EC 710: Entrepreneurship and Management

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 710	Entrepreneurship and Management	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1 Explain entrepreneurship, management and innovation with an emphasis on their evolution.

2 Identify and describe various institutional support for starting new business, assessment of demand and supply in potential areas of growth, opportunity identification and feasibility analysis.

3 Analyze the importance of technology management with respect to organizational finance, ethics, team work and project planning.

4 Investigate techno-economic feasibility of a project, prepare a report, develop a business plan and critically evaluate.

5 Identify the outcomes of innovation with regard to IPR and patents in technology oriented business.

6 Assess various successful entrepreneurial profiles, analyze the industrial manufacturing ecosystem and give a presentation on start-up companies by working in teams and discuss case examples.

UNIT 1:

Entrepreneurship: Concept, meaning, need and competencies/qualities/traits of an entrepreneur, technopreneurship. Innovation: Introduction, Motivating to innovate, introduce core ideas about how to think about innovation, including key theories about factors that affect innovation. An in depth review of how companies structure to encourage and develop innovation. Product development and design. **08 Hours**

UNIT 2:

Role of financial institutions: Role of financial institutions in entrepreneurship development like District Industry Centers (DICs), State Financial Corporations, Small Industries Service Institutes (SISIs), Small Industries Development, Bank of India (SIDBI), National Small Industries Corporation (NSIC) and other relevant institutions/organizations. Market Survey and Opportunity Identification

(Business Planning):How to start an industry, procedures for registration of industry, assessment of demand and supply, in potential areas of growth, understanding business opportunity, considerations in product selection, data collection for setting up new ventures.

08 Hours

UNIT 3:

Engineering Management: Introduction to Engineering Management: Motivation (discussion on historic engineering marvels), Engineering and Management, historical development of engineering management, systems approach to management, scientific approach to management , case examples

08 Hours

UNIT 4:

Technology management: Functions of technology management: planning and forecasting, decision making, organizing, motivating and leading technical people, controlling. Managing projects: Project planning and acquisition, project organization, leadership and control. Case Studies.

08 Hours

UNIT 5:

Project Report Preparation: Preliminary report, Techno-economic feasibility report, Project viability. Case studies. **08 Hours**

Text books:

1. **Peter Duckers**, *"Innovation and Entrepreneurship Practice and Principles*", Heinnemann, 1985.
2. **Morse and Babcock,** "*Managing Engineering and Technology",* 4th.edition, PHI Learning Private Limited, New Delhi, 2009.
3. **Poornima Charanthimath,** "Entrepreneurship Development and small Business Enterprises", Pearson Education, 2nd Edition 2009.
4. **Barringer, Duane,** *"Entrepreneurship Successfully Launching New Ventures*", 4th edition, Prentice Hall, 2009.

E Resource:

EC 720: Power Electronics

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 720	Power Electronics	3	0	1	4	50	50	100

Course outcome: At the end of the course, the student should be able

1. Explain the various power devices and circuits.
2. Analyze different power electronics circuits.
3. Design power circuits to meet the given specifications.
4. Design and demonstrate the working of various power electronic circuits.
5. Demonstrate the skill sets using modern tool for analysis and simulation of power electronics circuits.

UNIT 1:

Power Semiconductor Devices: Introduction to Power Electronics- Power Diodes- Types, rating and switching characteristics. Current controlled devices- BJTs and Thyristors – Construction, operation, switching characteristics, rating and types. Voltage controlled devices: Power MOSFETs and IGBTs – construction, operation, switching characteristics, rating and types. Principles of series and parallel operation of power switching devices. Different types of Power Electronic circuits.

08 Hours

UNIT 2

Firing and Protection Circuits**:** Firing circuits for power electronic devices, Gate driver circuits for SCR, MOSFET and IGBT and base driving for power BJT, Over voltage, over current and gate protections, Necessity of isolation, pulse transformer, opto-coupler , Design of snubbers.

08 Hours

UNIT 3

Controlled Rectifiers: Introduction, Performance of Single phase fully controlled and semi controlled converters with R and RL Loads for continuous and discontinuous current modes. AC Voltage Controllers: - Introduction, On-Off and Phase control, Single –phase Bidirectional controllers with resistive and inductive loads. **08 Hours**

UNIT 4

DC – DC Converters or Choppers: Introduction, principle of operation, analysis of Buck, Boost, and Buck-boost converters, operation with R and RL loads, and their control strategies, performance parameters and classification. **08 Hours**

UNIT 5

Inverters**:** Introduction, principle of operation, performance parameters, and control strategies of Single phase Full and Half Bridge inverters with R and RL Loads, Introduction to Three phase, Current source inverters, Power Supplies: UPS, SMPS. **08 Hours**

TEXT BOOKS:

1. **Muhammad H. Rashid: "***Power Electronics – Circuits, Devices and Applications***"**, 3rd edition, Pearson Education/ PHI, 2011.
2. **R.S. Ananda Murthy, V. Nattarasu: "***Power Electronics***"**, 2nd Edition, Sanguine Technical Publishers, India, 2005.
3. **Daniel W. Hart:** "*Power Electronics*", 1st Edition, McGraw Hill, 2011.
4. **L. UMANAND:** *"Power Electronics Essentials and applications*", 3rd Edition, John Wiley and sons, Inc, 2009.
5. **V.R Moorthi:** "*Power Electronic Devices, Circuits & Industrial Applications*", 1st Edition, Oxford University Press, 2005.

E Resource:

1. https://www.youtube.com/playlist?list=PLgwJf8NK-2e5Hnu82T1CYLZ8kbZs4Jx8x
2. https://www.youtube.com/playlist?list=PLA07ACBDE053A8229

EC 720L: Power Electronics Lab

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 720L	Power Electronics Lab	0	0	1	1	50	50	100

List of Experiments

1. Analysis of static and dynamic characteristics of MOSFET and IGBT.
2. Analysis of static and dynamic characteristics of Power Transistor and SCR.
3. Performance analysis of Controlled HWR and FWR using RC triggering/ UJT firing circuit.
4. Performance of Single phase fully controlled and semi controlled converters for R and RL loads for continuous current mode.
5. Performance analysis of AC voltage controller using Triac- Diac combination.
6. Performance analysis of Series and Parallel inverters.
7. Performance analysis of Single phase bridge inverter for R and RL Load and voltage control by single pulse width modulation.
8. Performance analysis of two quadrant choppers.
9. Study and performance analysis of single phase semi controlled converter fed separately excited DC motor for continuous current mode.
10. Study of Generation of firing signals for converters / inverters using digital circuits / microprocessors.

EC 731: Automotive Electronics

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 731	Automotive Electronics	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. **Exhibit** the knowledge of working of Sensors and actuators in Electronic fuel injection, ignition systems and Active / Passive safety systems.
2. **Demonstrate**, a comprehension of the roles and implementations of various bus systems used in automotive networking.
3. **Explain** and **analyze** the main requirements, trends and selection criteria of sensors for automotive applications.
4. **Exemplify** the different measuring principles involved in sensors and evaluate for automotive applications.
5. **Demonstrate** the knowledge of basic principle of actuators and explain the mechanism of hybrid drives.
6. Work efficiently in a group and complete the assigned task by **demonstrating** skills related to documentation and oral communication.

UNIT 1

Electrical and electronic systems in the vehicle: Overview, Motronic-engine management system, Electronic diesel control, Lighting technology, Electronic stability program, Adaptive cruise control, Occupant-protection systems.

SLE: Advanced engine management technologies – Artificial intelligence and Neural computing.

08 Hours

UNIT 2

Networking and bus systems: Cross-system functions, Requirements for bus systems, Classification of bus systems, Applications in the vehicle, coupling of networks, Examples of networked vehicles.

Architecture of electronic systems & Control Units: Overview, Vehicle system architecture. Control units: Operating conditions, Design, Data processing, Digital modules in the control unit and control unit software.

SLE: Connected cars, central electrical control. **08 Hours**

UNIT 3

Automotive sensors: Basics and overview, automotive applications, Sensor market, Features of vehicle sensors, Sensor classification, Selection of sensor technologies**.**

SLE: Advanced instrumentation technology – holography, telemetry, telematics. **08 Hours**

UNIT 4

Sensor measuring principles: Sensors for the measurement ofposition, speed, rpm, acceleration, pressure, force, and torque, Flow meters, temperature sensors,

Sensor types: Engine speed sensors, Hall phase sensors, Sensors for transmission control & wheel speed, Yaw-rate sensors, Pressure sensors, Temperature sensors, Accelerator-pedal sensors, Steering angle sensors, Position sensors, Axle sensors, Piezoelectric knock sensors, Acceleration sensors, Force & torque sensors, Rain/light sensors.

SLE: LVDT, Dynamic vehicle position sensor, optical sensor, light sensor. **08 Hours**

UNIT 5

Actuators: Electromechanical & fluid mechanical actuators, Electrical machines

Hybrid drives: Drive concepts, operating strategies for electric hybrid vehicles, Recuperative brake system, Electrical energy accumulators.

SLE: Wireless EV charging, advanced electric vehicle technology. **08 Hours**

Text Books:

1. **Robert Bosch GmbH,** *"Bosch Automotive Electrics and Automotive Electronics",* 5th Edition, Springer Vieweg, 2014.
2. **William B. Ribbens,** *"Understanding Automotive Electronics: An Engineering Perspective",* 8thEdition, Elsevier, 2017
3. **A. K. Babu,** *"Automotive Electrical and Electronics",* Khanna Publishers, 1st Edition, 2018.

4. **John F. Kershaw, Ed.D. and James D. Halderman,** *"Automotive Electrical and Electronic Systems",* 5th Edition, Pearson Prentice Hall, 2007.
5. **Barry Hollembeak,** *"Automotive Electricity and Electronics",* Cengage Learning, 6th Edition, 2014.

E- Resource:

1. https://www.youtube.com/playlist?list=PLCBA3EF828DFE7B0E
2. https://www.youtube.com/watch?v=STDlCdZnIsw&list=PLE06CAA834360BB39
3. https://www.youtube.com/watch?v=OWbXjvtG7Dc&list=PL5__U-kYrFIg5OEfvtnw0Cp1u8pqe1DMN

EC 732: Nano science and Technology

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 732	Nano science and Technology	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Explain the fundamental concepts of Nano science and technology.
2. Research analysis on Nano structures and Nano particles.
3. Investigation on advanced nanotechnology issues.
4. Demonstrate the skill sets using software tools for case study problems.

UNIT 1

Introduction: Overview of nano science and engineering. Classification of Nanostructures, Electronic properties of atoms and solids, Fabrication methods, Top down processes, Bottom up processes methods for templating the growth of nanomaterials. **08 Hours**

UNIT 2

Characterization: Classification, Microscopic techniques, Field ion microscopy, scanning probe techniques, diffraction techniques: bulk, surface, spectroscopy techniques: photon, radiofrequency, electron, surface analysis. **08 Hours**

UNIT 3

Inorganic semiconductor nanostructures: overview of semiconductor physics, Quantum confinement in semiconductor nanostructures: quantum wells, quantum wires, quantum dots, super lattices, band offsets, electronic density of states. Semiconductor nano crystals, colloidal quantum dots, self-assembly techniques. Optical, electrical and structural characterization of semiconductor nanostructures.

08 Hours

UNIT 4

Properties of nanoparticles: metal nano clusters, semiconducting nanoparticles, rare gas and molecular clusters, methods of synthesis. Carbon nanostructures and its applications. Self-assembling nano structured molecular materials and devices, methods to prepare and pattern nanoparticles, templated nanostructures. Nanomagnetism in technology and challenges. **08 Hours**

UNIT 5

Introduction to Bionanotechnology: New tools in biological systems, Biomimetic nanotechnology: DNA as building block, Molecular electronics and its applications, Applications of FET label free electrical DNA biosensor arrays, impact of nanotechnology on the environment. **08 Hours**

Self-Learning Components: Bonding of atoms and electronic conduction, Reflection High Energy Electron Diffraction (RHEED), Position-sensitive Atom Probe (POSAP) Spectroscopy, Light emitting semiconductor quantum dots, nano cuboids, graphene, carbon quantum dots, single crystalline silicon, thin film transistor arrays.

Text Books:

1. **Ed Robert Kelsall, Ian Hamley, Mark Geoghegan,** *"Nanoscale science and technology"*, John Wiley and Sons Pvt. Ltd., 2007.
2. **Charles P Poole, Jr, Frank J Owens** *"Introduction to Nanotechnology"*, John Wiley and Sons Pte. Ltd., Copyright 2006, Reprint 2011.
3. **MehmatOzsoz,** *"Electrochemical DNA biosensors"*, Pan Stanford publishing Pvt. Ltd. Singapore, 2012.

E-Resources

1. https://nptel.ac.in/courses/104103019/6
2. https://www.youtube.com/watch?v=ebO38bbq0_4
3. https://www.youtube.com/watch?v=urkHytFJmck

EC 733: Satellite Communication

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 733	Satellite Communication	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Explain the basic concepts of orbital mechanics of satellites.
2. Apply the basic concepts to identify the satellites design criteria and to design space link.
3. Summarize different aspects of earth segment and quantifying various parameters.
4. Explain the working of multiple access techniques used for satellite communication.
5. Explore the different application of satellite communication.
6. Demonstrate the skill sets related to software tools in the analysis and simulation, case study and submit a report in satellite communication.

UNIT 1

Satellite Orbits : Introduction, Kepler‟s Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits – Look Angle Determination- Limits of visibility –eclipse-Sub satellite point –Sun transit outage-Launching Procedures - launch vehicles and propulsion . **08 Hours**

UNIT 2

Space Segment and Space Link Design: Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems, Telemetry, Tracking and command. Satellite uplink and downlink Analysis and Design, link budget, E/N calculation- performance impairments-system noise, inter modulation and interference, Propagation Characteristics and Frequency considerations- System reliability and design lifetime.

08 Hours

UNIT 3

Earth Segment: Introduction – Receive – Only home TV systems – Outdoor unit – Indoor unit for analog (FM) TV – Master antenna TV system – Community antenna TV system – Transmit – Receive earth stations – Problems – Equivalent isotropic radiated power – Transmission losses – Free-space transmission – Feeder losses – Antenna misalignment losses – Fixed atmospheric and ionospheric losses – Link power budget equation – System noise – Antenna noise – Amplifier noise temperature – Amplifiers in cascade – Noise factor – Noise temperature of absorptive networks – Overall system noise temperature – Carrier to- Noise ratio – Uplink – Saturation flux density – Input back off – The earth station – HPA – Downlink – Output back off – Satellite TWTA output – Effects of rain – Uplink rain– Fade margin – Downlink rain – Fade margin – Combined uplink and downlink C/N ratio – Inter modulation noise. **08 Hours**

UNIT 4

Satellite Access: Modulation and Multiplexing: Voice, Data, Video, Analog – digital transmission system, Digital video Broadcast, multiple access: FDMA, TDMA, CDMA, Assignment Methods, Spread Spectrum communication, compression – encryption. **08 Hours**

UNIT 5

Satellite Applications: INTELSAT Series, INSAT, VSAT, Mobile satellite services: GSM, GPS, INMARSAT, LEO, MEO, and Satellite Navigational System. Direct Broadcast satellites (DBS)- Direct to home Broadcast (DTH), Digital audio broadcast (DAB) - Worldspace services, Business TV(BTV), GRAMSAT, Specialized services – E –mail, Video conferencing, Internet. **08 Hours**

Self-Learning Components: Remote Sensing Satellites, Weather Forecasting Satellites, Navigation Satellites.

Text Books:

1. **Dennis Roddy**: *"Satellite Communications"*, 4th Edition, McGraw- Hill International edition, 2006.
2. **Timothy Pratt, Charles Bostian, and Jeremy Allnutt**: *"Satellite Communications"*, 2nd Edition, Wiley India Pvt. Ltd, 2017, ISBN: 978-81-265-0833-4.
3. **Anil K. Maini, Varsha Agrawal**: *"Satellite Communications"*, 2nd Edition Wiley India Pvt. Ltd., 2015, ISBN: 978-81-265-2071-8.

4. **M.Richharia**: *"Satellite Communication Systems-Design Principles"*, 2nd Edition, Macmillan 2003.

E-Resource

1. **https://nptel.ac.in/syllabus/117105131**
2. **https://nptel.ac.in/syllabus/117107036**

EC 734: Quantum Computing and Communication

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 734	Quantum Computing and Communication	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Explain the concepts and challenges of quantum mechanics as applied to communications.
2. Apply the techniques which determine the performance of a quantum network.
3. Analyze how applications actually operate over quantum a communication channel.
4. Design and simulate the behavior of quantum networks.

UNIT 1:

Fundamental Concepts: Global Perspectives, Quantum Bits, Quantum Computation, Quantum Algorithms, Quantum Information, Postulates of Quantum Mechanisms. **08 Hours**

UNIT 2:

Quantum Computation: Quantum Circuits – Quantum algorithms, Single Orbit operations, Control Operations, Measurement, Universal Quantum Gates, Simulation of Quantum Systems, and Quantum Fourier transform, Phase estimation, Applications. **08 Hours**

UNIT 3:

Quantum Computers: Guiding Principles, Conditions for Quantum Computation, Harmonic Oscillator Quantum Computer, Optical Photon Quantum Computer – Optical cavity Quantum electrodynamics, Ion traps, Nuclear Magnetic resonance. **08 Hours**

UNIT 4:

Quantum Information: Quantum noise and Quantum Operations – Classical Noise and Markov Processes, Quantum Operations, Examples of Quantum noise and Quantum Operations – Applications of Quantum operations, Limitations of the Quantum operations formalism, Distance Measures for Quantum information. **08 Hours**

UNIT 5:

Quantum communication: Quantum communication with continuous variables: phase space in quantum optics, continuous-variable entanglement, teleportation and entanglement swapping, entanglement distillation, quantum cryptography. Quantum computation with continuous variables. An ensemble of identical two-level atoms, electromagnetically induced transparency, quantum memories and quantum repeaters, the atomic ensemble of a single qubit, photon-photon interactions via atomic ensembles,

08 Hours

Self-Learning Components: Quantum Error Correction - Theory of Quantum Error –Correction, Constructing Quantum Codes, Stabilizer codes, Fault – Tolerant Quantum Computation, Entropy and information – Shannon Entropy, Von Neumann, Strong Sub Additivity, Data Compression, Entanglement as a physical resource.

Text Books:

1. **Michael A. Nielsen & Isaac L. Chuang,** *Quantum Computation and Quantum Information* 10th Edition Cambridge University Press - 2010
2. **P. Kok and B. W. Lovett**, *Introduction to Optical Quantum Information Processing,* 1st edition, Cambridge university press – 2010.
3. **D. Bouwmeester, A. K. Ekert, and A. Zeilinger**, eds. *The Physics of Quantum Information*, Springer-2013
4. **L. Mandel, and E. Wolf.** *Optical Coherence and Quantum Optics*, 1st edition, Cambridge University Press 1995

E-Resource

1. **https://youtu.be/xnmpWfQKPSE?list=PLo4DhXMUkdvU9rZvEQYLdly5dABHvlZuD**
2. **https://youtu.be/Vzh5guYUyvM?list=PLq-Gm0yRYwThGmlypvSFQ-kT2rPaXKAZ5**

EC 735: Bio-medical Signal Processing

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 735	Bio-medical Signal Processing	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Apply basic knowledge to study origins and characteristics of biomedical signal.
2. Analyze the different sources of noise and artifacts of biological signals.
3. Design model to study various events and waveform complexities of different biological signals.
4. Implement an algorithm as a team-member to design and implement using modern tools.

UNIT 1:

Introduction to Biomedical Signals: Classification of signals, the nature of biomedical signals, the action potential, objectives of biomedical signal analysis, Difficulties in biomedical signal analysis, computer aided diagnosis. **08 Hours**

UNIT 2:

Neurological signal processing: The brain waves and its potentials, The electrophysiological origin of brain waves, The EEG signal and its characteristics, EEG analysis, Linear prediction theory, The Autoregressive (AR) method, Recursive estimation of AR parameters, Spectral error measure, Adaptive segmentation, Transient detection and elimination- The case of epileptic patients, overall performance. **08 Hours**

UNIT 3:

Data acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of sleep-wake transitions, Hypnogram model parameters, Event history analysis for modeling sleep. **08 Hours**

UNIT 4:

Adaptive Interference/Noise Cancellation: A review of Wiener filtering problem, Principle of an Adaptive filter, The steepest-descent algorithm, the Windrow-Hoff least mean square adaptive algorithm, Adaptive noise canceller, Cancellation of 60Hz interference in ECG, canceling of maternal ECG in fetal ECG. **08 Hours**

UNIT 5:

Cardio-logical Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters and their estimation, The use of multi-scale analysis for parameter estimation of ECG waveforms, Arrhythmia analysis monitoring, long term continuous ECG recording.

08 Hours

Self-Learning Components: ECG Data Reduction Techniques, Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Data compression techniques comparison.

Text Books:

1. **D C Reddy:** *"Biomedical Signal Processing Principles and Techniques",* 1st Edition, Tata McGraw Hill publications, 2005.
2. **Rangaraj M. Rangayyan:** "*Biomedical Signal Analysis A case study approach*" , 2nd Edition, John Wiley publications, 2002
3. **Willis J Tompkins:** *"Biomedical Digital Signal Processing"*, Prentice Hall, 2000.
4. **Eugene N. Bruce:** "*Biomedical Signal Processing & Signal Modeling*," Wiley publications, 2001.

E-Resource

1. Ocw.mit.edu › Courses › Health Sciences and Technology MIT Open Course War
2. http://ocw.mit.edu
3. www.vub.ac.be/en/study/fiches/30340/biomedical-signals-and-images
4. www.crcpress.com › Biomedical Science › Biomedical Imaging.
5. downloads.hindawi.com/journals/special issues/129194.pdf

EC 736: E-Waste Management

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 736	E-Waste Management	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Explain the issues related to E-waste and its management.
2. Assess the societal, health and safety issues E-waste and its management.
3. Propose engineering solutions to E-waste and its management for society and environment.
4. Decide on the ethical principles of recycling E-waste.
5. Discuss and orally present the case studies of E-waste and its management in a team.

UNIT 1:

Introduction to WEEE: A global scenario: Introduction, Mapping of E-waste flows: New geographies, WEEE management in Asia, Disposal practices with benchmark, E-waste sources**,** Generation, An estimation to e-waste, Pollutants in e-Waste, Effects of e-waste on human health and environment.

08 Hours

UNIT 2:

Environmental of E-waste management: E-waste and global scenario, Challenges posed to the environment, management and legal frame work for managing E-waste, Role of different stake holders in environmental management of E-waste, perspectives, Biorecovery of precious metal nanoparticles from waste electrical and electronics equipments. Chemical hazards associated with treatment of waste electrical and electronic equipment, Environmental contamination and health effects due to e-waste recycling. **08 Hours**

UNIT 3:

Regulations to E-waste management: E-waste policy and regulation, ITU- Technical guidelines, ITU-Present Activities Problems in the implementation of a strategy on ICT-waste, Electronic Waste Management in India, Existing Regulations and guidelines, Life Cycle Analysis and Sustainable

Engineering especially from an Electrical and Electronics industry Perspectives, Socio-Economic Life Cycle Analysis (SLCA) of E-Waste Management in Developing countries. **08 Hours**

UNIT4:

Recycling of E-Waste: Exposure pathway of pollutants emitted from Recycling of E-Waste, Quantification of Pollutants in Dust, Air and Water, Risk Assessment (According to USEPA method) of Recycling of E-Waste, Recovery of Valuable Rare-Earth metals from E waste, E-Waste Management Rules of India (2011 and 2016 Rules), E-waste Regulations from around the World (European, North America etc.), WEEE rules, EPR concepts, Compare and Contrast with Indian E-waste rules.

08 Hours

UNIT 5:

Biotechnological treatment of E-Waste: Biotechnological initiatives in E-waste management: Recycling and business opportunities, Hydrometallurgical recovery of metals from E-waste, Recovery of waste PCB's through pyrometullurgy, E-waste management in India. **08 Hours**

Text Books:

1. **Majeti Narasimha Vara Prasad**, *"Electronic waste management and technology treatment",* Ist Edition, Elsevier, 2019.
2. **Freeman M. H**. "*Standard Handbook of Hazardous Waste Treatment and Disposal*", McGraw-Hill Company, USA 1989.
3. **Lagrega M.D, Buckingham P.L., and Evans J.C**, *"Hazardous Waste Management"*, McGraw Hill International Edition 1994.
4. **Michal D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans.** *"Hazardous Waste Management:"* Second Edition. Environmental Resources Management: Waveland Press, Inc. (2010).
5. **Wentz C.A** *"Hazardous Waste Management"*, McGraw Hill 1989.

E Resource:

EC 741: Internet of Things

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 741	Internet of Things	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Able to identify the basic concepts, enabling technologies, possibilities and applications of IOT from a present and a futuristic view point
2. Demonstrate and analyze the requirements and configurations for Connectivity Technologies.
3. Able to explain and analyse the routing protocols suitable for IOT
4. Able to identify and analyze the Embedded Devices for IOT s.
5. Demonstrate comprehensive understanding about applications, case study, test bed scenarios related to IOT , based on group task, seminars etc.,

UNIT 1

Introduction to IoT: The definition and characteristics of the Internet of Things, main assumptions and perspectives.. Platform for IoT devices, Device architectures, physical design, logical design, Enabling technologies, IoT Levels & Deployment Templates, ITU-T IoT Reference Model

08 Hours

UNIT 2:

IOT and M2M : comparison, Devices and gateways, Managing M2M data- Data generation, Data acquisition, Data validation, Data storage, Data processing, Data remanence, Data analysis.

08 Hours

UNIT 3

IoT components, inter-dependencies, SoA, gateways, comparison between IoT & Web, difference protocols, complexity of networks, wireless networks, scalability, protocol classification, MQTT & SMQT(NPTEL Lec6 week 2)Service oriented protocols (COAP).-Communication protocols based on the exchange of messages(MQTT), XMPP, AMQP. **08 Hours**

UNIT 4

Zigbee: Zigbee architecture, routing algorithm, security, IEEE 802.15.4, 6LowPAN, RFID, NFC, Embedded Devices for IoTs, Cloud and FOG computing. **08 Hours**

UNIT 5

Applications and Case Studies: Smart Grid, Home Automation, Smart City, agriculture, health care, IIoT. **08 Hours**

Self-Learning Components: Paper/ Journals on Recent trends in IoT

Text Books:

1. **Rajkumar Buyya**: *"Internet of Things : Principles and Paradigms"*
2. **Raj Kamal**: "*Internet of Things - Architectures and Design principles"*
3. **Olivier Hersent**: "*The Internet of Things"* , Willey student edition, Reprint, 2015
4. **Jan Ho¨ller**: "*From Machine-to-Machine to the Internet of Things"*, Academic Press, 2014
5. **Arshdeep Bahga**: "*Internet of Things"*, Universities press,2015

E Resource:

1. https://nptel.ac.in/courses/106105166/
2. https://freevideolectures.com/blog/guide-to-learn-internet-of-things-iot/

EC 742: Storage Area Network

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 742	Storage Area Network	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Demonstrate a knowledge of fundamentals of storage systems and network technologies.
2. Describe the different types of RAID implementations and their benefits.
3. Analyze the metrics used for designing storage area networks.
4. Demonstrate the knowledge of various concepts and techniques of storage virtualization.
5. Describe the different role in providing disaster recovery and business continuity capabilities.
6. Demonstrate an ability to work individually or in a team to carry out assigned tasks, by leveraging recent open source tools, adhering to standard practices and ethics; Communicate effectively in oral and verbal methods.

UNIT 1:

Introduction: Introduction to Information Storage and Management, Storage System Environment Information Storage, Evolution of Storage Technology and Architecture, Data Center Infrastructure, Key Challenges in Managing Information, Information Lifecycle Components of Storage System Environment, Disk Drive Components, Disk Drive Performance, Fundamental Laws Governing Disk Performance, Logical Components of the Host, Application Requirements and Disk Performance.

08 Hours

UNIT 2:

Data Protection, Intelligent Storage system, Direct-Attached Storage and SCSI: Implementation of RAID, RAID Array Components, RAID Levels, RAID Comparison, RAID Impact on Disk Performance, Hot Spares Components of an Intelligent Storage System, Intelligent Storage Array, Types of DAS, DAS Benefits and Limitations, Disk Drive Interfaces, Introduction to Parallel SCSI,

08 Hours

UNIT 3:

Storage Area Networks, NAS, IP SAN: Overview of Fiber Channel, The SAN and Its Evolution, Components of SAN, FC Connectivity, Fiber Channel Ports, Fiber Channel Architecture, Zoning, Fiber Channel Login Types, FC Topologies, General – Purpose Service vs. NAS Devices, Benefits of NAS, NAS File I / O, Components of NAS, NAS Implementations, NAS File-Sharing Protocols, NAS I/O Operations, Factors Affecting NAS Performance and Availability. iSCSI, FCIP. **08 Hours**

UNIT 4:

Content-Addressed Storage, Storage Virtualization and Business Continuity: Fixed Content and Archives, Types of Archive, Features and Benefits of CAS, CAS Architecture, Object Storage and Retrieval in CAS, CAS Examples Forms of Virtualization, SNIA Storage Virtualization Taxonomy, Storage Virtualizations Configurations, Storage Virtualization Challenges, Types of Storage Virtualization. Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis, BC Technology Solutions. **08 Hours**

UNIT 5:

Backup and Recovery, Local Replication and Remote Replication: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods, Backup Process, Backup and restore Operations, Backup Topologies, Backup in NAS Environments, Backup Technologies. Source and Target, Uses of Local Replicas, Data Consistency, Local Replication Technologies, Restore and Restart Considerations, Creating Multiple Replicas, Management Interface, Modes of Remote Replication, Remote Replication Technologies, Network Infrastructure. **08 Hours**

Self-Learning Components: Case study: Replacing a server with storage Networks, Case Studies: Direct Access File System, General Parallel File System.

Text Books:

1. **Somasundaram Gnanasundaram, Alok Shrivastava:** "*Information Storage and Management"*, Second edition, Wiley India 2013.
2. **Ulf Troppens, Rainer Erkcns and Wolfgang Muller**, *"Storage Networks Explained",* John Wiley & Sons, 2003.
3. **Robert Spalding,** *"Storage Networks - The Complete Reference",* Tata McGraw Hill, 2011.

4. **Richard Barker and Paul Massiglia:** "*Storage Area Network Essentials ACompleteGuide to understanding and Implementing SANs*", Wiley India, 2006.
5. **Marc Farley:** *"Storage Networking Fundamentals – An Introduction to Storage Devices, Subsystems, Applications, Management, and File Systems"*, Cisco Press, 2005.

E-Resource:

1. NPTEL Videos: nptel.ac.in/courses/106108058/
2. https://clickforacess.files.wordpress.com/2017/11/san-book.pdf -- (ISM Textbook PDF).

EC 743: Cryptography and Network Security

Course code	Course title	Hours/week			Credits	CIE Marks	SEE Marks	Total Marks
		L	T	P				
EC 743	Cryptography and Network Security	3	0	0	3	50	50	100

Course outcome: At the end of the course, the student should be able

1. Encrypt and decrypt data using symmetric key and public-key ciphers
2. Analyse solutions for effective key management and distribution and conduct cryptoanalysis
3. Analyse and use cryptographic data integrity algorithms and user authentication protocols
4. Analyse the cause for network attacks and describe the working of various advanced security controls
5. Explore the attacks and controls associated with IP, transport-level, web and E-mail security
6. Demonstrate an ability to work individually or in a team to carry out assigned tasks, by effectively managing resources adhering to standard practices and ethics.

UNIT 1:

Overview: Computer Security Concepts, Security Attacks, Security Services and Security Mechanisms, OSI security architecture, Model for network security. Encryption Techniques: Symmetric cipher model, Substitution techniques, Transportation techniques, Rooter machine, Steganography, Problems.

08 Hours

UNIT 2:

Block Ciphers and DES (Data Encryption Standards): Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher operation. **08 Hours**

UNIT 3:

Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Problems. Other Public Key crypto Systems and Key Management: Key management, Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems. **08 Hours**

UNIT 4:

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hah Functions, Security of Hash functions and MAC's, Problems.

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard. **08 Hours**

UNIT 5:

Electronic Mail Security: Pretty good privacy, S/MINE, Data compression using ZIP, Radix-64 conversion, PGP random number generator.

IP Security: Overview, IP security architecture, ESP (Encapsulating security pay load), Problems.

08 Hours

Self-Learning Components: Authentication Applications: Kerberos, X.509 authentication services. Firewalls: Firewall design principles, trusted systems, System viruses.

Text Books:

1. **William Stallings**, "*Cryptography and network Security – principles and practice*", 7th edition, Pearson Education(Asia)Pvt. Ltd. Pearson Education, 2017.
2. **Behrouz A. Forouzan**, **Debdeep mukhopadhyay**, "*Cryptography and Network Security*" second edition, Mcgraw-Hill Education, 2010.
3. **AtulKahte,"** *Cryptography and Network security*", 3rd Ed, McGrawhill Education(India), 2013

E-Resource: