#### **Text Books:**

1. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing," Pearson Education, 3<sup>rd</sup> Edition, 2007.
2. Anil K Jain, "Fundamentals of Digital Image Processing," PHI.
3. Kenneth R. Castleman, "Digital Image Processing," Pearson Education, 2015.

#### **References Books:**

1. B. Chanda and D. Dutta Majumder, "Digital Image Processing and Analysis," PHI, 2<sup>nd</sup> Edition, 2013.
2. Chris Solomon and Toby Breckon, "Fundamentals of Digital Image Processing: A Practical Approach with Examples in Matlab," Wiley Blackwell, 1<sup>st</sup> Edition
3. Maria Petrou, and Costas Petrou, "Image Processing: The Fundamentals," Wiley Publications, 2<sup>nd</sup> Edition.
4. Wilhelm Burger and Mark J. Burge, "Principles of Digital Image Processing: Fundamental Techniques," Springer, 2011.



**Paper Code: BCS 412**

**L P C**

**Paper Title: Wireless Sensor Networks**

**4 0 4**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

1. Question No. 1 should be compulsory and cover the entire syllabus. This question should have objective or short answer type questions. It should be of 20 marks.
2. Apart from Question No. 1, rest of the paper shall consist of four units as per the syllabus. Every unit should have two questions. However, student may be asked to attempt only 1 question from each unit. Each question should be of 10 marks.

**UNIT I**

**Introduction:** Mobile Ad-hoc Networks (MANETs), Introduction to Sensor Networks, Constraints and Challenges, Advantage of Sensor Networks, Applications of Sensor Networks.

**Architecture:** Single-Node Architecture- Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems, Network Architecture- Sensor Network Scenarios, Optimization Goals, Gateway Concepts. **[10H]**

**UNIT II**

**Networking Sensors:** Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, classification of MAC protocols, MAC protocols for sensor network, location discovery, S-MAC, IEEE 802.15.4., Routing Protocols- Energy-Efficient Routing, Geographic Routing. **[10H]**

**UNIT III**

**Infrastructure Establishment:** Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control, Case study of Wireless Sensor Networks for different applications. **[10H]**

**UNIT IV**

**Platform, Tool and Security:** Sensor Node Hardware Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, Security issues in Sensor Networks, Future Research Direction. **[10H]**

**Text Books:**

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Net-

- works,” John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, “Wireless Sensor Networks- An Information Processing Approach,” Elsevier, 2007.
  3. C.Siva Ram Murthy and B.S.Manoj, “Ad hoc Wireless Networks Architectures and Protocols,” Pearson Education, 2<sup>nd</sup> Edition.

**References Books:**

1. Dr.Xerenium, Shen, and Dr. Yi Pan, “Fundamentals of Wireless Sensor Networks, Theory and Practice,” Wiley Series on Wireless Communication and Mobile Computing, 1<sup>st</sup> Edition, 2010.
2. KazemSohraby, Daniel Minoli, & TaiebZnati, “Wireless Sensor Networks- Technology, Protocols, And Applications,” John Wiley, 2007.
3. Bhaskar Krishnamachari, “Networking Wireless Sensors,” Cambridge University Press, 2005.
4. Anna Hac, “Wireless Sensor Network Designs,” John Wiley, 2003.

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**UNIT I**

**Finite Wordlength Effect**, Multirate signal processing, Sampling of continuous time signals, Periodic sampling, Frequency domain representation of sampling, Reconstruction of bandlimited signal from its samples, Discrete time processing of continuous time signals, Continuous time processing of discrete time signals, Changing the sampling rate using discrete time processing, Fractional delay FIR and IIR filter, Variable delay filters. **[10H]**

**UNIT II**

**IoT - Internet of Things:** - Overview & Introduction, Concepts behind the Internet of Things, Difference between IoT & WoT(Web of Things), Business & industry aspects of IoT, Making Things Smart: Getting Things onto the Internet, IoT Communication Protocols, (RFID + NFC - Wireless networks + WSN - RTLS + GPS - Agents + Multiagent systems), Implications for Society. **[10H]**

**UNIT III**

**Computer Vision and Image Processing**, Image processing; segmentation, grouping, and boundary detection; recognition and detection; motion estimation and structure from motion, Optical character recognition (OCR), Face detection, Smile detection, Object recognition (in supermarkets), Vision based biometrics, Object recognition (in mobile phones), Special effects: shape capture, motion capture. **[10H]**

**UNIT IV**

**Introduction to Robotics**, Types of locomotion, hopping robots, legged robots, wheeled robots, stability, maneuverability, controllability; Mobile robot kinematics and dynamics, Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, dynamics simulation of mobile robots. **[10H]**

### **Text Books:**

1. Sanjit K. Mitra, "Digital Signal Processing: A Computer Based Approach," Tata McGraw-Hill, 2<sup>nd</sup> Edition, 2001.
2. Allan Y. Oppenheim & Ronald W. Schaffer, "Digital Signal Processing," PHI, 2004.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications," Springer, 2011.
4. Mittal and Nagrath, "Robotics and Control," Tata McGraw-Hill Education, 2003.
5. K. S. Fu, Ralph Gonzalez, and C. S. George Lee, "Robotics, Control, Sensing, Vision and Intelligence," McGraw Hill International, 1987.
6. Saeed B. Niku, "Introduction to Robotics Analysis, Systems & Applications," PHI, 2002

### **References Books:**

1. J. R. Johnson, "Introduction to Digital Signal Processing," PHI, 2000.
2. B. Somanthan Nair, "Digital Signal Processing: Theory, Analysis & Digital Filter design," PHI, 2004.
3. <http://dret.net/lectures/iot-spring15/>
4. <http://www.upf.edu/pr/3377/22632.pdf>
5. [http://web.cs.wpi.edu/rek/IoT/Internet\\_of\\_Things\\_Vision\\_F15.pdf](http://web.cs.wpi.edu/rek/IoT/Internet_of_Things_Vision_F15.pdf)
6. <http://web.cs.wpi.edu/rek/IoT/Fall2015.html>

**Note:-** BEC 414 is offered as an Open Elective and the contents may be revised from time to time depending upon recent trends.

**Paper Code: BAS 420**

**L P C**

**Paper Title: Business Entrepreneurship**

**3 0 3**

**INSTRUCTIONS TO PAPER SETTERS:**

**Maximum Marks: 60**

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**UNIT I**

**Introduction:** The entrepreneur, definition, characteristics; leadership, risk taking, decision making and business planning, role of entrepreneur, entrepreneurship and an entrepreneurial perspective, significance of entrepreneurship, Innovation and entrepreneur, entrepreneurial behavior and psycho-theories, social responsibility. **[08H]**

**UNIT II**

**Promotion of a Venture:** Opportunities analysis; external environmental analysis, economic, social and technological, competitive factors, fundamentals of feasibility plan, forms of business enterprises, Sole proprietorship, partnership and corporations, legal requirements of establishment of a new unit. **[07H]**

**UNIT III**

**Financial Resources,** rising of funds and documentation required. Project financing: fixed and working capital requirements, equity financing, securities market, venture capital, debt financing, banks and financial institutions and other non-bank financial sources, Government programmes, direct loan assistance and subsidies. **[08H]**

**UNIT IV**

**Managing Growth and Transition:** the organization life cycle; The entrepreneurs perspective, changing roles. Entrepreneurial Development Programmes (EDP): EDP, their role, relevance and achievements; role of government in organizing EDP's critical evaluation.. **[07H]**

**Text Books:**

1. Vasant, DCSAI, "Entrepreneurship," Himalaya Publishing House, 2003.

2. Ram Chandran, "Entrepreneurial Development," Tata McGraw Hill, New Delhi, 2008.
3. I. M. Pandey, "Venture Capital - The Indian Experience," Prentice Hall of India, 2003.
4. Shiba Charan Panda, "Entrepreneurship Development," Anmol Publications, New Delhi, 2014.

**References Books:**

1. S. B. Srivastava, "A practical guide to industrial entrepreneurs," Sultan Chand & Sons, New Delhi, 1992.
2. Prasana Chandra, "Project Preparation, Appraisal, Implementation," TMH, New Delhi, 2002.
3. David Holt, "Entrepreneurship: New Venture Creation," Prentice-Hall of India, New Delhi, 1992.

**Paper Code: BAS 422**

**L P C**

**Paper Title: Organizational Behavior**

**3 0 3**

**INSTRUCTIONS TO PAPER SETTERS:**

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**UNIT I**

**Introduction to Management and Organizational Behaviour:** Introduction- Meaning and Nature of Management, Management Functions and Processes, Scientific Management Theories; Taylor and Scientific Management; Evolution of Organizational Behaviour- Classical, Neo Classical and Modern Approaches, Contemporary School of Management Thoughts, Theories of Organization. **[08H]**

**UNIT II**

**The Individual Behaviour-** Factors affecting Individual Behaviour, Personality, Learning Process, Motivational Process, Perceptual Process, Attitudes and Values.

**Group Behaviour:** Groups- Definition, Types, Theories of Group formation, Group Roles and Norms, Interpersonal relations, Group Dynamics, Leadership Styles & Leadership Development. **[07H]**

**UNIT III**

**Behaviour in the organization:** Introduction, Issues between organizations and individuals. Interpersonal behaviour: Conflict in Organizations: nature of conflict, levels of conflict, conflict management styles. Management of Organizational Conflicts. Employee stress: forms, causes, implications, approaches to stress management. **[08H]**

**UNIT IV**

**Organizational structure & Design,** Organizational Designs; Emerging Design Options Different Organizational Structures; Communication Process, Organizational Culture (creation and sustenance of cultures), Organizational Ethos, Dimensions of Culture, Model for Managing Change, Forces for Change, resistance to change, Management of resistance. **[07H]**

### **Text Books:**

1. Stephen P. Robinson, "Organisational Behaviour," PHI, 11<sup>th</sup> Edition, 2007.
2. L. M. Prasad, "Organizational Behaviour," Sultan Chand & Sons, 2001.
3. Udai Pareek, "Understanding Organizational Behavior," Oxford University Press, 1<sup>st</sup> Edition, 2004.
4. Robbins, Judge, and Sanghi, "Organizational Behavior," Pearson, 2009.

### **Reference Books:**

1. Stoner, et. al., "Management," PHI, 6<sup>th</sup> Edition, 2002.
2. J. S. Chandan, "Organizational Behaviour," Vikas Publishing House, 2004.
3. Joseph W. Weiss, "Organizational Behaviour & Change, Managing Diversity, Cross-Cultural Dynamics & Ethics," Vikas Publishing House, 2<sup>nd</sup> Edition, 2001.
4. Jit S Chandan, "Organisational Behaviour," Vikas Publishing House, 3<sup>rd</sup> Edition, 2006.
5. Fred Luthans, "Organizational Behaviour," McGraw Hill International Edition, 9<sup>th</sup> Edition, 2002.
6. Kavita Singh, "Organization Behaviour Text and Cases," Pearson, 2010.