| Course Code | 17B11EC732 (NBA Code: C433-1) | Semester Even (specify Odd/Even) | Semester 8th Session 2022 -2023 Month from Jan. to June |
|---|---|---|---|
| Course Name | Cognitive Communication Systems | | |
| Credits | 4 | Contact Hours | 4 |

| Faculty (Names) | Coordinator(s) | Dr. Juhi Gupta |
|---|---|---|
| | Teacher(s) (Alphabetically) | Dr. Juhi Gupta |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| CO1 | Understand the concepts of various generation of wireless communication and spectrum scarcity. | Understanding (C2) |
| CO2 | Understand the concepts of radio (CR) architecture, functions of cognitive radio. | Understanding (C2) |
| CO3 | Analyzing the Spectrum sharing and management and Spectrum sensing methods. | Analyzing (C4) |
| CO4 | Evaluating the performance of optimization of dynamic spectrum access and management. | Evaluating (C5) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Introduction | Introduction of various generation of wireless communication, Probability and Random Process, Spectrum scarcity, cognitive radio (CR) architecture, functions of cognitive radio, Fundamental challenges and issues in designing cognitive radio. | 8 |
| 2. | Spectrum sharing and management | Spectrum access models,dynamic spectrum access (DSA), underlay, overlay and hybrid cognitive radio, Potential applications of cognitive radio. | 8 |
| 3. | Spectrum sensing | Interference temperature/channel estimation , Detection of spectrum holes, Practical spectrum sensing approaches, Collaborative sensing, External Sensing. | 12 |
| 4. | Techniques for optimization of dynamic spectrum access and management | Optimization techniques, Constrained optimization, Lagrangian method, Optimality, Primal-dual algorithm, Linear programming and the simplex algorithm, Non-linear programming , applications of cognitive radio. | 14 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |
| **Total** | **100** |

| | **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) |
|---|---|
| 1. | E. Hossain, D. Niyato, and Z. Han, Dynamic Spectrum Access and Management in Cognitive Radio Networks, Cambridge University Press, 2009 (ISBN: 978-0-521-89847-8). |
| 2. | Cognitive radio networks, Kwang-Cheng Chen, Ramjee Prasad, John Wiley & Sons Ltd. |
| 3. | Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, HuseyinArslan, Springer. |
| 4. | Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition. |

| Course Code | 18B12EC412 | Semester Even (specify Odd/Even) | Semester 8th  Session  2022 -2023 Month from Jan to June | |
|---|---|---|---|---|
| Course Name | Multimedia Communications | | | |
| Credits | 4 | | Contact Hours | 3-1-0 |

| Faculty (Names) | Coordinator(s) | Richa Gupta |
|---|---|---|
| | Teacher(s) (Alphabetically) | |

| COURSE OUTCOMES Upon completion of the course, the students will be able to | | COGNITIVE LEVELS |
|---|---|---|
| C430-7.1 | familiarize with basics of data compression used in the development of various construction algorithms for source codes. | Applying [C3] |
| C430-7.2 | identify theoretical and practical requirements for implementation and designing of Error Resilient Codes. | Applying [C3] |
| C430-7.3 | learn fundamentals of transform coding, digital image processing and its applications. | Applying [C3] |
| C430-7.4 | analyze the need of image compression & video compression and distinguish between different image CODECs. | Analyzing [C4] |
| C430-7.5 | familiarize with psychoacoustic principle used in the development of audio codec standards. | Analyzing [C4] |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Review of Information Theory | Introduction, Information Measure, Discrete entropy. Joint and conditional entropies. | 3 |
| 2. | Data Compression | Uniquely Decipherable Codes and Instantaneous Codes. Kraft - McMillan inequality. Noiseless coding Theorem. Data Compression: Lossless Compression and Lossy Compression. Optimal codes. Construction algorithms of source codes – Huffman Codes,  Shannon - Fano codes, Arithmetic Codes, Lempel Ziv Welch Code and Run Length Coding. | 8 |
| 3. | Error Resilient Codes | Reversible Variable Length Codes: Introduction, Types of RVLCs, Construction Algorithms of Symmetrical and Asymmetrical RVLCs. Applications of RVLCs in Multimedia Communications. | 8 |
| 4. | Multimedia Information Representation and Transform Coding | Introduction, Digital Principles, Representations of text, image, audio and video data. Transform Coding, Discrete Cosine Transforms – 1 D and 2D. Energy compaction. | 3 |

| 5. | Digital Image Processing | Basics of digital image processing, Structure of the Picture Information, luminance and chrominance components, RGB components. Image Enhancement, Image segmentation, Image Restoration and Morphological Image Processing. | 12 |
|---|---|---|---|
| 6. | Image Compression | Basics of Image Compression, Joint Photographic Expert Group (JPEG) compression. | 3 |
| 7. | Video Compression | Basic principle of video processing, I, P and B pictures in video content, Structure of video frame, Macroblock, Motion Estimation and Compensation, Compression on the block level, Video Coding Standards. | 4 |
| 8. | Audio Compression | Basics of Audio Signal Processing, Principle of Psychoacoustic and its applications, Audio Compression and Standards for Audio codec. | 4 |
| | | **Total number of Lectures** | **45** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (Research Assignment, Assignment, Quiz, Class Tests) |
| **Total** | **100** |

**Project Based Learning:** Students are required to prepare a consolidated summary (including approach, limitations, pros and cons, applications, scope etc.) of any recent research paper published in reputed International Conference or International Journal related to Image and Video processing. They will submit this research assignment towards the end of the semester.

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

| 1. | M. Bosi and R. Goldberg, Introduction to Digital Audio Coding and Standards. Kluwer Academic, Boston, 2003. |
|---|---|
| 2. | R. C. Gonzalez and R. E. Woods, Digital Image Processing Using MATLAB, Prentice Hall, 2009. |
| 3. | K. Sayood, Introduction to data compression, Elsevier, 4th edition. |
| 4. | A. K. Jain, Fundamentals of Digital Image Processing, Prentice Hall, 1989. |

# Detailed Syllabus
## Lecture-wise Breakup

| Course Code | 18B12EC417 | Semester Even (specify Odd/Even) | Semester 8th Session 2022 -2023 Month from Jan to June | | |
|---|---|---|---|---|---|
| **Course Name** | Satellite Communication | | | | |
| **Credits** | 3 | | **Contact Hours** | 3-0-0 | |

| Faculty (Names) | Coordinator(s) | Dr. Neetu Joshi |
|---|---|---|
| | Teacher(s) (Alphabetically) | Dr. Neetu Joshi |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| C433-4.1 | Define Satellite and its historical background, outline the basic concepts of Satellite communications, recall the Kepler's laws of planetary motion. | RememberingLevel (C1) |
| C433-4.2 | Develop the equations of the orbit, explain the satellite launching and launch vehicles and outline terminology of earth-orbiting Satellites. | AnalyzingLevel(C4) |
| C433-4.3 | Demonstrate the space segment, antenna subsystem, estimate different parameters and design uplink and downlink. | Creating Level (C6) |
| C433-4.4 | Apply various multiple access techniques for satellite communication and analyze Noise and Bandwidth. Also Interpret applications of various types of satellites established in different earth orbits. | Evaluating Level (C5) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Introduction | Introduction to the Subject and its Importance. Contents. Books and Reading References. Evaluation. Space Environment. Artificial Satellites. Communication Satellites. | 4 |
| 2. | Satellite Orbits and Frequency Bands | Orbital Mechanics. Orbits Employed for Satellite Communication like LEO, MEO & GEO, their Merits and Demerits. Satellite Launching. Launch Vehicles. Radio Wave Propagation Effects. Communication Window. | 8 |
| 3. | Communication Satellites and Link Design | Geostationary Communication Satellite-Transponder. Ground Station System. Communication Link-Consideration, Calculation and Design. Power and Bandwidth Limitations and Budget. | 8 |
| 4. | Modulation Techniques | Modulation and Demodulation Techniques. Performance Analysis- Noise and Bandwidth. | 6 |
| 5. | Multiple Access | Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) | 7 |

| 6. | Different Communication Satellite Systems | VSAT. Navigational Satellites. Broadcasting Satellites. Remote Sensing Satellites. Low and Medium Earth Orbit Satellites. INSAT. INTELSAT. | 5 |
|---|---|---|---|
| 7. | Some Communication Satellite Applications | DBS TV. Multimedia Transmission Related Issues, Advantages& Bit Rates for Digital TV, HDTV, Bandwidth Considerations, and Introduction to Compression Standards. Convergence of Communication, Introduction to IPTV. | 4 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T-1 | 20 |
| T-2 | 20 |
| T-3 (End Semester Examination) | 35 |
| TA | 25 |
| **Total** | **100** |

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

| 1. | T. Pratt, C.W. Bostian and J.E. Allnut, Satellite Communications, 2 Ed, John Wiley & Sons (Asia), 2003 |
|---|---|
| 2. | Dennis Roddy, Satellite Communications, 4 Ed, Tata Mcgraw Hill, 2006 |
| 3. | G. Maral& M. Bousquet, Satellite Communications Systems- Systems, Techniques and Technology, 4 Ed, John Wiley and Sons, 2002. |
| 4. | Richard Brice, Newness Guide to Digital TV, 2Ed, 2003. |
| 5. | Gerard O' Driscoll, Next Generation IPTV Services and Technologies, John Wiley & Sons, 2008 |

# Detailed Syllabus
## Lecture-wise Breakup

| Subject Code | 19B12EC412 | Semester Even | Semester:8ᵗʰ, Session:2022-23 Month:Jan to June |
|---|---|---|---|
| **Subject Name** | Advance Topics in Wireless Communications | | |
| **Credits** | 3 | **Contact Hours** | 3 |
| **Faculty (Names)** | **Coordinator(s)** | Dr. Bajrang Bansal | |
| | **Teacher(s) (Alphabetically)** | Dr. Bajrang Bansal | |

**Course Objectives:**This course gives an insight into wireless MIMO systems and the calculation of their capacity in the presence of fading.

| S. No. | Course Outcomes | Cognitive Levels/ Blooms Taxonomy |
|---|---|---|
| **C433-3.1** | Explain basics of MIMO systems and need of diversity schemes. | Remembering Level (C1) |
| **C433-3.2** | Analyze the effect of fading in the wireless medium and mathematical modeling of fading channels. | AnalyzingLevel (C4) |
| **C433-3.3** | Analyze channel capacity expression of MIMO systems. | AnalyzingLevel (C4) |
| **C433-3.4** | Evaluate performance of the MIMO detection system and need of UWB systems. | EvaluatingLevel (C5) |

| Module No. | The subtitle of the Module | Topics | No. of Lectures |
|---|---|---|---|
| 1. | Introduction to MIMO systems | Evolution of wireless generation technologies and their transition challenges. Need and expectation of next generation of wireless technology. Basic concepts of random variables. Introduction of Wireless communication systems, diversity-multiplexing, trade-off, and transmit diversity schemes. Concept of SISO, SIMO, MISO, and MIMO systems. | 8 |
| 2. | Fading Environments | Wireless Channel Fading and Distribution: Small scale, large scale, and multipath fading channels. Rayleigh, Rician, Exponential, Nakagami-m, Lognormal and α-κ-μ distributions. | 10 |
| 3. | Channel capacity of MIMO systems | Ergodic anddeterministic Capacity for SISO and MIMO channels, Capacity ofi.i.d., separately correlated and keyhole Rayleigh fading MIMO channels. Power allocation in MIMO systems: Uniform, | 10 |

| | | adaptive, and near-optimal power allocation. | |
|---|---|---|---|
| 4. | Space-time codes and MIMO detection | Space-Time codes: Advantages, code design criteria, Alamouti space-time codes, SER analysis of Alamouti space-time code over fading channels. MIMO detection: ML, ZF, MMSE based detection. | 10 |
| 5. | UWB Technology | Definition of UWB, FEC mask, properties, and limitation of UWB signal. UWB channel Modelling: IEEE 802.15.3a and IEEE 8032.15.4a standards. | 4 |
| **Total number of Lectures** | | | 42 |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |
| **Total** | **100** |

**Project-based learning:** Students will learn about the multiple input multiple output (MIMO) wireless communications systems to improve the system performance. Further, they will study various fading distributions to analyze the effect of the channel over the signal. Additionally, students will study and design the space-time codes and MIMO detectors to mitigate fading in channels.

| **Recommended Reading**(Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication, etc. in IEEE format) | |
|---|---|
| 1. | R. S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, Cambridge University Press, 2017. |
| 2. | S. Emami, UWB Communication Systems: Conventional and 60 GHz, 2013 |
| 3. | Chung G. Kang, Jaekwon Kim, Wŏn-yŏng Yang, and Yong Soo Cho, MIMO-OFDM Wireless Communications with MATLAB, John Wiley & Sons, 2010. |
| 4. | MohinderJankiraman-Space-Time Codes and MIMO Systems,Springer New York, 2004. |
| 5. | B. Kumbhani and R. S. Kshetrimayum, MIMO Wireless Communications over Generalized Fading Channels, 2017. |

| **Course Code** | 19B12EC415 | **Semester Even (specify Odd/Even)** | **Semester** VIII **Session** 2022-23 **Month from** Jan **to** June |
|---|---|---|---|
| **Course Name** | **Digital Integrated Circuits in Deep Submicron Technology** | | |
| **Credits** | 3 | **Contact Hours** | 3 |

| **Faculty (Names)** | **Coordinator(s)** | Dr. Shruti Kalra |
|---|---|---|
| | **Teacher(s) (Alphabetically)** | |

| **COURSE OUTCOMES** | | **COGNITIVE LEVELS** |
|---|---|---|
| C434.1 | Recall the important concepts of logic gates, static input-output characteristics, noise margins and propagation delay | Remembering Level (C1) |
| C434.2 | Illustrate the key issues in deep submicron technology node. | Understanding Level (C2) |
| C434.3 | Identify and solve static and dynamic design issues for high speed combinational and sequential circuits. | Applying Level (C3) |
| C434.4 | Analysis and design of VLSI memories | Analyzing Level (C4) |

| **Module No.** | **Title of the Module** | **Topics in the Module** | **No. of Lectures for the module** |
|---|---|---|---|
| 1. | Introduction to deep submicron digital IC Design | Review of digital logic gate design and digital integrated circuit design, MOS transistor operation in deep submicron technology. | 6 |
| 2. | MOS inverter circuits | Analytical modeling of CMOS inverter in submicron technology node, Pseudo NMOS inverters, sizing inverters. | 9 |
| 3. | Static MOS gate circuits | Analytical modeling of CMOS gate circuits, complex CMOS gates, Multiplexer circuits, D Flip flop and latches | 9 |
| 4. | High speed CMOS logic design | Load capacitance calculations, improved delay calculations with input slope, gate sizing for optimal path delay, optimizing paths with logical effort. | 7 |
| 5. | Transfer gate and dynamic logic design | Pass Transistor, capacitive feedthrough, charge sharing, sources of charge loss, TG logic, Dynamic D-Latch | 6 |
| 6. | Introduction to semiconductor memory design. | MOS Decoders, Static RAM cell design, SRAM column I/o circuitry. | 5 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |
| **Total** | **100** |

**Project Based Learning**: **The course will teach the technical skill to accomplish as well as enhance project planning. Students will be doing projects (in groups of 2-3) with given specifications, which will result in a designing of digital integrated circuits for deep submicron technology implemented through HSPICE.**

| **Recommended Reading material:** (Books/Journals/Reports/Websites etc.: Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format) | |
|---|---|
| 1. | Veendrick, Harry. *Deep-submicron CMOS ICs: from basics to ASICs*. Springer Publishing Company, Incorporated, 2015. |
| 2. | Hodges, David A. *Analysis And Design Of Digital Integrated Circuits, In Deep Submicron Technology (special Indian Edition)*. Tata McGraw-Hill Education, 2005. |

| Course Code | 20B12EC415 | Semester (specify Odd/Even) | Even | Semester 8 Month from | Session 2022 -2023 Jan to Jun |
|---|---|---|---|---|---|
| Course Name | Network Security | | | | |
| Credits | 3 | | Contact Hours | 3-0-0 | |

| Faculty (Names) | Coordinator(s) | P C Gupta |
|---|---|---|
| | Teacher(s) (Alphabetically) | P C Gupta |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| C434-4.1 | At the completion of the course, students will be able to understand the security requirements of networked information systems and general principles of cryptography. | Understanding (C2) |
| C434-4.2 | At the completion of the course, students will be able to apply above concepts for understanding security mechanisms used for network access, message confidentiality, message authentication non-repudiation. | Applying (C3) |
| C434-4.3 | At the completion of the course, students will be able to apply the above security mechanisms to understand of standard security protocols used in the IP network. | Applying (C3) |
| C434-4.4 | At the completion of the course, students will be able to analyze<br>a) network vulnerabilities to adversarial attacks/intrusions, and<br>b) security solutions for preventing such attacks/intrusions. | Analyzing (C4) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Security concepts and terminology | General security concepts, need for security & security mechanisms | 2 |
| 2. | Symmetric-key & Asymmetric-key Cryptosystems | (a) Classical encryption methods<br>(b) Mathematical foundations I – Modular arithmetic<br>(c) Block ciphers, DES, 3 DES, AES<br>(d) Modes of operation of block ciphers<br>(e) Stream ciphers, RC4<br>(f) Mathematical foundations II – Finite fields<br>(g) Asymmetric-key cryptography, RSA, ElGamal<br>(h) Elliptic curve cryptography | 14 |
| 3. | Message Authentication & Digital Signatures | (a) Content integrity verification, hash functions, SHA<br>(b) Message Authentication Code (MAC),<br>(c) HMAC, CMAC<br>(d) Digital signature, RSA and ElGamal, applications of digital signatures | 3 |
| 4. | Key Distribution | (a) Symmetric-key distribution, Diffie-Hellman key exchange, Key Distribution Centre (KDC)<br>(b) Public Key distribution, Digital certificates, X.509, Certification Authority (CA), Public Key Infrastructure | 2 |

| 5. | Entity Authentication & Security for Remote Access | (a) Fixed and one-time passwords, authentication based on challenge-response.<br>(b) Kerberos<br>(c) PAP, CHAP, EAP protocols, RADIUS | 3 |
|---|---|---|---|
| 6. | Security at the Transport and Network Layers | (a) Security at the IP layer, VPN, IPsec, AH, ESP protocols<br>(b) Security at the Transport layer, TLS protocol | 6 |
| 7. | Security in Wireless Networks | (a) Architecture of wireless LAN<br>(b) WEP, RSN protocols | 2 |
| 8. | Network Vulnerabilities & Malware | (a) IP attacks, TCP attacks, DOD & DDOS attacks<br>(b) Firewalls – packet filtering, stateful inspection, proxy, circuit level<br>(c) Intrusion Detection Systems (IDS)<br>(d) Malware | 7 |
| 9. | Security at the Application Layer | (a) Secure Electronic Transaction (SET)<br>(b) Email security, SMIME, PGP | 3 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

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

| | **Recommended Reading material:** (Books/Journals/Reports/Websites etc.:  Author(s), Title, Edition, Publisher, Year of Publication etc. in IEEE format) |
|---|---|
| 1. | Gupta, Prakash C., *Cryptography and Network Security*, PHI, 2014 |
| 2. | Stallings W., *Cryptography & Network Security*, 6th Ed., Pearson, 2014 |
| 3. | Forouzan, BA., *Cryptography & Network Security*, 3rd Ed., McGraw-Hill, 2015 |

| Course Code | 18B12EC411 | Semester Even (specify Odd/Even) | Semester VIII Session 2022 -2023 Month from January to June |
|---|---|---|---|
| **Course Name** | Introduction to IOT | | |
| **Credits** | 3 | **Contact Hours** | 3 |

| Faculty (Names) | **Coordinator(s)** | Dr. Vijay Khare (62) |
|---|---|---|
| | **Teacher(s) (Alphabetically)** | Dr. Vijay Khare (62),Dr. Abhay Kumar (128) |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| **C434-7.1** | **Outline the basic concepts of IOT with networking and protocol considerations in IOT scenario.** | Understand (C2) |
| **C434-7.2** | **Identify various IOT hardware platforms and their utilization with various sensors and actuators.** | Apply (C3) |
| **C434-7.3** | **Experiment the basic concepts of python programming and make use of them in image processing, data analytics and machine learning applications.** | Apply (C3) |
| **C434-7.4** | **Examine various case studies and cloud platforms in an IOT scenario for monitoring, control and analysis.** | Analyze (C4) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | IOT Basics and its Importance | Introduction to IOT (People Connecting to Things, Things Connecting to Things, Definition of IOT, History of IOT), IOT Components (Sensors & Actuators, Things, Communications, Networks, The Internet, Protocol Stack), Evolution of Connected Devices, IOT Applications, IOT Companies, Baseline Technologies (Machine to Machine (M2M) Communication, Cyber Physical Systems (CPS), Web of Things (WOT)), Address Crunch in IOT, IOT Terminologies (IOT Node, LAN, MAN & WAN, IOT Gateway & Proxy), IOT Network Configuration (Gateway Prefix Allotment, Impact of Mobility on Addressing, Concept of Tunneling, Multi-homing), IPv4 Versus IPv6. | 6 |
| 2. | Basics of IOT Networking | Introduction to IOT Networking, Networking Standards and Technologies (Network Access & Physical Layer, Internet Layer, Transport Layer, The application layer), IOT Networking Protocols, Network Access and Physical layer IoT Network Technologies ((LPWAN (Low Power Wide Area Network), Cellular, Bluetooth Low Energy (BLE), RFID, NFC, Zigbee, Wifi, Ethernet), Internet layer IoT network technologies (IPv6, 6LoWPAN, and RPL), | 6 |

| | | Application layer IoT network technologies (HTTP, HTTPS, MQTT, AMQP, and XMPP), IoT networking considerations and challenges, IoT Platforms Capabilities. | |
|---|---|---|---|
| **3.** | IoT supported Hardware platforms (Arduino) & data visualization using cloud. | Introduction to Arduino (Different Arduino boards, Arduino Uno board description and its pin configuration, Arduino IDE and program uploading, different functions related to GPIOs and special functions (PWM and Serial communication), Interfacing with Arduino using processing language (LED, Switch, Seven Segment, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), Interrupts, use of simulator and compiler,  basics of HTML, Arduino supported IOT modules (Ethernet &Wifi Shield) and their configuration, Monitoring of sensor data on cloud and Web based controlling of actuators. | 12 |
| **4.** | Introduction to Python, Data Analytics, Machine Learning and Case Studies. | Introduction to python, python IDE, Data types, various programming constructs (loops, if, else etc.), operators, functions, modules, data handling (pandas), file operations, Image operations (PIL-pillow), data plotting in python (Matplotlib), basics of machine learning in python (Scikit) and related case studies. | 10 |
| **5.** | IoT supported Hardware platforms (Raspberry pi) & its Applications | Introduction to Raspberry pi (Raspberry pi different model comparison, Pin Configuration, Raspberry Pi operating system choices, Set up your Raspberry pi, Raspbian OS, Remote Access using SSH, Remote Access using TightVNC), Interfacing with Raspberry pi using python and use of open source libraries (LED, Switch, LCD, DC Motor, Relay, IR, LDR and DHT11 sensor), IOT Applications (Water management system, Weather monitoring station on cloud, Smart Agriculture System, Smart Energy meter, Pollution Monitoring system, Smart Dustbin management system. | 8 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

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

**Project Based Learning Component:** This course teaches IoT using a building block approach, which allows one to visualize the requirement of an IoT framework and then to design it efficiently. IoT cuts across different application domain verticals ranging from civilian to defence sectors. These domains include agriculture, space, healthcare, manufacturing, construction, water, and mining, which are presently transitioning their legacy infrastructure to support IoT. The course will teach IoT based system design using IoT boards, namely Arduino, ESP8266, and Raspberry Pi. The course will introduce various interfacing techniques for popular input devices including sensors, output devices and communication protocols. It will also teach effective embedded programming techniques in python with application to image processing and Machine Learning. It will have a significant practical component, which will be achieved by providing real time demonstrations of various case studies based on IoT.

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

| | |
|---|---|
| **1.** | "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman (CRC Press) |
| **2.** | "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti (Universities Press) |

| Subject Code | 16BINEC831 | Semester: Even (specify Odd/Even) | Semester 8<sup>th</sup>Even, Session 2022-23 Month from Jan. to June |
|---|---|---|---|
| Subject Name | Sonar System and Acoustic Imaging | | |
| Credits | 3 | Contact Hours | 3-0-0 |

| Faculty (Names) | Coordinator(s) | Kapil Dev Tyagi |
|---|---|---|
| | Teacher(s) | Kapil Dev Tyagi |

| S. NO. | DESCRIPTION | COGNITIVE LEVEL |
|---|---|---|
| C434-2.1 | define and explain sonar terminology and choose parameters for side scan sonar according to the required azimuth and range resolutions. | Applying (Level C3) |
| C434-2.2 | select parameters for synthetic aperture sonar (SAS) as per the design requirements. | Applying (Level C3) |
| C434-2.3 | analyze the continuous time frequency modulation (CTFM) technique for sonar applications. | Analyzing (Level C4) |
| C434-2.4 | apply and discover signal processing application for ship speed measurement system like JANUS. | Analyzing (Level C4) |
| C434-2.5 | take part in the development of simple array design for acoustic localization. | Analyzing (Level C4) |

| Module No. | Subtitle of the Module | Topics in the module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Side Scan and Sector Scan Sonar | Introduction to sonar system. Side scan sonar, sector scan sonar, beam-forming methods in sector scans sonar. | 6 |
| 2. | Modulation Scanning | Swept frequency delay line scanning, phase beam-forming, modulation scanning, multistage beam-forming, DFT beam-former. | 8 |
| 3. | Synthetic aperture sonar | Limitation of scanning sonar, Basic of synthetic aperture sonar, matched filtering, Doppler shift aspects, range resolution in synthetic aperture sonar, minimum sampling rate for synthetic aperture sonar, spot lights, and squints in synthetic aperture sonar. | 8 |
| 4. | CTFM | Continuous time frequency modulation technique (CTFM), blind time problem in CTFM,dual demodulator CTFM technique, phase difference radial projection | 8 |

| | | method. | |
|---|---|---|---|
| **5.** | **Signal processing for Ship speed measurement** | Estimation of moving target speed in water,GPS, DGPS, SQUID, Doppler log, JANUS, Issues in Doppler log methods, correlation-log, | 6 |
| **6.** | **Acoustic localization** | Localization using time delay estimation, Beacons, Pingers.Localization using three hydrophones, Localization using four hydrophones, Non-planar array using five hydrophones. | 6 |
| **Total number of Lectures** | | | **42** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |
| **Total** | **100** |

**Practical implementation of theory based learning**: On each topic covered in the course an experiment is designed and assigned to the students, so that the concept/algorithm covered can be written in the code form in MATLAB software.

**Project based learning**: Group of 3 students are formed to solve simulation based coding problems. This helps in deeper understating of the theory and motivate students to think on real world applications and problems. Practical knowledge acquired by the students during this course will boost their confidence and clarity on various topics and this ultimately help them in placement interviews and further motivate them to be an entrepreneur. After schemes like "Atmanirbhar Bharat"many project in the area of sonar will provide many entrepreneurial opportunities to the students specialized in the sonar system.

## List of Simulation Experiments in Sonar system and acoustic imaging

Ex1. Generate the sine wave of 1 kHz with sampling frequency of 10 kHz with constant amplitude and with initial phase of (i) 0 rad, (ii) pi/3 radians, (iii) pi/6 radians. Calculate the FFT of these signals and plot the magnitude and phase of these signals. Scale the frequency axis in Hz/kHz (take the Y scale normalized with maximum amplitude).

Ex2. Linear Chirp signal of with starting frequency of 100 Hz ending frequency of 2 KHz and duration of 1 sec.

Ex3. Generate Sine waves of 1 kHz with sampling frequency of 10 kHz and amplitude decreasing exponentially with different slops.

Ex4.Calculate the FFT of the signal plotted in Q1 a. b. and c. and scale the frequency axis in Hz/kHz (take the Y scale normalized with maximum amplitude).

Ex5.Draw the radiation pattern of a N element uniform array as a function of angle. Reference document is given in the study material.

Ex6.Let Fourier transform corresponding to a signal contains 10 impulses starting at 45 kHz at a gap of 5 kHz. Plot the time domain signal

| | |
|---|---|
| corresponding to this Fourier transform.<br>Ex7.Generate a signal s(t) consisting of three linear chirp signals. Each chirp signal c(t) has starting frequency of 100 Hz, ending frequency of 2 KHz and duration of 1 sec. In s(t) the first chirp signal c(t) has zero delay, the second has 100 ms delay and the third one has 300 ms delay. Take sampling rate 1 MHz. Correlate this composite signal with the chirp signal c(t) .<br>Ex8.Generate a signal consisting of the following signals A. a chirp signal c(t) as mentioned above B. a 2 second delayed signal of 50 KHz with duration 20 us. C. Series of 3 second delayed pulses (10) of 65 kHz of duration 31.6 us. Plot the spectrogram take averaging duration of 50 us. Take sampling rate at 1 MHz. | |

| | **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) |
|---|---|
| **1.** | Lawrence J. Ziomek,**An Introduction to Sonar Systems Engineering**, Taylor & Francis Inc, 2017. |
| **2.** | A. D. Waite, **Sonar for Practising Engineers**, 3$^{rd}$edition, John Wiley & Sons, 2002. |
| **3.** | Authors: **Au**, Whitlow W.L.The Sonar of Dolphins, Springer-Verlag New York, ISBN 978-1-4612-4356-4, 1993. |

| Course Code | 15B19EC891 | Semester: Even (specify Odd/Even) | Semester: 8th Session 2022 -2023 Month from: January to June |
|---|---|---|---|
| Course Name | Project Part-2 | | |
| Credits | 12 | Contact Hours | ---- |

| Faculty (Names) | Coordinator(s) | Megha Agarwal, Rahul Kaushik |
|---|---|---|
| | Teacher(s) (Alphabetically) | Abhishek Kashyap, Megha Agarwal, Rahul Kaushik,, Shivaji Tyagi |

| COURSE OUTCOMES- At the completion of the course, students will be able to, | | COGNITIVE LEVELS |
|---|---|---|
| C451.1 | Summarize the contemporary scholarly literature, activities, and explored tools/ techniques/software/hardware for hands-on in the respective project area in various domain of Electronics Engineering. | Understanding level (C2) |
| C451.2 | Analyze/Design the skill for obtaining the optimum solution to the formulated problem with in stipulated time | Analyzing level (C4) |
| C451.3 | Evaluate /Validate sound conclusions based on evidence and analysis | Evaluating level (C5) |
| C451.4 | Develop the skill in student so that they can communicate effectively in both verbal and written form. | Creating Level (C6) |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| Mid Sem Viva | 20 |
| Final Viva | 30 |
| Day to Day | 30 |
| Project Report | 20 |
| **Total** | **100** |

**Project based learning:** Project part II is the continuation of Project part 1 done in the previous semester. The Project work is by far the most important single piece of work in the B. Tech programme. It provides the opportunity for student to demonstrate independence and originality, to plan and organize a large Project over a long period and to put into practice some of the techniques, student have been taught throughout the course.In Project work initially, first all students are advised to make groups having 2-3 students in each group and also to select the supervisor of their own choice and research field. The students are also advised to choose a Project that involves a combination of sound background research, software skill, or piece of theoretical work. Interdisciplinary Project proposals and innovative Projects are encouraged and more appreciable. Objective of project part II is for the students to learn and experience all the major phases and processes involved in solving "real life engineering problems related to electronics and communication or Interdisciplinary area. The major outcome of this project work must be well-trained the students. More specifically students must have acquired:

• System integration skills

 • Documentation skills

• Project management skills

• Problem solving skills

• Team work skill.

| Course Code | 15B1NHS832 | Semester Even (specify Odd/Even) | Semester VIII Session 2023-2024 Month from January -June 2023 |
|---|---|---|---|
| Course Name | International Studies | | |
| Credits | 3 | Contact Hours | 3(3-0-0) |

| Faculty (Names) | Coordinator(s) | Dr. Ila Joshi/ Dr Gaurika Chugh |
|---|---|---|
| | Teacher(s) (Alphabetically) | Dr. Gaurika Chugh/ Ila Joshi |

| CO Code | COURSE OUTCOMES | COGNITIVE LEVELS |
|---|---|---|
| C402-8.1 | Demonstrate an understanding of the basic concepts in the area of international studies | Understanding (C2) |
| C402-8.2 | Compare the changes in India's foreign policy in the Cold War era and the post Cold War era | Applying (C3) |
| C402-8.3 | Analyze the major political developments and events since the 20th century | Analyzing (C4) |
| C402-8.4 | Demonstrate an understanding of the rise of new power centres in the changing world order | Understanding (C2) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Basic Concepts | Balance of power and Collective security National Interest and its instruments | 4 |
| 2. | An Overview of Twentieth Century International Relations History | World War I: Causes and Consequences Significance of the Bolshevik Revolution Rise of Fascism / Nazism World War II: Causes and Consequences | 8 |
| 3. | Cold War Politics | Origin of the Cold War Evolution of the Cold War Collapse of the Soviet Union Causes of the End of the Cold War | 8 |
| 4. | India's foreign policy during the Cold War era | Basic Determinants (Historical, Geo-Political, Economic, Domestic and Strategic) India's Policy of Non-alignment | 6 |
| 5. | India's foreign policy in the Post-Cold War era | India and SAARC India and the Look East policy Impediments to regional co-operation: river water disputes; illegal cross-border migration; ethnic conflicts and insurgencies; border disputes | 8 |
| 6. | Emergence of Other Power Centres | European Union Rise of Asia Powers- Russia, China and Japan | 8 |
| | | **Total number of Lectures** | **42** |

| Evaluation Criteria | |
| --- | --- |
| **Components** | **Maximum Marks** |
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (Project/ Quiz/Attendance) |
| **Total** | **100** |

Project Based Learning: Each student would form a group of 3-4 and submit projects on India's foreign policy and rise of new power centres. This project would help the students' research about the India's relations- economic, political and diplomatic and also consider a variety of perspectives and interpretations of current world events.

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

| | |
| --- | --- |
| 1. | A. Chatterjee, *International Relations Today*. Noida, India: Pearson, 2019 |
| 2. | Appadorai, &M.S.Rajan, *India's Foreign Policy and Relations*. New Delhi, India: South Asian Publisher, 1985 |
| 3. | E.H. Carr,*International Relations between the Two World Wars: 1919-1939*. New York, USA: Palgrave, 2009 |
| 4. | J. Baylis &S. Smith, Ed. *The Globalization of World Politics: An Introduction to International Relations*. Oxford, UK: Oxford University Press, 2011 |
| 5. | P. Calvocoressi, *World Politics: 1945—2000*. Essex, UK: Pearson,2009 |
| 6. | P.Zelikow, *The Road less travelled: The secret battle to end the great war,1916-17*. New York, USA: Public Affairs, 2021 |
| 7. | R,Cooper, *The Ambassadors: thinking about diplomacy from Machiavelli to modern times*. London,UK: Weidenfeld & Nicolson, 2021 |

| Course Code | **16B1NHS831** | **Semester: Even** **(specify Odd/Even)** | **Semester: VIII Session** 2022 -2023 **Month: JAN 2023 –JUNE 2023** |
|---|---|---|---|
| **Course Name** | Gender Studies | | |
| **Credits** | 3 | **Contact Hours** | 3-0-0 |

| Faculty (Names) | **Coordinator(s)** | Prof Alka Sharma |
|---|---|---|
| | **Teacher(s) (Alphabetically)** | Prof Alka Sharma <br><br> Shikha Kumari |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| **C401-19.1** | Demonstrate knowledge of the construct of gender and the way itintersects with other social and cultural identities ofrace, class, ethnicity andsexuality | Understand(C2) |
| **C401 - 19.2** | Apply feminist and gender theory in an analysis of gender including an examination of the social construct of femininity andmasculinity | Apply (C3) |
| **C401- 19.3** | Analyze the ways in which societal institutions and power structures such as the family, workplace impact the material and social reality of women"s lives | Analyze (C4) |
| **C401-19.4** | Assess the need for Gender Sensitization and Gender Inclusivity and its practice in contemporarysettings | Evaluate (C5) |
| **C401- 19.5** | Evaluate and interpret information from a variety of sources including print and electronic media, film, video and other information technologies | Evaluate (C5) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | **Introducing Gender Issues** | • Sex andGender <br> • Types ofGender <br> • Gender Roles <br> • Gender Division ofLabor <br> • Gender Stereotyping and GenderDiscrimination | 9 |
| 2. | **Gender Perspectives of Body & Language** | • Biological, Phenomenological and Socio-Cultural Perspectives ofbody <br> • Body as a Site and Articulation of PowerRelations <br> • Cultural Meaning of Female Body andWomen"s Lived Experiences <br> • The Other andObjectification | 6 |
| 3. | **Social Construction of Femininity &Feminism** | • Bio-Social Perspective ofGender <br> • Gender as AttributionalFact <br> • Feminine &Feminist <br> • Major Theorists of Feminism Challenging Cultural Notions of Femininity <br> • Feminism Today: Radical, Liberal, Socialist, Cultural, Eco feminism & Cyberfeminism <br> • Images of Women in Sports, Arts, Entertainment, Media and Fashion Industry ;Cultural Feminism& | 9 |

| | | | |
|---|---|---|---|
| | | Celebrating Womanhood | |
| | | • Analysis of role women have played acrosscultures | |
| 4. | **Social Construction of Masculinity** | • Definition and Understanding ofMasculinities<br>• Sociology of Masculinity& itsTypes<br>• Social Organization of Masculinity and Privileged Position ofMasculinity<br>• Politics of Masculinity andPower<br>• Major Theorists ofMasculinity<br>• Masculine Identities in Literature, Cinema & Media. | 9 |
| 5. | **Gender Sensitization Empowerment &Gender Inclusivity** | • Women & Women Rights InIndia<br>• From Women's Studies to Gender Studies:A ParadigmShift<br>• Gender Sensitization & Gender Inclusivity<br>• Gender Studies & Media: Creating NewParadigms in Gender &Culture | 9 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

| **Components** | **MaximumMarks** |
|---|---|
| T1 | 20 |
| T2 | 20 |
| EndSemesterExamination | 35 |
| TA | 25 (Project/ Assignment) |
| **Total** | **100** |

**Students will be given a project on the construction of gender and how does the major institution of the society has shaped their gender.**

| | **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. ( Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) |
|---|---|
| **1** | Davis K., et al, "*Handbook of Gender and Women's Studies. London: Sage. (2006)* |
| **2** | Helgeson, Vicki S., "*The Psychology of Gender",* Pearson(2012) |
| **3** | Friedan B., "*The Feminine Mystique"*, Penguin. (1971/1992) |
| **4** | DebeauvoirS. , "*The Second Sex"*, Vintage (1953/1997) |
| **5** | Wharton Amy S., "*The Sociology of Gender: An Introduction to Theory & Research*", Wiley-Blackwell (2005) |
| **6** | Pachauri G.," *Gender, School & Society*", R.Lall Publishers( 2013) |
| **7** | Connell R.W, "*Masculinities*", Cambridge: Polity. (1985) |
| **8** | MacInnes J., "The *End of Masculinity"*. Buckingham: Open University Press. (1998) |
| **9** | Kaul A.& Singh M., *"New Paradigms for Gender Inclusivity*", PHI Pvt Ltd (2012) |

| Subject Code | 17B1NHS732 | Semester: Even | Semester: 8<sup>th</sup>        Session:  2022 -2023 Month:  January to June |
|---|---|---|---|
| Subject Name | INDIAN FINANCIAL SYSTEM | | |
| Credits | 3 | Contact Hours | 3 (3-0-0) |

| Faculty (Names) | Coordinator(s) | 1. Dr. Mukta Mani (Sec 62) 2. Dr Sakshi Varshney (Sec 128) |
|---|---|---|
| | Teacher(s) (Alphabetically) | 2. Dr Mukta Mani 2. Dr Sakshi Varshney |

| NBA Code | Course Outcomes | Cognitive Level |
|---|---|---|
| C402-31.1 | Understand the interlinkage of components of the financial system and financial instruments of the Money market and Capital market. | C2 |
| C402-31.2 | Analyze ways of fundraising in domestic and international markets | C4 |
| C402-31.3 | Understand the functioning of the Stock market and evaluate securities for investment. | C5 |
| C402-31.4 | Apply the knowledge of Mutual Funds and Insurance in personal investment decisions | C3 |
| C402-31.5 | Apply knowledge of Income tax for the calculation of the tax liability of an individual. | C3 |

| Module No. | Subtitle of the Module | Topics in the module | No. of Hours |
|---|---|---|---|
| 1. | Introduction | Meaning, Importance, and functions of Financial system. Informal and Formal financial systems, Financial markets, Financial Institutions, Financial Services and Financial instrument | 3 |
| 2. | Money Market | Features of money market Instruments: Treasury bills, commercial bills, commercial papers, certificates of deposit, call and notice money, Functions of money market, Linking of money market with Monetary policy in India | 3 |
| 3. | Capital Market | Features of Capital market instruments: Equity shares, Bonds. Fundraising through Initial Public Offering, Rights issue, Preferential allotment and Private Placement. Process of IPO-Intermediaries in IPO, Book building process and allotment of shares | 3 |

| | | | |
|---|---|---|---|
| 4. | Foreign investments in India | Fundraising from the foreign market through Foreign direct investment and foreign institutional investment, ADR, GDR, ECB, and Private equity. | 3 |
| 5. | Stock Market | Trading in the secondary market- Stock exchanges, regulations, demutualization, broker, a listing of securities, dematerialization, trading, short selling, circuit breaker, stock market indices- methods of calculation of indices. | 3 |
| 6. | Stock Valuation and Analysis | Investing basics: Consideration of Risk and Return, Stock Valuation and Analysis- Fundamental analysis: Economy, industry and company analysis; Technical Analysis of stocks using technical charts | 7 |
| 7. | Investing in Mutual Funds and Insurance | Mutual Funds: Basics, Types of funds, risk and return considerations in the selection of funds; Insurance: Basics, Life insurance and health insurance, types of policies | 6 |
| 8. | Overview of Income Tax | Basics of Income tax Concept of the previous year, assessment year, person, income. Calculation of Income tax liability for individuals: Income from salaries- basic, DA, HRA, leave salary, Gratuity, Pension, Allowances and Perquisites; Income from Capital Gain, Deductions under sections 80C to 80U. | 14 |
| **Total number of Lectures** | | | **42** |

**Evaluation Criteria**

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

Project-Based Learning: The students will form groups of 4-5 students. They will carry out a stock analysis of a selected company on the basis of fundamental and technical analysis techniques studied in lecture classes. Finally, they will give their recommendation about the performance of the stock.

| **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEE format) | |
|---|---|
| 1 | Pathak Bharti V, *Indian Financial System,* 5th Edition, Pearson Education, 2018 |
| 2 | Madura Jeff, *Personal Finance*, 6th Ed, Pearson Education, 2017. |
| 3 | Machiraju H R, *Indian Financial System*, 5th Ed, Vikas Publication, 2019 |

| 4 | Bhole L M and Mahakud, J., *Financial Institutions and Markets*, 5th ed. Tata McGraw Hill Publication, 2017. |
|---|---|
| 5 | Singhania & Singhania, Students Guide to Income Tax, 67th Edition, Taxmann Publication, August 2022. |
| 6 | *How to Stimulate the Economy Essay* [Online]Available: https://www.bartleby.com/essay/How-to-Stimulate-the-Economy-FKJP5QGATC |
| 7 | Reserve Bank of India, 'Money Kumar & the Monetary Policy', 2007 |
| 8 | Ashiwini Kumar,Sharma,' De-jargoned: Book building process, Live Mint,2015. |
| 9 | Madhavan, N. "Pushing the accelerator instead of brakes: Can Subhiksha make a comeback?", Business Today, 28th June 2009. |
| 10 | Kaul, Vivek, "Master Move: How Dhirubhai Ambani turned the tables on the Kolkata bear cartel", The Economic Times, July 1, 2011. |

| Course Code | 18B12HS814 | Semester Even | | Semester VIII Session 2022 -2023 Month from Jan to June | |
|---|---|---|---|---|---|
| Course Name | Knowledge Management | | | | |
| Credits | 3 | | Contact Hours | 3-0-0 | |
| Faculty (Names) | Coordinator(s) | Dr. Anshu Banwari | | | |
| | Teacher(s) (Alphabetically) | Dr. Anshu Banwari | | | |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| C402-30.1 | Demonstrate the way knowledge is embedded in today's organization and behavioral aspects involved in managing it | Understanding Level (C2) |
| C402-30.2 | Compare and contrast different methods of KM to preserve, nurture, share and manage knowledge | Understanding Level (C2) |
| C402-30.3 | Identify appropriate methods for knowledge integration to gain competitive advantage | Applying Level (C3) |
| C402-30.4 | Identify the legal ramifications arising from knowledge sharing and an insight into the ethical concerns faced by individuals and organizations | Applying Level (C3) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Introduction to Knowledge Management | Cognition and Knowledge Management, Data, Information and Knowledge, Types of Knowledge, Reasoning and Heuristics, Expert Knowledge, Human thinking and Learning, Knowledge Management myths | 4 |
| 2. | Life Cycle of a knowledge Management System | Challenges in building Knowledge Management Systems, Conventional V/S Knowledge Management System Lifecycle, Knowledge Management System Life Cycle, System Justification, Role of Rapid Prototyping, Selecting an expert, Role of Knowledge developer | 6 |
| 3. | Knowledge Creation and Knowledge Architecture | Models of Knowledge Creation and Transformation, Knowledge Architecture, The people Core, Identifying Knowledge centers, The technical core | 5 |
| 4. | Capturing Tacit Knowledge | Evaluating the expert, Developing a Relationship with expert, Fuzzy reasoning and the quality of Knowledge capture, Interview as a tool, Knowledge capture techniques | 6 |
| 5. | Knowledge Codification and | Codification Tools and Procedures, The knowledge Developer's Skill set, Quality assurance, Approaches to | 6 |

| | System Implementation | Logical testing and Acceptance testing, Issues related to deployment | |
|---|---|---|---|
| 6. | Knowledge Transfer and Knowledge Sharing | Transfer strategies, Inhibitors of Knowledge transfer, Role of Internet in Knowledge Transfer | 5 |
| 7. | Managing Knowledge Workers | Business Roles in the Learning Organizations, Work adjustment and the Knowledge Worker, Technology and the Knowledge worker, Role of the CKO, Managing Considerations, Managing Knowledge Projects | 5 |
| 8. | Ethical, Legal and Managerial Issues | Knowledge Owners, Legal Issues, Ethical Decision cycle, Major threats to Ethics, The Privacy factor | 5 |
| **Total number of Lectures** | | | **42** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (Assignments, Project) |
| **Total** | **100** |

**Project based learning:** Students have to form a group (maximum 5 students in each group) and have to identify an organization who has successfully implemented knowledge management. Students have to analyze techniques, tools and methods adopted by organization to preserve, nurture, share and manage knowledge. Understanding of different methods, processes and techniques used by organizations for successful KM implementation enhances the students practical understanding on how knowledge management is integrated into different business functions. These days most of the organizations are using knowledge management in their various endeavors. This subject surely enhances student's employability in all those organizations where knowledge management has been implemented or where they are planning to implement knowledge management.

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

| 1 | **D. Hislop,** Knowledge Management in Organizations, Oxford University Press, 2013 |
|---|---|
| 2. | **E. M. Awad and H. M. Ghaziri,** Knowledge Management, Pearson Education, 2007 |
| 3. | **S. Warier**, Knowledge Management, Vikas Publishing House, 2011 |
| 4. | **Tan, H., Carrillo, P. and Anumba, C.J**., Case study of knowledge management implementation in a medium-sized construction sector firm. Journal of Management in Engineering, 28 (3), pp. 338 – 347, 2012 |
| 5. | **RagsdelL, G., Ortoll Espinet, E. and Norris, M.,** Knowledge management in the voluntary sector: a focus on sharing project know-how and expertise. Knowledge Management Research and Practice, 12(4), pp.351–361, 2014 |
| 6. | **K. North and G. Kumta,** Knowledge Management, 2nd ed. 2018 ed., Springer, 2018 |

| Subject Code | 18B12HS815 | Semester Even | Semester VIII  Session  2022-23 |
|---|---|---|---|
| | | | Month from  Jan to June 2023 |

| Subject Name | **QUALITY ISSUES IN ENGINEERING** |
|---|---|
| Credits | 3 (3-0-0) |

| Credits | 3 (3-0-0) | Contact Hours | 3-0-0 |
|---|---|---|---|

| Faculty (Names) | Coordinator(s) | Dr. Akarsh Arora |
|---|---|---|
| | Teacher(s) (Alphabetically) | Dr. Akarsh Arora |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| C402-32.1 | Apply the concepts of quality within quality management systems by understanding various perspectives, historical evolution; and contributions of key gurus in the field of quality | Apply Level (C3) |
| C402-32.2 | Determine the effectiveness of acceptance sampling using single and double sampling plans and operating characteristic curves | Evaluate Level (C5) |
| C402-32.3 | Determine quality by employing a wide range of basic quality tools, lean concepts and process improvement techniques such quality function deployment | Evaluate Level (C5) |
| C402-32.4 | Examine the importance of six sigma, various quality standards, awards, certifications | Analyze Level (C4) |

| Module No. | Subtitle Of The Module | Topics In The Module | No. Of Lectures For The Module |
|---|---|---|---|
| 1. | Fundamentals And Evolution Of Quality | Introduction, Dimensions Of Quality, Fundamentals, History Of TQM, Contemporary Influences | 6 |
| 2. | Quality Tools And The Improvement Cycle | Various Costs, Juran's Coq Accounting Statement, Voice Of Customers: Kano's Model, House Of Quality, QFD Process, Seven Tools For Quality Management | 9 |
| 3. | Benchmarking | Meaning, Process, Methods | 3 |
| 4. | Quality Gurus | Contribution of Quality Gurus | 3 |
| 5. | Six Sigma | Six Sigma, Capability Of A Process/Product/Service, DMAIC Process | 6 |
| 6. | Lean Concepts | Kaizen, Poka-Yoke, Andon, Kanban, JIT, 5-S, 7 Mudas | 3 |
| 7. | Statistical Thinking And Applications | Statistical Process Control, Acceptance Sampling, Specification And Control Limits, Control Charts For Variables, Control Charts For Attributes | 6 |

| 8. | Quality Awards And Certifications | MBNQA, RGNQA, Deming Prize, ISO Standards | 3 |
|---|---|---|---|
| 9. | Quality Strategy For Indian Industry | India's Quality Journey, Quality Management In India | 3 |
| Total Number Of Lectures | | | 42 |

**Project-based Learning**: Students are required to visit any business organization to observe the brief about the organization; its products; its suppliers; its operations; its processes, Quality control system and techniques followed by the company, Quality standards met by the company, application of quality tools or lean manufacturing system, Sigma capability of products or processes, DMAIC methodology, application and relevance of the quality concepts studied in the course. Collecting information on quality systems, quality standards, quality certifications or awards received, and sigma capability will upgrade students' knowledge and strengthen their skills to tackle multiple quality engineering issues along with employability.

**Evaluation Criteria**
**Components**                **Maximum Marks**
T1                 20 (Written)
T2                     20 (Written)
End Term                 35 (Written)
TA                     25 (Project Assignment, Quiz)
**Total**          **100**

| | Recommended Reading material: |
|---|---|
| **1.** | Besterfield D. H., Besterfield-Michna C., Besterfield G. H., Besterfield-Sacre M. *Total quality management*, Prentice Hall, 1999. |
| **2.** | Evans, J. R., Dean J. W. *Total quality management, organization and strategy*, Thomson, 2003. 399 p. |
| **3.** | Kanji G. K., Asher M. *100 Methods for Total Quality Management*. London: SAGE Publications, 1996. |
| **4.** | Oakland G. F. *Total Quality Management*, Oxford, 1995. |
| **5.** | Goetsch D. L., Davis S. B. *Quality management. Introduction to TQM for production, processing and services*. New Jersey: Prentice Hall, 2003. |
| **6.** | John S. Oakland. *Total Quality Management and Operational Excellence*: Text with cases, Fourth edition, 2014 |
| **7.** | Dale H. Besterfield. *Total Quality Management*, (Revised Edition). India: Pearson, 2011. |

| Course Code | 18B12PH811 | Semester Even (specify Odd/Even) | Semester VIII Session 2022 -2023 Month from January to June |
|---|---|---|---|
| **Course Name** | Photonics and Applications | | |
| **Credits** | 3 | **Contact Hours** | 3 |

| Faculty (Names) | Coordinator(s) | Navneet Kumar Sharma |
|---|---|---|
| | Teacher(s) (Alphabetically) | Navneet Kumar Sharma |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| **C402-3.1** | Recall the fundamental properties of light and the processes involved in the generation of light | Remember Level (C1) |
| **C402-3.2** | Interpret the theory of fiber optics | Understand Level (C2) |
| **C402-3.3** | Apply the fundamentals of various nonlinear optical effects in technology; make use of holography and its applications | Apply Level (C3) |
| **C402-3.4** | Compare the operational principles, characteristics and trade-offs of optical detectors and modulators of light | Analyze Level (C4) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Lasers | Review of different types of laser systems. LEDs, Semiconductor lasers, Quantum well lasers, Modes of laser cavity, Q-switching and Mode locking in lasers. | 8 |
| 2. | Fiber Optics | Numerical aperture, Step and graded index multimode fibers, attenuation and dispersion, modes in optical fibers. Single mode fiber, mode cutoff and mode field diameter. Connector and splice losses, Erbium doped fiber amplifier and Characterization techniques including OTDR. | 10 |
| 3. | Photo detectors | Semiconductor photo detectors. | 5 |
| 4. | Optical Electronics | Wave propagation in anisotropic media, Electro-optic effect: phase and amplitude modulation. Acousto-optic effect: modulators, deflectors and tunable filters, Magneto-optic effect: modulators. | 4 |
| 5. | Optical devices | Electro-optical device, Acousto-optical device, Magneto-optical device, Voice communication, Optical communication. | 2 |
| 6. | Nonlinear Optics | SHG, Sum and Difference frequency generation, parametric amplification, wavelength converters, Self focusing with lasers. | 6 |
| 7. | Holography | Recording and Reproduction of Hologram, Applications of holography. | 4 |
| 8. | Applications of Photons in Memory devices | CD, VCD, DVD. | 1 |
| | | **Total number of Lectures** | **40** |

| Evaluation Criteria | |
|---|---|
| **Components** | **Maximum Marks** |
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 [Attendance (05 M), Class Test, Quizzes *etc* (06 M), Assignments in PBL mode (10 M) and Internal assessment (04 M)] |
| **Total** | **100** |

| | **Recommended Reading material:** Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format) |
|---|---|
| **1.** | R. P. Khare, *Fiber Optics and Optoelectronics*, Oxford University Press. |
| **2.** | A. K. Ghatak and K. Thyagarajan, *Optical Electronics*, Cambridge university Press. |
| **3.** | A. K. Ghatak and K. Thyagarajan, *An Introduction to Fiber Optics*, Cambridge university Press. |
| **4.** | B. B. Laud, *Lasers and Nonlinear Optics*, New Age International. |

**Project based learning:** Each student in a group of 4-5 students will opt a topic and will do the theoretical study in detail. The students will submit their report. To make the subject application based, the students analyze the optical fiber applications, holography applications and use of photons in memory devices. This shall improve the skills and employability of the students in laser and photonic industries.

| Course Code | 18B12PH812 | Semester: Even | Semester: 8, Session : 2022 -2023 Month from: January to June |
|---|---|---|---|
| Course Name | Astrophysics | | |
| Credits | 3 | Contact Hours | 3 |

| Faculty (Names) | Coordinator(s) | Prof. Anirban Pathak |
|---|---|---|
| | Teacher(s) (Alphabetically) | Anirban Pathak |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| CO1 | Relate historical development of astrophysics with the modern concepts and recall the mathematical techniques used & definition of different units | Remembering (C1) |
| CO2 | Explain the models of universe, ideas of stellar astrophysics, life cycles of stars, physical principles that rules galaxies, and general theory of relativity | Understanding (C2) |
| CO3 | Apply mathematical principles and laws of physics to solve problems related to astrophysical systems | Applying (C3) |
| CO4 | Compare different models of universe and decide which one is logically acceptable and why | Analyzing (C4) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1 | Introduction to Astrophysics | Historical development of astrophysics (from mythology to contemporary astrophysics), Mass, length and time scales in astrophysics, sources of astronomical information (effect of discovery of spectroscopes and photography), astronomy in different bands of electromagnetic radiation (e.g. Optical astronomy, infra-red astronomy radio astronomy, X-ray astronomy. Gamma-ray astronomy etc. with specific mention of Hubble space telescope). Kirchoff's law, Doppler effect and Hubble's law. | 8 |
| 2. | Stellar Astrophysics | Classification and nomenclature of stars. Basic equations of stellar structure, main sequence, red giants and white dwarfs, HR diagram, stellar evolution, supernovae, extra solar planets. | 8 |
| 3. | Death of a star | End states of stellar collapse: degeneracy pressure of a Fermi gas, structure of white dwarfs, Chandrasekhar mass limit, neutron stars pulsars and black holes. | 6 |
| 4. | Our galaxy | The shape and size of Milky way and its interstellar mater | 2 |
| 5. | Extragalactic astrophysics | Normal galaxies, active galaxies, cluster of galaxies, large-scale distribution of galaxies. | 6 |
| 6. | GTR and Models of Universe | Qualitative idea of general theory of relativity (without using tensor calculus) and its implications. Different models of universe. Specific attention to the ideas | 6 |

| | | related to big bang, cosmological constants, dark matter and dark energy. | |
|---|---|---|---|
| 7. | Astrobiology | Drake equation and related questions. | 2 |
| 8. | Conclusion | Review of the present status of Astrophysics and open questions. | 2 |
| | | **Total number of Lectures** | **40** |

**Evaluation Criteria**

| **Components** | **Maximum Marks** |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 |

(a) Quizes /class tests (05 M),
(b) Attendance (05 M)
(c) Internal Assessment (05)
(d) Assignments in PBL mode (10 M)

**Total**                    **100**

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

| 1. | Astrophysics for Physicists, Arnab Rai Choudhuri, Cambridge University Press, Delhi, 2010. |
|---|---|
| 2. | Astrophysics: Stars and Galaxies, K D Abhyankar, University Press, Hyderabad, 2009. |
| 3. | Facts and Speculations in Cosmology, J V Narlikar and G Burbidge, Cambridge University Press, Delhi, 2009. |
| 4. | The Cosmic Century, Malcolm Longair, Cambridge University Press, Cambridge, 2006. |
| 5. | An Introduction to Astrophysics, Baidyanath Basu, Prentice Hall of India, Delhi 1997. |
| 6. | Fundamentals of Equations of State, S. Eliezer, A Ghatak and Heinrich Hora, World Scientific, Singapore, 2002. Only Chapter 15. |

**Project based learning: Project report (5-7 pages in pdf format indicating Name, Enroll No. and Batch) is to be uploaded in google class room before starting of End Term Exam. Max 5 students can work on one topic given in the list** (Dark Matter, Dark Energy, Expanding Space time, Merger of Black holes, Failed stars, Detection of Gravitational Waves, Light cone in GTR, Particle production radiation era, Did big bang happened ?, Discover life: ET etc.**), however, they may prepare different reports. Report should include introduction, definition, mathematics, principle, working, figures, applications etc.**

| Course Code | 18B12PH814 | Semester: Even | Semester: VIII Session: 2022 -2023 Month: January to June |
|---|---|---|---|
| Course Name | Plasma Physics | | |
| Credits | 3 | Contact Hours | 3 |

| Faculty (Names) | Coordinator(s) | Dr. Anuraj Panwar |
|---|---|---|
| | Teacher(s) | Dr. Anuraj Panwar |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| C402-34.1 | Define terminology and concepts of plasma physics with various natural phenomena and engineering applications. | Remembering Level (C1) |
| C402-34.2 | Summarize plasma and explain its electric, magnetic, dielectric and thermal properties. | Understand Level (C2) |
| C402-34.3 | Develop magneto-hydrodynamic fluid and kinetic models to explain various phenomena taking place in homogeneous, isotropic and anisotropic plasma conditions. | Apply Level (C3) |
| C402-34.4 | Analyze and formulate mathematical / analytical expressions for various nonlinear processes in plasmas. | Analyze Level (C4) |
| C402-34.5 | Evaluate physical problems, estimate their numerical solutions and draw inferences from the results. | Evaluate Level (C5) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Introduction to the Plasma State | Elementary concepts, definition of temperature Debye Shielding, plasma parameters, applications of Plasma Physics, Production of Plasmas in the laboratory, Drifts of charged particles under the effect of different combinations of electric and magnetic fields and Mirror Machine. | 10 |
| 2. | Fluid description of plasmas | Relations of Plasma Physics to ordinary electromagnetics, dielectric constant of a plasma, collisions, equation of continuity, macroscopic parameters of plasma, two and one fluid equations for plasma. | 04 |
| 3. | Nonlinear Waves in Plasmas | Plasma oscillations, space charge waves of warm plasma, ion-acoustic waves and electromagnetic waves in magnetized plasma. | 08 |
| 4. | Diffusion and Resistivity | Decay of Plasma by diffusion, diffusion across a magnetic field, single fluid MHD equations, Diffusion in fully ionized Plasmas, Bohm diffusion and Neoclassical diffusion. | 06 |
| 5. | Stability of fluid plasma | The equilibrium of plasma, classification of plasma instabilities, stability analysis: Two stream instability and Gravitational instability or Rayleigh Taylor instability (Plasma supported against gravity by magnetic field). | 04 |
| 6. | Nonlinear effects | Ponderomotive force, Parametric instabilities, decay instability, two plasmon decay, stimulated Raman scattering and stimulated Brillouin scattering, non linear Landau damping. | 06 |
| 7. | Controlled thermo-nuclear fusion | Magnetic and inertial confinement schemes, ITER, TOKAMAK. | 02 |
| | | **Total number of Lectures** | **40** |

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (Quiz+PBL+Attendance+class performance) |
| **Total** | **100** |

| | Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Textbooks, Reference Books, Journals, Reports, Websites etc. in the IEEE format) |
|---|---|
| **1.** | F. F. Chen., *Introduction to Plasma Physics,* Springer (2016). |
| **2.** | Krall and Trievelpiece, *Principles of Plasma Physics*, McGraw-Hill (1973). |
| **3.** | W. L. Kruer, *The Physics of laser plasma interactions*, Addison Wesley (1988). |
| **4.** | Liu and Tripathi, *Interaction of electromagnetic waves with electron beams and plasmas*, World Scientific (1994). |

**Project based Learning (PBL):** Students groups may be formed to submit project reports on natural and engineering applications of plasma physics. Students may be asked to make presentations on topics like mirror machine, plasma diffusion, Raman scattering and plasma fusion devices. Students may be asked to present recent published articles on plasma applications. Students may be asked to solve plasma physics problems by using their expertise computer language

| Course Code | 20B12MA411 | Semester Even | Semester VIII Session 2022 -2023 Month from Jan 2023 to June 2023 | |
|---|---|---|---|---|
| Course Name | Multi Attribute Decision Making | | | |
| Credits | 3 | | Contact Hours | 3-0-0 |
| Faculty (Names) | Coordinator(s) | Dr. Dinesh C. S. Bisht | | |
| | Teacher(s) (Alphabetically) | Dr. Dinesh C. S. Bisht | | |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| After pursuing the above mentioned course, the students will be able to: | | |
| CO-1 | explain basic steps in decision analysis and decision-making environments. | Understanding Level (C2) |
| CO-2 | apply group decision making methods to reach a collective decision. | Applying Level (C3) |
| CO-3 | develop the concept of multi criteria decision making process and attributes. | Understanding Level (C2) |
| CO-4 | apply elementary methods to solve multi attribute decision making problems. | Applying Level (C3) |
| CO-5 | analyze value based and outranking methods to solve multi attribute decision making problems. | Analyzing Level (C4) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Decision Analysis | Basic Steps in Decision Analysis, Decision-Making Environments, Decision Making Under Uncertainty, Decision Making Under Risk, Utility Theory, Decision Tree. | 8 |
| 2. | Group Decision Making | GDM Methods, Content-Oriented Methods, and Disadvantages of Non ranked Voting, Preferential Voting System, and Social Choice Functions. | 7 |
| 3. | Multicriteria Decision Making | Multi-attribute Decision Making, Multi Objective Decision Making, Decision Making Process, Structuring Process, Decision Matrix, Attributes, Normalization, Attribute Weight Assignment Methods. | 8 |
| 4. | Elementary Methods for | Dominance Relation method, Even-Swap method, Lexicographic method Maximax method, Maximin | 8 |

| | MADM | method, Conjunctive method, Disjunctive method, Median Ranking, Analytic Hierarchy Process, Analytic Network Process. | |
|---|---|---|---|
| 5 | Value Based and Outranking Methods | Multi Attribute Value Theory, Simple Additive Weighting, Weighted Product, TOPSIS Outranking Methods. | 11 |

| **Total number of Lectures** | | | **42** |
|---|---|---|---|

**Evaluation Criteria**

| Components | Maximum Marks |
|---|---|
| T1 | 20 |
| T2 | 20 |
| End Semester Examination | 35 |
| TA | 25 (Quiz and Assignments) |
| **Total** | **100** |

**Project based learning:** Students are divided in a group of 4-5 to do a survey on the applications of classical and recent multi attribute decision making techniques in their respective branches. The student recognizes the multi attribute decision making problems arising in real life and solves these problems with the help of MADM techniques learnt in this course.

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

| 1. | Ishizaka, Alessio, and Philippe Nemery. *Multi-criteria decision analysis: methods and software.* John Wiley & Sons, 2013. |
|---|---|
| 2. | Xu, Zeshui. *Uncertain multi-attribute decision making: Methods and applications.* Springer, 2015. |
| 3. | Tzeng, Gwo-Hshiung, and Jih-Jeng Huang. "Multi Attribute Decision Making: Methods and Applications." *USA, CRC Press.* 2016. |

| Course Code | 16B1NMA831 | Semester Even | Semester VIII  Session 2022-2023 Month from  Jan 2023 to June 2023 | | |
|---|---|---|---|---|---|
| Course Name | Optimization Techniques | | | | |
| Credits | 3 | | Contact Hours | 3-0-0 | |
| Faculty (Names) | Coordinator(s) | Dr. Ram Surat Chauhan | | | |
| | Teacher(s) (Alphabetically) | Dr. Ram Surat Chauhan | | | |

| COURSE OUTCOMES | | COGNITIVE LEVELS |
|---|---|---|
| After pursuing the above mentioned course, the students will be able to: | | |
| C402-2.1 | apply generalized, revised and dual simplex method for linear programming problems (LPP). | Applying Level (C3) |
| C402-2.2 | apply graphical, algebraic and linear programming techniques for pure and mixed strategy problems in game theory. | Applying Level (C3) |
| C402-2.3 | classify and solve the problems on queuing and inventory models. | Analyzing Level (C4) |
| C402-2.4 | solve and analyze the network scheduling and sequencing problems. | Analyzing Level (C4) |
| C402-2.5 | make use of dynamic programming technique to solve complex linear programming problems. | Applying Level (C3) |
| C402-2.6 | determine numerical solution of nonlinear multidimensional problems. | Evaluating Level (C5) |

| Module No. | Title of the Module | Topics in the Module | No. of Lectures for the module |
|---|---|---|---|
| 1. | Review of Linear Programming | Convex sets, Linear Programming Problems (LPP), graphical method, simplex method and its variants, revised simplex method, Duality theory, dual simplex method, sensitivity analysis. | 08 |
| 2. | Game Theory | Rectangular Games, Minmax Theorem, Graphical Solution of 2×n, 3×n, m×2, m×3 and m×n Games, Solution of games using LPP technique. | 06 |
| 3. | Queuing Theory & Inventory Model: | Introduction, Steady-State Solutions of Markovian Queuing Models: M/M/1, M/M/1 with limited waiting space, M/M/C, M/M/C with limited waiting space. Inventory Models: Deterministic and Probabilistic models. | 08 |
| 4. | Sequencing & Scheduling | Processing of Jobs through Machines: Processing of n jobs through two machines, two jobs through m machines and n jobs through m machines. Project Scheduling: Network diagram, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT). | 07 |

| 5. | Dynamic Programming | Discrete and Continuous Dynamic Programming: Bellman's principle of optimality, linear and nonlinear dynamic programming problems, Simple Illustrations. | 06 |
|---|---|---|---|
| 6. | Nonlinear Programming | Unimodal function, One Dimensional minimization problem: Newton's method, Golden section method, Fibonacci search method, Bisection method. Multidimensional minimization problem: Steepest descent method, Multidimensional Newton's method. | 07 |
| | | **Total number of Lectures** | **42** |

**Evaluation Criteria**

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

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

| 1. | Taha, H. A., Operations Research - An Introduction, Tenth Edition, Pearson Education, 2017. |
|---|---|
| 2. | Rao, S. S. - Engineering Optimization, Theory and Practice, Third Edition, New Age International Publishers, 2010. |
| 3. | Hillier F., Lieberman G. J., Nag,B. and Basu, P., Introduction to Operations Research, 10th edition, McGraw-Hill, 2017. |
| 4. | Wagner, H. M., Principles of Operations Research with Applications to Managerial Decisions, 2nd edition, Prentice Hall of India Pvt. Ltd., 1980. |