

**ADAMAS UNIVERSITY**

**SCHOOL OF ENGINEERING & TECHNOLOGY**

**SoET 2.0**

**(Engineering +)**

**UG PROGRAM**

**Course Structure of**

**B.Tech in Computer Science & Engineering**

**Applicable for Academic Year: 2019-20**

**ADAMAS UNIVERSITY**

Adamas Knowledge City

Barasat-Barrackpore Road

P.O-Jagannathpur, District-24 Parganas(North)

Kolkata-700126

**ADAMAS UNIVERSITY**

**SCHOOL OF ENGINEERING & TECHNOLOGY**

**B.Tech PROGRAMME**

**First Year**

|  |  |  |  |  |  |  |  |  |  |
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| **SEMESTER I** | | | | | | | | | |
| **S. No** | **Type** | | **Course Code** | **Course Title** | **L** | **T** | **P** | **Contact**  **Hrs/wk** | **Credits** |
|  | Theory  **BSC** | | **SMA41101** | Engineering Mathematics-I | 3 | 1 | 0 | 4 | 4.0 |
|  | Theory  **BSC** | | **SPH41109/SCY41106** | Engineering Physics  /Engineering Chemistry | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **ESC** | | **ECS41101/EEE41102** | Introduction to Programming /Electrical and Electronics Technology | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **HSSM** | | **HEN41117** | HSSM –I (English Communication-I) | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **HSSM/BSC** | | **HEN41119/SBT41108** | HSSM –II (ENGINEERING ETHICS, VALUES AND THE LAWS) / Life Sciences | 3 | 0 | 0 | 3 | 3.0 |
|  | Practical  **BSC** | | **SPH41209/ SCY41206** | Engineering Physics Lab/  Engineering Chemistry Lab | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **ESC** | | **ECS41201/ EEE41202** | Programming Lab/  Electrical and Electronics Technology Lab | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **ESC** | | **ECE41201/EME41202** | Engineering Drawing and CAD/  Engineering Workshop | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **MC** | | **EMC41201** | Communication and Collaboration Skill -I | 0 | 0 | 2 | 2 | 1 |
| **Total** | | | | | **15** | **1** | **11** | **27** | **23** |
| **SEMESTER II** | | | | | | | | | |
| **S. No** | **Type** | **Course Code** | | **Course Title** | **L** | **T** | **P** | **Contact**  **Hrs/wk** | **Credits** |
|  | Theory  **BSC** | **SMA41102** | | Engineering Mathematics– II | 3 | 1 | 0 | 4 | 4.0 |
|  | Theory  **BSC** | **SCY41106/**  **SPH41109** | | Engineering Chemistry  / Engineering Physics | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **ESC** | **EEE41102/ ECS41101** | | Electrical and Electronics Technology  / Introduction to Programming | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **BSC/ HSSM** | **SBT41108/ HEN41119** | | Life Sciences/ HSSM –II (ENGINEERING ETHICS, VALUES AND THE LAWS) | 3 | 0 | 0 | 3 | 3.0 |
|  | Theory  **ESC** | **EME41104** | | Engineering Mechanics | 3 | 0 | 0 | 3 | 3.0 |
|  | Practical  **HSSM** | **HEN41212** | | HSSM – III  (Professional Communication in English) | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **BSC** | **SCY41206/ SPH41209** | | Engineering Chemistry Lab  /Engineering Physics Lab | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **ESC** | **EEE41202/ ECS41201** | | Electrical and Electronics Technology Lab  / Programming Lab | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **ESC** | **EME41202/ ECE41201** | | Engineering Workshop/  Engineering Drawing and CAD | 0 | 0 | 3 | 3 | 2.0 |
|  | Practical  **MC** | **EMC41202** | | Communication and Collaboration Skill -II | 0 | 0 | 2 | 2 | 1 |
| **Total** | | | | | **15** | **1** | **14** | **30** | **25** |
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**Total Credit (First Year): 48**

**HSSM:** Humanities, Social Sciences & Management; **BSC:** Basic Science; **ESC:** Engg. Science; **PC:** Program Core

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| **Semester- III** | | | | | | | | |
| **S.**  **No** | **Type** | **Course Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory | HEC42180 | HSSM –IV (Economics for Engineers) | 3 | 0 | 0 | 3 | 3 |
| 2. | Theory | SMA42111 | Probability, Statistics and Numerical Methods | 3 | 1 | 0 | 4 | 4 |
| 3. | Theory | ECS42107 | Engineering Science Course (Introduction to Python) | 3 | 0 | 0 | 3 | 3 |
| 4. | Theory | ECS42105 | Switching Circuits and Logic Design (Prof. Core- II) | 3 | 0 | 0 | 3 | 3 |
| 5. | Theory | ECS42103 | Formal Languages and Automata Theory (Prof. Core- III) | 3 | 0 | 0 | 3 | 3 |
| 6. | Theory | ECS42101 | Data Structures and Algorithms (Prof. Core-I ) | 3 | 0 | 0 | 3 | 3 |
| 7. | Practical | ECS42201 | Data Structures and Algorithms Lab (Prof. Core-I Lab) | 0 | 0 | 3 | 3 | 2 |
| 8. | Practical | EMC42101 | Design Thinking for Engineers | 0 | 0 | 3 | 3 | 2 |
| 9. | Practical | SET42403 | Capstone Project -A | 0 | 0 | 2 | 2 | 1 |
| **Total** | | | | **18** | **1** | **8** | **27** | **24** |

**Second Year**

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| **Semester-IV** | | | | | | | | |
| **S.**  **No** | **Type** | **Course**  **Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory | ECS42110 | Operations Research | 3 | 0 | 0 | 3 | 3 |
| 2. | Theory | ECS42112 | Design & Analysis of Algorithm | 3 | 0 | 0 | 3 | 3 |
| 3. | Theory | ECS42114 | Object Oriented Programming | 3 | 0 | 0 | 3 | 3 |
| 4. | Theory | ECS43101 | Software Engineering | 3 | 0 | 0 | 3 | 3 |
| 5. | Theory | ECS43103 | Computer Architecture | 3 | 0 | 0 | 3 | 3 |
| 6. | Practical | SMA42211 | Numerical Techniques Lab | 0 | 0 | 3 | 3 | 2 |
| 7. | Practical | ECS42212 | Design & Analysis of Algorithm Lab | 0 | 0 | 3 | 3 | 2 |
| 8. | Practical | ECS42214 | Object Oriented Programming Lab | 0 | 0 | 3 | 3 | 2 |
| 9. | Practical | SET42406 | Interdisciplinary Project Work | 0 | 0 | 5 | 5 | 3 |
| 10. | Practical | SET42404 | Capstone Project -B | 0 | 0 | 2 | 2 | 1 |
| **Total** | | | | **15** | **0** | **17** | **32** | **25** |
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**Total Credit (Second Year):49**

**Third Year**

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| **Semester-V** | | | | | | | | |
| **S.**  **No** | **Type** | **Course Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory | ECS43105 | Compiler Design (Prof. Core- VIII) | 3 | 0 | 0 | 3 | 3 |
| 2. | Theory | ECS43107 | Database Management Systems (Prof. Core- IX) | 3 | 0 | 0 | 3 | 3 |
| 3. | Theory | ECS43102 | Operating Systems (Prof. Core- X) | 3 | 0 | 0 | 3 | 3 |
| 4. | Theory |  | Prof. Elective -I | 3 | 0 | 0 | 3 | 3 |
| 5. | Practical | ECS43205 | Compiler Design Lab (Prof. Core- VIII Lab) | 0 | 0 | 3 | 3 | 2 |
| 6. | Practical | ECS43207 | Database Management Systems Lab (Prof. Core- IX Lab) | 0 | 0 | 3 | 3 | 2 |
| 7. | Practical | ECS43202 | Operating Systems Lab (Prof. Core- X Lab) | 0 | 0 | 3 | 3 | 2 |
| 8. | Theory | SET43101 | Venture Ideation for Beginners | 2 | 0 | 0 | 2 | 2 |
| 9. | Project | SET43403 | Capstone Project -C | 0 | 0 | 2 | 2 | 1 |
| **Total** | | | | **14** | **1** | **11** | **25** | **21** |

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| **Semester-VI** | | | | | | | | |
| **S.**  **No** | **Type** | **Course Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory | ECS43104 | Computer Networks (Prof. Core- XI) | 3 | 0 | 0 | 3 | 3 |
| 2. | Theory | ECS43106 | Artificial Intelligence and Machine Learning (Prof. Core- XII) | 3 | 0 | 0 | 3 | 3 |
| 3. | Theory |  | Prof. Elective -II | 3 | 0 | 0 | 3 | 3 |
| 4. | Theory |  | Open Elective -I | 2 | 0 | 0 | 2 | 2 |
| 5. | Practical | ECS43204 | Computer Networks Lab (Prof. Core- XI Lab) | 0 | 0 | 3 | 3 | 2 |
| 6. | Practical | ECS43206 | Artificial Intelligence and Machine Learning Lab (Prof. Core- XII Lab) | 0 | 0 | 3 | 3 | 2 |
| 7. | Practical |  | Prof. Elective –II Lab | 0 | 0 | 3 | 3 | 2 |
| **Total** | | | | **11** | **00** | **09** | **20** | **17** |

**Total Credit (Third Year): 38**

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| **Semester-VII** | | | | | | | | |
| **S.**  **No** | **Type** | **Course**  **Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory | MBA43144 | HSSM –V (Industrial Management) | 3 | 0 | 0 | 3 | 3 |
| 2. | Theory |  | Prof. Elective -III | 3 | 0 | 0 | 3 | 3 |
| 3. | Theory |  | Prof. Elective -IV | 3 | 0 | 0 | 3 | 3 |
| 4. | Theory |  | Open Elective –II | 3 | 0 | 0 | 3 | 3 |
| 5. | Theory |  | Open Elective –III | 3 | 0 | 0 | 3 | 3 |
| 6. | Practical |  | Prof. Elective –III Lab | 0 | 0 | 3 | 3 | 2 |
| 7. | Internship/Training | ECS44601 | Summer Internship | -- | -- | -- | -- | 2 |
| 8. | Project | ECS44401 | Minor Project | 0 | 0 | 6 | 6 | 3 |
| **Total** | | | | **15** | **00** | **09** | **24** | **22** |

**# Summer Internship for 30 days will be taken at the end of 6th semester, and will be evaluated in the 7th semester.**

**Fourth Year**

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| **Semester-VIII** | | | | | | | | |
| **S.**  **No** | **Type** | **Course Code** | **Subject Name** | **L** | **T** | **P** | **Contact**  **Hrs/week** | **Credits** |
| 1. | Theory/Project | ECS44402 | Industry Work Experience / SIRE\* / Major Project | 0 | 0 | 0 | 12 (For Major Project  only) | 5 |
| 2. | Viva | ECS44502 | Comprehensive Viva Voce | ------ | | | ------ | 2 |
| **Total** | | | |  |  |  |  | **7** |

**\*SIRE: Scientific Investigation & Research Experience**

**Total Credits (Fourth Year): 29**

**Total Credits (Over four years): 48+49+38+29 = 164**

**List of Electives:-**

**PE I (Theory): Applied Graph Theory (ECS43111)**

**Communication Network (ECS43113)**

**Big Data Analytics (ECS43115)**

**PE II (Theory):** **High Performance Computer Architecture (ECS43110)**

**Pattern Recognition (ECS43112)**

**Computational Geometry (ECS43114)**

**PE III (Theory): Image Processing (ECS44101)**

**Cloud Computing (ECS44103) Information Retrieval (ECS44105) Computer Graphics (ECS44107)**

**Artificial Neural Network and Deep Learning (ECS44109)**

**PE III (Lab): Image Processing Lab (ECS44201)**

**Cloud Computing Lab (ECS44203)**

**Information Retrieval Lab (ECS44205)**

**Computer Graphics Lab (ECS44207)**

**Artificial Neural Network and Deep Learning Lab (ECS44209)**

**PE IV (Theory):** **Cryptography & Cyber Security (ECS44111)**

**Internet of Things (IoT) (ECS44113)**

**5G Wireless Communication Network (ECS44115)**

**OE I (Theory): Artificial Intelligence (ECS43116)/ Computational Geometry (ECS43114)**

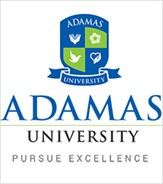
**OE II (Theory): Machine Learning (ECS44117)**

**OE III (Theory):Internet of Things (IoT) (ECS44113)**

**OE IV (Theory):** **Computer Graphics (ECS44121)**

**Credit Distribution**

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| --- | --- | --- | --- | --- |
| **Sl.**  **No.** | **Category** | **Breakup of Credits** | **AU Credit Distribution**  **%** | **AICTE**  **Credit Distribution**  **%** |
| 1. | **Humanities & Social Sciences Courses** | **08** | **08** | **07** |
| 2. | **Management + Economics + Commerce Courses** | **06** |
| 3. | **Basic Science Courses** | **29** | **17** | **16** |
| 4. | **Engineering Science Courses** | **27** | **15** | **15** |
| 5. | **Professional Core Courses** | **79** | **45** | **40** |
| 6. | **Professional Elective Courses** | **14** | **08** | **11** |
| 7. | **Open Elective Courses** | **12** | **07** | **11** |
| **Total Credits** | | **175** | **100** | **100** |



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**SoET 2.0**

**(Engineering +)**

**UG PROGRAM**

**Course Structure of**

**B.Tech in Computer Science & Engineering**

**Applicable for Academic Year: 2019-20**

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Adamas Knowledge City

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P.O-Jagannathpur, District-24Parganas(North)

Kolkata-700126

**Semester-I**

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| **Engineering Mathematics– I** | | **SMA41101** | **3-1-0** | **4 Credits** | |
| **Module 1:**  **Group Theory:** Review of concept of set theory, Binary operations, group, abelian group, subgroups, necessary and sufficient condition for a subset of group to be a subgroup, ring, field, examples.  **Sequences and Series:** Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.  **Vector Algebra:** Scalar and vector fields, Vector product, Scalar triple product and their  interpretation, directional derivative, gradient, Curl, divergence. | | | | | **[20]** |
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| **Module 2:**  **Differential Calculus (Functions of one Variable):**Limit, continuity, differentiability of functions of single variable, successive differentiation, Leibnitz’s theorem, Rolle’s Theorem, Cauchy’s mean value theorem, Taylor’s and Maclaurin’s theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature.  **Differential Calculus (Functions of several variables):**Limit, continuity, Differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, Euler s theorem on homogeneous functions, harmonic functions, maxima and minima of functions of several variables, Lagrange’s  method of multipliers. | | | | | **[16]** |
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| **Module 3:**  **Integral Calculus:** Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals, reduction formulae. Convergence of improper integrals, tests of convergence, Beta and Gamma functions, elementary properties, Differentiation under integral sign, differentiation of integrals with variable limits, Leibnitz rule. Rectification, double and triple integrals, computations of area, surfaces and volumes, change of variables in double  integrals, Jacobian’s of transformations, integrals dependent on parameters, applications | | | | | **[14]** |
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| **Module4:**  **Ordinary Differential Equations:** First order differential equations, exact, linear and Bernoulli’s form, second order differential equations with constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler’s equations, Cauchy-Legendre’s equation system of differential equations. | | | | | **[10]** |
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| **Text Books:** | |
| 1 | ErwynKreyszig : Advanced Engineering Mathematics, John Wiley and Sons |
| 2 | B.V. Ramana, Higher Engineering Mathematics Tata McGraw-Hill. |
| 3 | B.S.Grewal : Higher Engineering Mathematics, Khanna Publications |
| **Reference Books:** | |
| 1 | C B Gupta, S R Singh, Mukesh Kumar: Engineering Mathematics, McGraw Hill Publication. |
| 2 | R.K.Jain and S.R.K.Iyengar : Advanced Engineering Mathematics, Narosa Publishing  House, 2002 |

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| **Applied Physics** | | **SPH41109** | **3-0-0** | **3 Credits** | |
| **Module 1:Mechanics** !  **Interference of Light:** Interference due to division of wavefront and division of amplitude, Young’s double slit expt., Interference, Principle of Superposition, Interference from parallel thin films, wedge shaped films.    **Diffraction:** Single slit diffraction, Diffraction grating, dispersive power of Grating, resolving power of prism and grating.  **Polarization:** Introduction, production of plane polarized light by different methods, Brewster and Malus Laws. Double refraction, Nicol prism, specific rotation, | | | | | **[10]** |
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| **Module 2: Optics**  Laser: Introduction, temporal and spatial coherence, principle of Laser, stimulated and spontaneous emission, Einstein’s Coefficients, He-Ne Laser, Ruby Laser, Application of Lasers.    Fibre Optics: Introduction, numerical aperture, step index and graded index fibres, attenuation & dispersion mechanism in optical fibers (Qualitative only), application of optical fibres, optical communication (block diagram only) | | | | | **[5]** |
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| **Module 3: Electromagnetic Theory**  **Electromagnetic Theory (EMT):**  Motion of Charged Particles in crossed electric & magnetic fields, Velocity Selector & Magnetic focussing, Gauss law, continuity equation, inconsistency in Ampere’s Law, Maxwell’s equations (differential and integral forms), poynting vector, Poynting Theorem (Statement only), propagation of plane electromagnetic waves in conducting and non-conducting medium. | | | | | **[10]** |
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| **Module 4: Mechanics**  Central and non-central forces, Inverse square force, SHM, Damped, undamped and forced Oscillations (no derivations).  **Special theory of Relativity:**Frame of reference, basic postulates of special relativity, Lorentz transformations (space – time coordinates & velocity only), mass energy relation, length contraction, time dilation. | | | | | **[10]** |
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| **Module 5: Quantum Mechanics & Statistical Physics:**  De-Broglie Hypothesis, wave function and its properties, expectation value, Wave Packet, Uncertainity principle. Schrodinger Equation for free Particle, Time Dependent Schrodinger Equation, Particle in a box (1-D), Single step Barrier, Tunnelling effect.  Qualitative Features of Maxwell Bollzman, Bose-Einstein and Fermi-Dirac statistics distribution, functions & their comparison (no derivation). | | | | | **[10]** |
| **Module 5 :Solid State Physics**  Formation of energy bands in metals, semiconductors and insulators; intrinsic and extrinsic semiconductors, Fermi energy levels for doped, undoped semiconductors and pn junction; Tunnel diode, Zener diode.  **Superconductivity:** Meissner Effect, Type I and Type II Superconductors, BCS theory (Qualitative only), properties of superconductors & applications. | | | | | **[10]** |
| **Module 5: X-Rays**:  production and properties, Crystalline and Anorphous solids (Brief) Bragg’s Law, Applications.  **Ultrasonics:**Introduction, Production of Ultrasonics (Magentostriction and piezoelectric methods), engineering applications. | | | | | **[10]** |

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| **Text Books:** | |
| 1 | Arthur Beiser, S RaiChoudhury, ShobhitMahajan, (2009), Concept of Modern Physics, 6th Edition, Tata-McGraw Hill. |
| 2 | V. Rajendran, Engineering Physics, Tata McGraw Hill, 1st Edition, 2010 |
| **Reference Books:** | |
| 1 | Hitendra K Malik, A. K. Singh, Engineering Physics, McGraw Hill, 1st Edition, 2009 |
| 2 | A J Dekker, Solid State Physics, Mcmillan India Ltd, 1st Ed. 2009 |

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| **Chemistry** | **SCY41106** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Thermodynamics:** Zeroth law, definition of temperature, 1st law, concept of enthalpy, specific heat of gases, 2nd law and definition of entropy, free energy, chemical potential, spontaneity criteria of chemical reaction |
|  |
| **Module 2:**  **Reaction Kinetics, Catalysis & Electrochemistry:** Differential and integrated rate laws,order and molecularity of reactions, rate determining step, zero order, 1st order & 2nd order reaction, Arrhenius equation, theories of reaction rates, theories of catalysis, electrode potential, redox reaction, Nernst Equation. |
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| **Module 3:**  **Solid State and Molecular Spectroscopy:**. Unit cells, Bravias lattice, packing fraction of SCC, BCC and FCC, Van der waals bonding, hydrogen bonding, band theory, conductors, semiconductors and insulators. Basic concepts of spectroscopy, selection rule, fundamentals of IR, UV-Vis, NMR spectroscopy |
|  |
| **Module 4:**  **Co-Ordination Chemistry:** Transition elements, concept of complex, Warner’s co-ordination theory, structure of co-ordination compounds, co-ordination number, types of ligands, isomerism: geometrical, optical, ionization, linkage & co-ordination isomerism, Theories of bonding in co-ordination compounds :crystal field theory |
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| **Module 5:**  **Reactivity of Organic Molecules, Different Types of Organic Reactions and Stereochemistry:** Inductive effect, hyper conjugation, resonance, carbocation, carbanion & free radicals, substitution reactions, addition reactions, elimination reactions, and their mechanisms. Introduction to stereochemistry, stereochemical nomenclature & terminology (chiral carbons, allenes, biphenyls, etc.) and nomenclature (R/S, E/Z, D/L, d/l). Identification of stereo chemical relationship (enantiomers, diastereomers, epimers, etc.). |
|  |
| **Module 6:**  **Polymers& Fuel Chemistry:** Polymerization, addition and condensation polymerization, and their mechanism, classification of plastics, synthesis, properties & industrial applications of PVC, teflon, polyester and phenolic resin, conducting polymers & biopolymers. Solid Fuel: Coal, Different types of coal, coal analysis. Liquid fuel: petroleum, classification of petroleum, Thermal cracking and reforming, octane number, cetane number, bio‑diesel, aviation Fuel. Gaseous fuels: natural, producer, water and bio gas. |

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| **Text Books:** | |
| 1 | P. W. Atkins, Physical Chemistry, ELBS/Oxford, 7th Edition, 1995 |
| 2 | G.W.Castellan, Physical Chemistry |
| 3 | D. A. McQuarrie and J.D. Simon, Physical Chemistry - a molecular approach, Viva Books Pvt. Ltd. (1998) |
| 4 | P. C. Rakshit, Physical Chemistry, Sarat Book House (7thEdition) |
| 5 | Cotton, F A,Wikinson G. and Gaus, P L,Basic Inorganic Chemistry |
| 6 | J. D. Lee, Concise Inorganic Chemistry, 4th Edition, ELBS, 1991 |
| 7 | I.L. Finar,Organic Chemistry,Vol – I & II, Pearson Education |
| 8 | Morrison & Boyd, Organic Chemistry |
| 9 | P. Sykes, Mechanism in Organic Chemistry, Orient Longman |
| 10 | Joel R. Fried, Polymer Science and Technology, Pearson Education (2ndEdition) |
| 11 | S. Sarkar, Fuels and Combustion, Taylor & Francis (3rdEdition), 2009 |
| 12 | Kuriacose& Raja Ram ,Chemistry in Engineering and Technology, Vol.1 & 2 by, Tata McGraw Hill & Co |

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| **Introduction to Programming** | | **ECS41101** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Basics of C Programming :**Characters used in C, Identifiers, Keywords, Data type & sizes, Constants &Variables, Various Operators used such as Arithmetic Operators, Relational & Logical Operators, Increment & Decrement Operators, Assignment Operators, Conditional or Ternary Operators, Bitwise Operators & Expressions; Standard Input & Output, formatted input scanf( ), formatted output printf( ); Flow of Control, if-else, switch-case, Loop Control Statements, for loop, while loop, do-while loop, nested loop, break, continue, goto, label and exit(  ) function | | | | | **[10]** |
|  |  | | | | |
| **Module 2:**  **Functions and Pointers:** Definition of Function, Declaration or Prototype of Function, Various types of Functions, Call by Value, Call by Reference, Recursion, Tail Recursion, Definition of Pointer, Declaration of Pointer, Operators used in Pointer, Pointer Arithmetic, Functions with Pointer  **Introduction to Data Structures:** Basic Terminology, Elementary Data Organization, Algorithm,  Efficiency of an Algorithm, Time and Space Complexity, Asymptotic notations: Big-Oh, Time- Space trade-off. Abstract Data Types (ADT) | | | | | **[8]** |
|  | | | | | |
| **Module 3:**  **Arrays and String:** Definition, Single and Multidimensional Arrays, Representation of Arrays - Row Major Order, and Column Major Order, Application of arrays – searching and sorting, Sparse Matrices and their representations. Definition of a String, Declaration of a String, Initialization of a String, Various String Handling Functions with example  **Structures and Unions:** Definition of a Structure, Declaration of a Structure & Structure Variable, Initialization of a Structure, Operators used in Structure, Structure within Structures, Union, Difference between a Structure and an Union  **Files:** Types of File, File Processing, Handling Characters, Handling Integers, Random File  Accessing, Errors During File Processing | | | | | **[9]** |
|  | | | | | |
| **Module 4:**  **Stacks and Queues:** ADT Stack, Array Implementation Multiple Stacks, Applications of Stacks – Conversion from Infix to Postfix, Evaluation of Postfix Expressions, Prefix Notation, etc. ADT queue, Linear Queue, Circular Queue, Priority Queue, Array Implementations of Queues, Applications of Queues Operations on Queue: Create, Add, Delete, Full and Empty, Circular  queues, Array and linked implementation of queues in C, Dequeue and Priority Queue. | | | | | **[8]** |

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| **Module 5:**  **Linked lists:** Array Implementation and Dynamic Implementation of Singly Linked Lists, Doubly Linked List, Circularly Linked List, Operations on a Linked List. Insertion, Deletion, Traversal, Polynomial Representation and Addition, Generalized Linked List.  **Trees**: Basic terminology, Binary Trees, Binary Tree Representation: Array Representation and Dynamic Representation, Complete Binary Tree, Algebraic Expressions, Extended Binary Trees, Array and Linked Representation of Binary trees, Tree Traversal algorithms: Inorder, Pre-order and Postorder, Threaded Binary trees, Traversing Threaded Binary trees, Huffman algorithm.  **Graphs:** Terminology, Sequential and linked Representations of Graphs: Adjacency Matrices, Adjacency List, Adjacency Multi list, Graph Traversal : Depth First Search and Breadth First Search, Connected Component, Spanning Trees, Minimum Cost Spanning Trees: Prims and Kruskal algorithm. Transistive Closure and Shortest Path algorithm: Warshal Algorithm and  Dijikstra Algorithm, Introduction to Activity Networks. | **[10]** |
| |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | |  | **Electrical and Electronics Technology** | **EEE41102** | **3-0-0** | **3 Credits** | | | | **Module 1: Introduction to Electrical Engineering**  Sources of energy; General structure of electrical power systems; Steam power generation;  Hydel power generation; Gas and Nuclear power generation; Power Transmission and Distribution; overhead lines; underground cables; Transformers; Basic Principle and operation | | | | | [09] |  | |  | | | | | |  | | **Module 2: DC Networks**  Kirchoff’s laws; node voltage method; mesh current method; Delta-star and star-delta conversion; Network theorems; Superposition principle; Thevenin’s theorem; Norton’s theorem | | | | | [09] |  | |  | | | | | |  | | **Module 3: AC Circuits**  Definitions: average and effective values of Sinusoids; Solution of R,L,C series circuits; Significance of j operator; complex representation of impedances; Phasor diagram; power factor, power in complex notation; solution of parallel and series – parallel Circuits; Three phase EMF  generation; delta and Y – connections; line and phase quantities | | | | | [08] |  | |  | | | | | |  | | **Module 4: Basics of Semi-Conductors and PN Junction**  Introduction; Carrier Concentrations- the Fermi Level; Electron and Hole Concentration at Equilibrium; Temperature Dependence of Carrier Concentration; Drift and diffusion current; The Hall Effect; Optical Absorption, Luminescence; PN Junction Diode in Equilibrium Conditions; PN Junction Diode in Forward Biased and Reverse Biased Condition; Breakdown in PN Junction Diodes.  **Bipolar Junction Transistors**  Introduction, Types: NPN and PNP; Current Components; Early Effect Ebber’s Moll Model; Different Configurations of a Transistor and its Characteristics; Transistor as an Amplifier (CE, CB, CC); Transistor as a Switch Introduction, Types: NPN and PNP; Current Components; Early Effect Ebber’s Moll Model; Different Configurations of a Transistor and its Characteristics;  Transistor as an Amplifier (CE, CB, CC); Transistor as a Switch | | | | | [10] |  | |  | | | | | |  | | **Module 5: Field Effect Transistors**  Introduction; JFET and MOSFET; Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.); Realization of switching circuits using MOSFET  **Electronics Instruments & Digital Electronics Fundamental:**  Signal generator, Multimeter, operation of CRO and its application. Number systems, Conversions and codes, Logic gates and truth tables. | | | | | [09] |  | | |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **HSSM –I** | | **HEN41117** | **3-0-0** | **3 Credits** | | | **Module 1:**  Communication Level 1   * Basics of Communication * Means of Communication * Barriers of Communication | | | | | **[8]** | |  |  | | | | | | **Module 2:**  Grammar and Syntax Level 1   * Tense * Idioms * One Word Substitutes * Articles * Prepositions * Sentence-making * Voice Change * Synonyms and Antonyms | | | | | **[8]** | |  |  | | | | | | **Module 3:**  Reading and Listening Skills Level 1   * Active Listening * Types of Listening * Listening Exercises * Reading Exercises | | | | | **[11]** | |  |  | | | | | | **Module 4:**  Speaking Skills Level 1   * Introduction * Description * Narration * Extempore | | | | | **[10]** | |  |  | | | | | | **Module 5:**  Writing Skills Level 1   * Composition * Letter Writing—simple applications * Essay/ Paragraph writing (argumentative and descriptive) | | | | | **[8]** | | **Text Books:** | | | | | | | 1 | Spoken English and Functional Grammar. P. C. Das. | | | | | | 2 | Essential Grammar in Use. Raymond Murphy. | | | | | | **Reference Books:** | | | | | | | 1 | A Practical Course in English Pronunciation. J Sethi, KamleshSadanand and D.V. Jindal. | | | | | | 2 | English for Technical Communication. NP Sudarshana and C Savitha. | | | | | | | | | | |  |   **Text Books:** | |
| ―Fundamentals of Data Structures‖, Illustrated Edition by Ellis Horowitz, Sartaj Sahni and Computer  Science Press. | |
| **Reference Books:** | |
| ―Algorithms, Data Structures, and Problem Solving with C++‖, Illustrated Edition by Mark Allen Weiss,  Addison-Wesley Publishing Company | |
| ―How to Solve it by Computer‖, 2nd Impression by R. G. Dromey, Pearson Education | |

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| **Text Books:** | |
| 1 | Basic Electrical Engineering-AbhijitChakrabarti, SudipNath, Chandan Kumar Chnada, Tata McGraw-  Hill publishing Limited, New Delhi |
| 2 | Principles of Electrical Engineering and Electronics- V K Mehta, Rohit Mehta , S Chand and Company  , New Delhi |
| 3 | Solid State Electronic Devices- Ben G. Streetman and Sanjay Kumar Banerjee, PHI. |
| **Reference Books:** | |
| 1 | Basic Electrical Engineering-D P Kothari, I J Nagrath, Tata Mcgraw-Hill Publishing Company, New  Delhi |
| 2 | Integrated Electronics: Analog & Digital Circuit Systems – Jacob Millman&Halkias, TMH |
| 3 | Digital Principles & Applications, 8th Edition by Donald P Leach, Albert Paul Malvino, GoutamSaha  (Tata Mcgraw Hill Publishing Co Ltd, 2014) |

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| **HSSM –II (Engineering Ethics, Values and the Laws)** | | **HEN41119** | **3-0-0** | **3 Credits** | |
| **Module 1:Introduction to Human Values:**  Character, Integrity, Credibility, Mutual Respect, Dedication, Perseverance, Humility and Perception. Self-Assessment & Analysis, Setting Life Goals, Consciousness and Self- Transformation. Team Work, Conflict Resolution, Influencing and Winning People, Anger Management, Forgiveness and Peace, Morality, Conscience. Yoga and Spirituality | | | | | **[9]** |
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| **Module 2:Harmony and Life Long Learning:**  Harmony in human being, Nature and Existence. Harmony in family and society – Responsibilities towards society, Respecting teachers. Transition from School to College  - Freedom & Responsibilities, Respecting Cultural Diversity, Learning beyond the  Classrooms, Independent study and research | | | | | **[9]** |
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| **Module 3:Introduction to Professional Ethics:**  Work Ethics, Engineering Ethics, Moral Dilemma, Moral Development Theories, Ethical Theories- Kantinism, Utilitarianism, etc , Case Studies for Choice of the theory, Code of  Ethics | | | | | **[10]** |
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| **Module 4:Individual to Global Issues:**  Industrial Standards, A Balanced Outlook on Law, Safety, Responsibility, Rights, Confidentiality, Conflict of Interest, Occupational Crime, Whistle Blowing, Environmental Ethics, Business Conduct in MNC, E-Professionalism (IPR, Internet Ethics & Privacy issues) | | | | | **[9]** |
| **Text Books:** | | | | | |
| 1 | Shetty, Foundation Course in Human Values and Professional Ethics [R.R. Gaur, R.Sangal, G.P. Bagaria] | | | | |

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| **Life Sciences** | | **SBT41108** | **3-0-0** | **3 Credits** | |
| **Module 1: BASIC CELL BIOLOGY**  Introduction; Living Organisms; Cells and Cell theory, Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell metabolism; Cell growth, reproduction, and differentiation; Cell division, cell cycle and apoptosis; ATP synthesis and Glycolysis;  Respiration and photosynthesis. | | | | | **[08]** |
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| **Module 2: BIOCHEMISTRY AND TRANSPORT PROCESS**  Chemistry of life: chemical bonds; Non-covalent interactions and free energy changes in biological processes; Fundamentals of momentum, heat and mass transport as applied to biological systems; Human body as a thermodynamic system; Blood Rheology, Fluid mechanical aspects of some diseases and organs; Biochemistry and Human biology; Stem cells and Tissue  engineering. | | | | | **[08]** |
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| **Module 3: CHEMICAL BIOLOGY**  Carbohydrates; Lipids; Proteins: structure and sequencing; DNA: structure and sequence, replication, recombination; RNA synthesis; Genetic code and protein biosynthesis; Recombinant  DNA technology. | | | | | **[04]** |
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| **Module 4: ENZYMES AND INDUSTRIAL APPLICATIONS**  Enzymes: mechanism, kinetics and inhibition; Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases. | | | | | **[04]** |
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| **Module 5: FERMENTATION TECHNOLOGY AND APPLICATIONS**  Introduction and scope of microbial processes. Sources of industrial cultures and maintenance. Alcoholic fermentation: Production of Industrial Alcohol. Brewing and malting, manufacture of wine and other distilled liquors. Microbial Foods – Food, Fodder and Baker's yeast, applications of the nonconventional raw materials; Nutritional characteristics of food yeast, mushroom production; Vitamins- Vitamin B-2, Riboflavin, Soya-sauce & cheese production. Production of  acids, viz., citric, lactic and gluconic acid. Mechanism of each fermentation, their uses. Production | | | | | **[10]** |

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| of Amino acids and Antibiotics and its new Developments. Production of Organic Acids its  spoilage and prevention. |  |
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| **Module 6: MECHANOCHEMISTRY**  Molecular Machines/Motors; Cytoskeleton; Biosensors; Bio-Micro devices. | **[02]** |
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| **Module 7: HUMAN PHYSIOLOGY**  Physiology of cells and molecules; cellular physiology of the nervous system; cardiovascular and respiratory systems; gastrointestinal and renal systems; endocrine and reproductive systems.  **IMMUNE SYSTEM AND CELL SIGNALING**  Immune system; General principles of cell signalling. | **[07]** |
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| **Module 8: IMPACT OF BIOLOGY ON SOCIETY AND MANKIND**  Crop management, Disease control, Biological Hazards and safety; Unsolved Problems in Biology. | **[02]** |

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| **Text Books:** | |
| 1 | S. ThyagaRajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, Richard W. Thilagaraj, S.  Barathi, and M. K. Jaganathan, "Biology for Engineers," Tata McGraw-Hill, New Delhi, 2012. |
| 2 | Biology for Engineers. Arthur T. Johnson. 2010 by CRC Pres. ISBN 9781420077636 |

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| **Engineering Physics Lab** | **SPH41209** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Determination of Young’s Modulus of a Beam by travelling microscope by FLEXURE method.
2. Carry Foster’s Method to Determine Resistance of a Given Coil.
3. Determination of the Coefficient of viscosity of water by Poiseulle’s Capillary Flow method.
4. To determine the wavelength of sodium light by forming Newton’s Ring.
5. Determination of Rigidity Modulus by dynamical method.
6. Determine the **Plank’s constant** using photocell.
7. To verify **Stefan’s law** by electrical method.
8. To study the **temperature** dependence of **reverse saturation current** in a junction diode and hence to determine the **Band gap.**
9. Determination of **specific charge(e/m)** of electron by J.J. Thomson’s method.
10. Determination of the **Rydberg constant** by studying hydrogen or helium spectrum.
11. Determination of **dielectric constant** of a given dielectric material.
12. Determination of **Hall coefficient** of Semiconductor.
13. Study **current – voltage characteristic load response** of photovoltaic solar cells.

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| **Engineering Chemistry Lab** | **SCY41206** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Determination of total hardness of water by complexometric titration method
2. Determination of carbonate and bicarbonate in water
3. Estimation of iron by permanganometry
4. Estimation of ferrous ion in Mohr salt
5. Dissolved oxygen by Winkler's method
6. Measurement of the coefficient of viscosity
7. Measurement of the surface tension
8. Kinetics of ester hydrolysis
9. pH metric titration
10. Conductometric titration
11. Determination of standard EMF of a Daniel Cell
12. Verification of Beer Lambert's law
13. Partition coefficient of iodine
14. Identification of organic Compounds using melting point
15. Solubility, functional group test of organic compounds

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| **Introduction to Programming Lab** | **ECS41201** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Familiarization with LINUX commands and vi editor.
2. Programs to demonstrate Decision Making, Branching and Looping, Use of break and continue statement etc.
3. Implementation involving the use of Arrays with subscript, String operations and pointers.
4. Implementation involving the use Functions and Recursion.
5. Implementation involving the use Structures and Files.
6. Implementation based on Stack Queues and Linked List for example Insertion and Deletion.

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| **Electrical and Electronics Technology Lab** | **EEE41202** | **0-0-3** | **2 Credits** |

**Experiments(Electronics Part):**

1. Familiarization of bread board and electronics elements such as R, L, C, diode, and BJT etc.
2. Familiarization of Function generator and measuring instruments such as CRO and mustimeter.
3. Study the V-I characteristic of PN junction diode and find knee voltage.
4. Study the input and output characteristic of bipolar junction transistor (BJT):
   1. Common emitter (CE) configuration
5. Study the transfer and drain characteristic of junction field-effect transistor (JFET),hence determine the drain resistance, transconductance factor, amplification factor.
6. Study the transfer and drain characteristic of MOSFET,hence determine the drain resistance, transconductance factor, amplification factor.
7. Realization of digital logic circuit using MOSFET (AND, OR, NOT etc.).

**Experiments (Electrical Part):**

1. Characteristic of lamps
2. Calibration of wattmeter & ammeter
3. Study of R.L.C. circuit.
4. Characteristic of fluorescent lamp
5. Thevenin’s Theorem
6. Superposition Theorem
7. Maximum power transfer theorem
8. Norton's Theorem
9. Open circuit and short circuit test of single phase transformer.

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| **Engineering Drawing and CAD** | | **ECE41201** | **0-0-3** | **2 Credits** | |
| **Module 1**: Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute;  Scales – Plain, Diagonal and Vernier Scales; | | | | | **[9]** |
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| **Module 2**: Orthographic Projections covering, Principles of Orthographic Projections  Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; | | | | | **[9]** |
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| **Module 3**: Projections of Regular Solids covering, those inclined to both the Planes- Auxiliary  Views; | | | | | **[8]** |
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| **Module 4**:Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder,  Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; | | | | | **[9]** |
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| **Module 5**: Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids;  Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions; | | | | | **[10]** |
| **Text Books:** | | | | | |
| 1 | Bhat, N.D.& M. Panchal (2008), Engineering Drawing, Charotar Publishing House | | | | |
| 2 | Shah, M.B. & B.C. Rana (2008), Engineering Drawing and Computer Graphics, Pearson Education | | | | |
| **Reference Books:** | | | | | |
| 1 | Dhawan, R.K. (2007), A Text Book of Engineering Drawing, S. Chand Publications | | | | |
| 2 | Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers | | | | |

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| **Engineering Workshop** | **EME41204** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Pattern Making; pattern material, pattern allowances and types of patterns;
2. Mould making Practice:
3. Uses of moulding tools: green sand moulding, gating system, risering system, core making; Making a product using sheet metal;
4. Basic Forging processes like upsetting, drawing down and forge welding; Practicing Resistance Spot Welding, Arc Welding and Gas Welding;
5. Machining of products involving lathe (operations: Straight Turning, Taper Turning, Chamfering, Grooving and Thread cutting), milling/shaping operations and finishing process(es).

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| **Communication and Collaboration Skill -I** | | **EMC41201** | **0-0-2** | **1 Credit** | |
| **Module 1: Introduction and self-assessment**  The students are introduced to Emotional Intelligence and the need for it. Self evaluation / assessment happen through a peer-peer / group activity. | | | | | **[4]** |
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| **Module 2:Bollywood in action**  The groups will form a team to make a movie. They will roles of director, producer, editor, actors, stuntmen etc. They learn to team up and communicate. A jury will be elected by the students. Each movie will be played. The jury will select the “AdOSCARS” winners. The winners are  required to make the speech accepting the award. | | | | | **[12]** |
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| **Module 3:Pages 3A, 3B, 3C, 3D Magazine / news paper supplement and daily broadcasts**  3 to 4 groups will be formed who will publish a magazine selecting a specific theme. They will  take multiple roles in this game. Every class, the groups will do news broadcast on their chosen theme. Video recording will be done, with follow up discussion on body language, tone etc. | | | | | **[12]** |
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| **Text Books:** | |
| 1 | Stephen R Covey, Seven Habits of Highly Effective People, Free Press, 1989 |
| 2 | Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998 |
| 3 | Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972 |
| 4 | Daniel Coleman, Emotional Intelligence, Bantam Book, 2006 |
| 5 | Innovation and Entrepreneurship (1985) by Peter F. Drucker. |

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| **Engineering Mathematics– II** | | **SMA41102** | **3-1-0** | **4 Credits** | |
| **Module 1:**  Linear Algebra: Elementary row and column operations on a matrix, Rank, echelon form, normal form, Inverse of a matrix using elementary operations, solution of system of algebraic equation, consistency, Caley-Hamillton theorem, eigenvalues and eigenvectors, Symmetric and skew- symmetric matrices, orthogonal matrices, complex matrices, Hermitian and skew-Hermitian matrices, algebraic and geometric multiplicity, diagonalization, vector spaces, linear dependence  of vectors, basis, linear transformations. | | | | | **[12]** |
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| **Module 2:**  Vector Calculus: Ordinary Integrals of vectors, multiple integrals, Jacobian, Line, surface and volume integrals of Vector fields, Gauss’ divergence theorem, Green’s and Stokes Theorems and their applications.  Complex Variables: Limit, continuity, differentiability and analyticity of functions, Cauchy- Riemann equations, line integrals in complex plane, Cauchy s integral theorem, independence of path, existence of indefinite integral, Cauchy’s integral formula, derivatives of analytic functions,  Taylor’s series, Laurent’s series, zeros and singularities, Residue theorem, evaluation of real integrals. | | | | | **[16]** |
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| **Module 3:**  Fourier series:Periodic functions, Fourier series, Euler's formulae, Dirichlet conditions, Change of interval, Even and odd functions, half range Fourier Sine & Cosine series. | | | | | **[07]** |
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| **Module4:**  Fourier Transform: Definition of Fourier integrals, Fourier Sine & Cosine integrals, Complex form of Fourier integral, Fourier sine & cosine transforms, complex form of Fourier transform, Linearity, shifting & scaling properties, modulation theorem, inverse Fourier transform, Fourier  transform of derivatives and its applications. | | | | | **[10]** |
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**SEMESTER – II**

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| **Text Books:** | |
| 1 | ErwynKreyszig : Advanced Engineering Mathematics, John Wiley and Sons |
| 2 | B.V. Ramana, Higher Engineering Mathematics, Tata McGraw-Hill. |
| 3 | David C. Lay, Linear algebra and its application, (Latest edition), Pearson publication, New Delhi. |
| **Reference Books:** | |
| 4 | B.S.Grewal : Higher Engineering Mathematics, Khanna Publications |
| 5 | C B Gupta, S R Singh, Mukesh Kumar: Engineering Mathematics, McGraw Hill Publication |
| 6 | R.K.Jain and S.R.K.Iyengar : Advanced Engineering Mathematics, Narosa Publishing House, 2002 |

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| **Engineering Mechanics** | **EME41104** | **3-0-0** | **3 Credits** |

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| **Module 1** - **Introduction to Statics**  Concept of particle and Rigid body, Vector, Introduction to Vector Algebra, Addition and subtraction of Vectors and different laws, Lami’s theorem, Free Vector, Bound Vector, Representation of Vectors in terms of I, j and k, Cross product and Dot product and their  application, scalar. | **[10]** |
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| **Module 2** - **Force System**  Introduction, Force, Two-Dimensional Force system, Resolution of Force, Moment, Couple, Varignon’s Theorem, Resultant of Forces.  **Equilibrium**  Introduction, Equilibrium in Two-Dimension, Free body Concept and Diagram, Equation of Equilibrium. | **[09]** |
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| **Module 3 - Distributed Force**  Introduction, Center of Mass and Centroid, Centroid of Mass, Centroid of Line and Area (Triangle, Circular section, Quadrilateral, Composite Area etc.). | **[08]** |
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| **Module 4** – **Friction**  Introduction, Concept of Friction, Law of Coulomb Friction, Angle of Repose, Coefficient of | **[09]** |

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| Friction, Application of Friction in Machines. |  |
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| **Module 5** - **Moment of Inertia**  Mass Moment of Inertia of Symmetrical bodies, Area Moment of Inertia, Introduction, M.I of Plane figures w.r.t an axis on its plane, M.I of plane figures w.r.t an axis perpendicular to its plane, Parallel axis theorem.  **Virtual Work**  Introduction of Virtual work, Principal of Virtual work, Application of Principal of Virtual work. | **[09]** |
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| **Text Books:** | |
| 1 | Engineering Mechanics [Vol-I & II] by Meriam&Kraige, 5th ed. – Wiley India |
| 2 | Engineering Mechanics by S.S. Bhavikatti and K.G. Rajashekarappa – New Age International |
| 3 | Mechanics of Solids by Crandall,Dahl and Sivakumar-MC Graw Hill ,5th Edition 2015,New  Delhi |
| **Reference Books:** | |
| 1 | Engineering Mechanics: Statics & Dynamics by I.H.Shames, 4th ed. – PHI |
| 2 | Engineering Mechanics by Timoshenko , Young and Rao, Revised 4th ed. – TMH |

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| **HSSM - III** | **HEN41212** | **0-0-3** | **2 Credits** |

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| **Module 1:**  **Listening Skill:** Types of Listening, Barriers to Listening, Situational listening, Weather Report, New Report, Songs and Lyrics, Subtitling, Following a Conversation, Announcements, Aural Comprehension. | | **[10]** |
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| **Module 2:**  **Speaking:** Pronunciation, Phonetics (Vowel and Consonant sounds), Sounds of English, Problems in Pronunciation, Situational Dialogue, Role Plays, Introduction, Description,  Mother Tongue Influence. | | **[09]** |
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| **Module 3:**  **Non-verbal Communication**: Body Language, Paralinguistic Parameters, Inter-cultural  Communication, Posture, and Deportment. | | **[05]** |
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| **Module 4:**  **Group Discussion**: Strategies and Importance, Different roles of participants, GD etiquette, Phraseology and Vocabulary. | | **[04]** |
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| **Module 5:**  **Writing Skills**  Interview preparation, Interview etiquette, Preparing a CV, Preparing an application, Mock interviews, Interaction in formal situations. | | **[06]** |
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| **Text Books:** | |
| 1 | Business Communication Today. Bovee, Thill, Schwatzman, Pearson Education |
| **Reference Books:** | |
| 1 | Spoken and Written Communication. Board of Editors. Orient Blackswan |
| 2 | M. S Gupta. Current English Grammar and Usage. Prentice Hall India Learning Private Limited; 2016 |
| 3 | P. C. Das. Spoken English and Functional Grammar. |
| 4 | Sangeeta Sharma and Binod Mishra. Communication skills for Engineers and Scientists. Prentice Hall  India Learning Private Limited, 2009 |

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| **Communication and Collaboration Skill -II** | | **EMC41202** | **0-0-2** | **1 Credit** | |
| **Module 1: ADA-TEDx sessions**  Individuals will be chosen + volunteers who will do ADA-TEDX talks on chosen subject of interest – current affairs / latest trends / technology / engineering / specific company. Voting for the best speaker. Group will present why they liked a specific speaker. Students will learn  how to prepare, create impact and public speaking. | | | | | **[8]** |
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| **Module 2:Debate sessions**  The groups will be given debate topics. They will be required to prepare. Everyone gets to speak on the topic for / against. Audience gets to vote for winners. | | | | | **[12]** |
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| **Module 3:Drama or stand-up comedy sessions**  Drama / Stand-up comedy topics will be chosen by students, They can pick from any source – movies, books etc. Everyone in the groups must have a role to play/act. The audience gets to  vote for winners. | | | | | **[8]** |

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| **Text Books:** | |
| 1 | Stephen R Covey, Seven Habitsof Highly Effective People, Free Press, 1989 |
| 2 | Carnegie Dale, How to win Friends and Influence People, New York: Simon & Schuster, 1998 |
| 3 | Thomas A Harris, I am ok, You are ok, New York-Harper and Row, 1972 |
| 4 | Daniel Coleman, Emotional Intelligence, Bantam Book, 2006 |
| 5 | Innovation and Entrepreneurship (1985) by Peter F. Drucker. |

**Semester-III**

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| **HSSM –IV (Economics for Engineers)** | | HEC42180 | **3-0-0** | **3 Credits** | |
| **Module 1: Basic Concepts and Theories of Economics**   * Introduction to The Literature of Microeconomics centring around Decision Making at Individual Level * Some Fundamental Concepts: Maximization, Equilibrium, and Efficiency * The Theory of Consumer Choice and Demand * The Theory of Supply * Market Equilibrium * Market Structure * Market Failure and Environmental Issues * Game Theory * Concept of Yield and Theories of Term Structure * The Theory of Asset Pricing * Decision-Making under Uncertainty: Risk and Insurance | | | | | **[20]** |
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| **Module 2: Sustainability Study of a Project**   * Budget plan * Estimation of the project cost * Prices, fees and cost recovery * Financing of recurrent costs * Sustainability of the activities generated by the project | | | | | **[10]** |
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| **Module 3: Economic Feasibility Study**   * Problem of Pricing under Oligopoly * Problem of Market Stagnation * Problem of Volatility in Open Economy * Problem of Global Meltdown * Problem of Financing a Project | | | | | **[12]** |
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| **Module 4: Project Report**   * Facets of Project Viability – Commercial, Technical, Financial * Outline of a Model Project Report * A Real Life Case Study | | | | | **[03]** |

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| **References:** | |
| 1 | Engineering Economy, Leland Blank and Anthony Tarquin, McGraw-Hill, New York, 7th Edition |
| 2 | How to Make Cash Flow Projections, Tim Spilker, https://[www.tgci.com/sites/default/files/pdf/How%20to%20Make%20Cash%20Flow%20Projections\_](http://www.tgci.com/sites/default/files/pdf/How to Make Cash Flow Projections_)  0.pdf |
| 3 | Esty, Benjamin C., Modern Project Finance: A Casebook, John Wiley & Sons, Inc., (New York,  NY). 2003 |
| 4 | Gregory Mankiw, Principles of Economics, South-WesternCollege, 6th Edition |

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| **Probability Statistics and Numerical Methods** | **SMA42111** | **3-1-0** | **4 Credits** |

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| **Module 1:**  **Statistics:** definition, scope and limitation, presentation of data, diagrammatic and graphical representation of data, measures of central tendency, mean, median and mode, geometric and harmonic mean and their limitations, Measure of variations, Range, Quartile, Variance, Standard deviation, Skewness, moment and Kurtosis.  **Correlation and Regression:** Introduction to Correlation analysis, Karl Pearson correlation  coefficient, Rank Correlation, Regression Analysis, Fitting Straight Lines, Method of least square, regression coefficients, properties of regression coefficients and applications | | [16] |
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| **Module 2:**  **Probability:** Introduction, Probability of an event, additive rule & multiplication rule, conditional probability Bayes’ rule and applications.  **Probability Distributions:** Random variable, discrete and continuous probability distribution, Mathematical expectation, Variance of a random variable, Binomial, Hyper-geometric, Geometric, Poisson distribution, Uniform, Normal, Exponential Distribution.  **Test of hypothesis:** Introduction, type I and type II Error, one and two tailed test, test on a single mean when variance is known & variance is unknown. Test on two means, test on a single mean population and test on two populations, one and two sample test for variance, ** 2 -Test for  goodness of fit and test for independence. | | [18] |
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| **Module 3:**  **Numerical Methods:** Introduction, Concept of Errors, Bisection Method, False Position Method, Secant Method, Newton-Raphson Method, Successive Approximation Method, Discussion of Convergence, Interpolation and Extrapolation, Calculus of difference, Newton’s Forward Interpolation Formula and Backward Interpolation Formula, Lagrange’s method, Newton’s divided difference formula, Inverse Interpolation and its applications.  **Numerical differentiation and integration:** Differentiation formulae based on polynomial fit,  trapezoidal, Simpson’s and Gaussian quadrature formulae. | | [16] |
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| **Module 4:**  **Solution of simultaneous linear equations and ordinary differential equations:** Gauss elimination method, pivoting, ill conditioned equations, Gauss Seidel and Gauss Jacobi iterative methods, Taylor series and Euler methods, Modified Euler method, error analysis, Runge-Kutta method. | | [10] |

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| **Text Books:** | |
| 1 | S.C. Gupta and V K Kapoor; Fundamentals of Mathematical Statistics, S Chand & Sons |
| 2 | T. Veerarajan, T Ramachandran; Numerical Methods. |
| **Reference Books:** | |
| 1 | Manish Goyal; Numerical methods and Statistical Techniques using ‘C’, Laxmi Publications pvt. Ltd. |
| 2 | S Dey and S Gupta; Numerical Methods ,Tata McGraw-Hill Education, 2013 |
| 3 | B.S. Grewal; Numerical methods in engineering and science, 42 Edition*,* Khanna*Publishers.* |

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| **Engineering Science Course (Introduction to Python)** | **ECS42107** | **3-1-0** | **4 Credits** |

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| **Module 1:**  **Introduction to Python:** Introduction to Python, Python variables, expressions, statements, Variables, Keywords, Operators & operands, Expressions, Statements, Order of operations, String operations, Comments, Keyboard input, Example programs, Functions- Type conversion function, Math functions, Composition of functions, Defining own function, parameters, arguments, Importing functions, Example programs | | [12] |
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| **Module 2:**  **Conditions & Iterations: Conditions-** Modulus operator, Boolean expression, Logical operators, if, ifelse, if-elif-else, Nested conditions, Example programs,  **Iteration-** while, for, break, continue, Nested loop, Example programs | | [8] |
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| **Module 3:**  **Recursion, Strings, List, Dictionaries, Tuples: Recursion-** Python recursion, Examples of recursive functions, Recursion error, Advantages & disadvantages of recursion  **Strings-** Accessing values in string, Updating strings, Slicing strings, String methods – upper(), find(), lower(), capitalize(), count(), join(), len(), isalnum(), isalpha(), isdigit(), islower(), isnumeric(), isspace(), isupper() max(), min(), replace(), split(), Example programs  **List-** Introduction, Traversal, Operations, Slice, Methods, Delete element, Difference between lists and strings, Example program  **Dictionaries-** Introduction, Brief idea of dictionaries & lists  **Tuples-** Introduction, Brief idea of lists & tuples, Brief idea of dictionaries & tuples | | [13] |
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| **Module 4:**  **I/O & File:** Data Streams, Creating Your Own Data Streams, Access Modes, Writing Data to a File, Reading Data from a File, Additional File Methods, Using Pipes as Data Streams  **Classes & Objects:** Creating class, Instance objects, Accessing attributes, Built in class attributes, destroying objects, Inheritance, Method overriding, Overloading methods, Overloading operators, Data hiding, Example program | | [10] |
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| **Module 4:**  **Python Exceptions** Exception handling: assert statement, Except clause - with no exceptions and multiple exceptions, Try - finally, raising exceptions, user-defined exceptions. | | [2] |

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| **Text Books:** | |
| 1 | Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O„Reilly Publication |
| 2 | Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress |
| **Reference Books:** | |
| 1 | Beginning Programming with Python for Dummies Paperback – 2015 by John Paul Mueller |
| 2 | Python Programming - Using Problem Solving Approach, Reema Thareja, OXFORD UNIVERSITY PRESS |

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| **Switching Circuits and Logic Design (Prof Core-II)** | | **ECS42105** | **3-1-0** | **4 Credits** | |
| **Module 1:**  **Switching Circuits:**Logic families: TTL, nMOS, CMOS, dynamic CMOS and pass transistor logic (PTL) circuits, inverters and other logic gates, area, power and delay characteristics, concepts of fan-in, fan-out and noise margin. | | | | | **[5]** |
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| **Module 2:**  **Switching theory:** Switching algebra, logic gates, switching functions, truth tables and switching expressions, minimization of completely and incompletely specified switching functions, Karnaugh map and Quine-McCuskey method, multiple output minimization, representation and manipulation of functions using BDD's, two-level and multi-level logic circuit  synthesis. | | | | | **[10]** |
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| **Module 3:**  **Combinational logic circuits:** Realization of Boolean functions using NAND/NOR gates,  Decoders, multiplexers. logic design using ROMs, PLAs and FPGAs. Case studies, fault diagnosis of combinational circuits | | | | | **[5]** |
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| **Module 4:**  **Sequential circuits:** Clocks, flip-flops, latches, counters and shift registers, finite-state machine model, Mealy and Moore machines, synthesis of synchronous sequential circuits, Conversion of Mealy m/c to Moore m/c and vice-versa, minimization and state assignment, Incompletely  specified m/c’s, asynchronous sequential circuit synthesis | | | | | **[15]** |
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| **Module 5:**  **ASM charts:** Representation of sequential circuits using ASM charts, synthesis of output and next state functions, data path control path partition-based design | | | | | **[5]** |
| **Text Books:** | | | | | |
| 1 | H. Taub and D. Schilling, Digital Integrated Electronics, McGraw-Hill | | | | |
| 2 | Z. Kohavi, Switching and Finite Automata Theory, Tata McGraw-Hill | | | | |
| 3 | Randy H. Katz and Gaetano Borriello, Contemporary Logic Design, Prentice Hall of India. | | | | |
| **Reference Books:** | | | | | |
| 1 | Giovanni De Micheli, Synthesis and Optimization of Digital Circuits, Tata McGraw-Hill. | | | | |
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| **Formal Languages and Automata Theory (Prof Core-III)** | | **ECS42103** | **3-1-0** | **4 Credits** | |
| **Module 1:**  **Regular Languages and finite Automata:** Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages, Regular language, Regular expressions, Deterministic finite automata (DFA), Deterministic finite automata (DFA) and equivalence with regular expressions, NFA and equivalence with DFA, Regular grammars and equivalence with  finite automata | | | | | **[9]** |
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| **Module 2:**  **Context Free Grammar**  Properties of regular languages, Pumping lemma for regular languages, Problem solving using pumping lemma, Minimization of finite automata, Context-free grammars (CFG), Context-free language (CFL), Chomsky normal forms, Greibach normal forms | | | | | **[8]** |
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| **Module 3:**  **Pushdown Automata**  Nondeterministic pushdown automata (NPDA), NPDA and equivalence with CFG, Parse trees, Ambiguity in CFG, Pumping lemma for context-free languages, Deterministic pushdown  automata, Deterministic CFLs, Closure properties of CFLs. | | | | | **[8]** |
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| **Module 4:**  **Context Sensitive Grammar**  Context-sensitive grammars (CSG), Context-sensitive Languages, Linear bounded automata, Linear bounded automata and equivalence with CSG, The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) languages, Turing-decidable (recursive) languages, Closure properties of recursively enumerable and recursive languages, Context-  sensitive grammars (CSG) and Languages, Linear bounded automata | | | | | **[10]** |
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| **Module 5:**  **Turing Machine**  Linear bounded automata and equivalence with CSG, The basic model for Turing machines (TM), Turing-recognizable (recursively enumerable) languages  And Turing-decidable (recursive) languages, Closure properties of recursively enumerable and recursive languages, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, Unrestricted grammars and equivalence with Turing machines, Church-  Turing thesis, universal Turing machine, Rice's theorem, undecidable problems about languages. | | | | | **[10]** |
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| **Text Books:** | |
| 1 | “Introduction to the Theory of Computation”, 3rd Edition, Michael Sipser, Cengage Learning. |
| 2 | “Introduction to Automata Theory, Languages, and Computation”, 3rd Edition, John E. Hopcroft,  Rajeev Motwani and Jeffrey D. Ullman, Pearson Education. |
| **Reference Books:** | |
| 1 | “Introduction to Computability”, Illustrated Edition by Frederick C. Hennie, Addison-Wesley. |
| 2 | “The Theory of Computation”, EE Edition by Bernard M. Moret, Pearson Education Asia. |
| 3 | **“**Introduction to Languages and the Theory of Computation”, Illustrated Edition by John C.Martin, |
|  | Tata McGraw Hill. |
| 4 | “Automata and Computability, Undergraduate Texts in Computer Science”, 2002 Reprint Edition  by Dexter C. Kozen, Springer. |

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| **Data Structures and Algorithms** | | **ECS42101** | **3-1-0** | **4 Credits** | |
| **Module 1:**  **Introduction:** Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.  **Arrays:** Array Definition: 1D array and 2D array, Different array operations: Insertion, deletion, traversing etc.; Algorithms for various operations and Complexity Analysis,  **Searching:** Linear Search and Binary Search Techniques and their complexity analysis. | | | | | **[9]** |
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| **Module 2:**  **Stacks and Queues:** ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority  Queue; Operations on each types of Queues: Algorithms and their analysis. | | | | | **[9]** |
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| **Module 3:**  **Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, Doubly linked list: operations on it and algorithmic analysis; Circular  Linked Lists: all operations their algorithms and the complexity analysis. | | | | | **[9]** |
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| **Module 4:**  **Trees:** Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, algorithms and analysis.  **Graph:** Basic Terminologies and Representations, Graph search and traversal algorithms and  complexity analysis. | | | | | **[9]** |
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| **Module 5:**  **Sorting and Hashing**: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison  among all the methods, Hashing. | | | | | **[9]** |

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| **Text Books:** | |
| 1 | “Fundamentals of Data Structures”, Illustrated Edition by Ellis Horowitz, SartajSahni and Computer  Science Press. |
| 2 | “Introduction To Algorithms”, Thomas H.Cormen, Thomas H Cormen, Charles E Leiserson, Ronald  L Rivest, Clifford Stein . |
| **Reference Books:** | |
| “Algorithms, Data Structures, and Problem Solving with C++”, Illustrated Edition by Mark Allen Weiss,  Addison-Wesley Publishing Company | |
| “How to Solve it by Computer”, 2nd Impression by R. G. Dromey, Pearson Education | |

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| **Data Structures and Algorithms Lab** | **ECS42201** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Write a menu based C program to insert a node at the beginning, after a specified position, at the end of a singly linked list.
2. Write a menu based C program to delete a node from the beginning, from a specified position, from the end of a singly linked list.
3. Write a menu based C program to display the data part of the nodes in reverse order, reverse the list and sort the elements of a singly linked list.
4. Write a menu based C program to insert a node at the beginning, after a specified position, at the end of a doubly linked list.
5. Write a menu based C program to delete a node from the beginning, from a specified position, from the end of a doubly linked list.
6. Write a menu based C program to display the data part of the nodes in reverse order, reverse the list and sort the elements of a doubly linked list.
7. Write a menu based C program to insert, delete and display operation of a linear queue by using singly linked list.
8. Write a menu based C program to insert, delete and display operation of a linear queue by using an array.
9. Write a menu based C program to implement push, pop and display operation of a linear queue by using singly linked list.
10. Write a menu based C program to implement push, pop and display operation of a linear queue by using an array.
11. Write a menu based C program to implement insert, delete and display operation of a circular queue by using an array.
12. Write a menu based C program to implement insert, delete and traverse operation of a binary search tree using doubly linked list.
13. Write a menu based C program to implement linear search, binary search and interpolation search algorithm.
14. Write a menu based C program to implement bubble sort, selection sort, and quick sort, merge sort, insertion sort, heap sort and radix sort algorithm.
15. Implement Tree Traversals, BFS, Graph Traversal, Shortest path and some topics on Spanning Tree using C.

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| **Design Thinking for Engineers** | EMC42101 | **2-0-0** | **2 Credits** |

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| **Module 1:**  Why Design Thinking and The Design Process provides context and an introduction to key concepts, terminology, and structure for the course.  Scoping, The Design Brief and Visualization introduces ways to clarify the scope of a project  and its intent, questions to explore, target stakeholders, and establishes the importance of pictures and storytelling in the overall process | | **[6]** |
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| **Module 2:**  Fundamentals of Ethnography and Identifying Insights reviews how to observe users in their “natural habitat” and efficiently extract useful patterns from collected data.  Establishing Design Criteria and Brainstorming shows how to develop a succinct expression of the ideal end state of a project, and deliberately generate many fresh  alternatives to the status quo | | **[8]** |
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| **Module 3:**  Concept Development and The Napkin Pitch details how to choose the best ideas,  assemble them into detailed solutions, and rationally evaluate them, as well introduce a simple, consistent format for summarizing and communicating new concepts | | **[6]** |
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| **Module 4:**  Assumptions Testing and Prototyping introduces a tool for surfacing key assumptions  underlying the attractiveness of a new concept and using data to assess the likelihood that they are true, as well as ways to create visual manifestations of concepts | | **[5]** |
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| **Module 5:**  Co-Creation, Learning Launches, and “So What?” highlights ways to engage stakeholders in the development of new concepts, conduct experiments in the world quickly and inexpensively, and lead innovation in organizations. | | **[5]** |
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| **Text Books:** | |
| **1.** | Jeanne Liedtka, Tim Ogilvie, and Rachel Brozenske, The Designing for Growth Field  Book: A Step-by-Step Project Guide (Columbia University Press, 2014). |
| **2.** | Jeanne Liedtka and Tim Ogilvie Designing for Growth: A Design Thinking Tool Kit for Managers (Columbia University Press, 2011) |
| Reference: | |
| 1 | Human-Centered Design Toolkit (IDEO); https://[www.ideo.com/post/design-kit](http://www.ideo.com/post/design-kit) |
| 2 | Design Thinking Boot Camp Bootleg (Stanford D-School); https://dschool.stanford.edu/resources/the-bootcamp-bootleg |
| 3 | Design Thinking for Educators (IDEO); https://designthinkingforeducators.com/ |
| 4 | Collective Action Toolkit (frogdesign); https://[www.frogdesign.com/wpcontent/uploads/2016/03/CAT\_2.0\_English.pdf](http://www.frogdesign.com/wpcontent/uploads/2016/03/CAT_2.0_English.pdf) |

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| **Capstone Project A** | SET42403 | **0-0-2** | **1Credits** |

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| **Module 1:**  Introduction to Aerial Robotics: Unmanned Aerial Vehicles, Quadrotors, Key Components of Autonomous Flight, State Estimation, Applications, Basic Mechanics, Dynamics and 1-D Linear Control, Design Considerations, Agility and Maneuverability, Component Selection, Effects of Size, Supplementary Material: Introduction, Dynamical Systems, Rates of Convergence, Matlab Tutorials - Introduction to the Matlab Environment, Programming Basics, Advanced Tools | | **[10]** |
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| **Module 2:**  Introduction to EV &&INDIAN and GLOBAL Scenario: Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs & HEVs, Comparison of EV Vs IC Engine, Technology Scenario, Market Scenario, Policies and Regulations, Payback and commercial model, Payback and commercial model, Polices in India. | | **[10]** |
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| **Module 3:**  **Introduction to Smart Cities:** Definition, Dimensions of smart city, socio-economic aspect for smart city planning, framework for smart city- Technology framework, Institutional framework, Human framework, Energy framework, Data management framework, transformation of urban digital and physical fabric of cities, Performance, Initiatives. | | **[10]** |

**SEMESTER – IV**

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| **Operations Research** | | **ECS42110** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Linear Programming Problems (LPP):**Basic LPP and Applications; Various Components of LP Problem Formulation.  **Solution of Linear Programming Problems**:Solution of LPP: Using Simultaneous Equations and Graphical Method; Definitions: Feasible Solution, Basic and non-basic Variables, Basic Feasible Solution, Degenerate and Non-degenerate Solution, Convex set and explanation with examples. Solution of LPP by Simplex Method; Charnes’ Big-M Method; Duality Theory.  Transportation Problems and Assignment Problems. | | | | | **[17]** |
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| **Module 2:**  **Network Analysis**: Shortest Path: Floyd Algorithm; Maximal Flow Problem (Ford-Fulkerson); PERT-CPM (Cost Analysis, Crashing, Resource Allocation excluded).  **Inventory Control:** Introduction to EOQ Models of Deterministic and Probabilistic; Safety Stock; Buffer Stock. | | | | | **[09]** |
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| **Module 3:**  **Game Theory:**  Introduction; 2-Person Zero-sum Game; Saddle Point; Mini-Max and Maxi-Min Theorems (statement only) and problems; Games without Saddle Point; Graphical Method; Principle of  Dominance. | | | | | **[10]** |
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| **Module 4:**  **Queuing Theory:**  Introduction; Basic Definitions and Notations; Axiomatic Derivation of the Arrival & Departure  (Poisson Queue). Poisson Queue Models: (M/M/1): ( / FIFO) and (M/M/1: N / FIFO) and problems. | | | | | **[09]** |

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| **Text Books:** | |
| 1 | H. A. Taha, “Operations Research”, Pearson |
| 2 | P. M. Karak – “Linear Programming and Theory of Games”, ABS Publishing House |
| 3 | Ghosh and Chakraborty, “Linear Programming and Theory of Games”, Central Book Agency |
| 4 | Ravindran, Philips and Solberg - “Operations Research”, WILEY INDIA |
| **Reference Books:** | |
| 1 | KantiSwaroop — “Operations Research”, Sultan Chand & Sons |
| 2 | Rathindra P. Sen—“Operations Research: Algorithms and Applications”, PHI |
| 3 | R. Panneerselvam - “Operations Research”, PHI |
| 4 | A.M. Natarajan, P. Balasubramani and A. Tamilarasi - “Operations Research”, Pearson |

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| **Design & Analysis of Algorithm** | **ECS42112** | **3-1-0** | **4 Credits** |

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| **Module 1:**  **Introduction:** Characteristics of algorithm. Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence  relations: Substitution method, Recursion tree method and Masters’ theorem. | | **[8]** |
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| **Module 2:**  **Fundamental Algorithmic Strategies:** Brute-Force, Greedy, Dynamic Programming, Branch- and-Bound and Backtracking methodologies for the design of algorithms; Illustrations of these techniques for Problem-Solving. Heuristics – characteristics and their application domains, case  studies on real-life problems. | | **[10]** |
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| **Module 3:**  **Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree,  Topological sorting, Network Flow Algorithm, case studies on real-life problems. | | **[10]** |
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| **Module 4:**  **Tractable and Intractable Problems:** Computability of Algorithms, Computability classes –  P, NP, NP-complete and NP-hard. Cook’s theorem, Standard NP-complete problems and Reduction techniques. | | **[9]** |
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| **Module 5:**  **Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE, Case studies on real-life problems for selecting appropriate algorithms,  Case studies on real-life problems for selecting appropriate algorithms | | **[8]** |

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| **Text Books:** | |
| 1 | Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest  and Clifford Stein, MIT Press/McGraw-Hill. |
| 2 | Fundamentals of Algorithms – E. Horowitz et al. |
| **Reference Books:** | |
| 1 | Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson. |
| 2 | Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T  Goodrich and Roberto Tamassia, Wiley. |
| 3 | Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA. |

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| **Object Oriented Programming** | | ECS42114 | **3-0-0** | **3 Credits** | |
| Module 1:  **OOP concept**: Data abstraction, encapsulation, inheritance, polymorphism, classes and objects; Properties of OOP, Procedural and object oriented programming paradigms.  Introduction to Java, data types, variables, constants, scope and validity of variables, various operators, operator hierarchy, expressions, data type conversion and casting, enumerated types, control flow and scope of blocks, conditional statements, loops, break and continue statements, stand-alone java programs, arrays, console input-output, formatting output, constructors,  methods, parameter passing, static fields and methods, access control, this reference, method overloading and overriding, recursion, garbage collection, building and exploring string class. | | | | | **[9]** |
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| Module 2:  **Inheritance:** Inheritance hierarchy, sub and super classes, Member accessing rules, super keyword, preventing inheritance: using final classes and methods, the Object class and its methods.  **Polymorphism:** dynamic binding, method overriding, abstract classes and methods.  Interfaces: Interfaces and Abstract classes, definition and implementation of interfaces, accessing through interface references, extending interfaces.  **Inner classes:** uses of inner classes, Various inner classes: local inner class, anonymous inner class, static inner class.  **Packages:** Definition, Creation and Access of a Package, Understanding “classpath”, importing packages. | | | | | **[9]** |
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| Module 3:  **Exception handling**: errors/exceptions occur in OOP, Benefits of exception handling, the classification of exceptions- exception hierarchy, checked exceptions and unchecked exceptions; usage of try-catch block, throw, throws and finally, re-throwing exceptions, exception specification, built in exceptions, user defined exceptions.  **Multithreading:** multiple processes vs. multiple threads, states of a thread, creating threads, interrupting threads, thread priorities, thread synchronization, inter-thread communication,  producer-consumer pattern. | | | | | **[9]** |
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| Module 4:  **Collection Framework:** Introduction to Collections, Overview of Collection frame work, Generics, Basic Collection classes: Array List, Vector, Hash table  **Files:** streams- byte streams, character streams, text input/output, binary input/output, random access file operations, File management.  Connecting to Database: JDBC / ODBC connection | | | | | **[9]** |
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| Module 5:  **GUI Programming**: AWT class hierarchy, Fundamentals of Swing, Swing vs. AWT, Containers  - JFrame, JApplet; Overview of swing, Applications of swing, Layout management - Layout manager types - border, grid and flow.  **Event handling**: Events, Event sources, Event classes, Event Listeners, Relationship between Event sources and Listeners, Delegation of event model, handling of a button click, handling of mouse events, Adapter classes.  **Applets:** Basics, Inheritance hierarchy for applets, applets vs. applications, life cycle of an applet, passing parameters to applets, security issues. | | | | | [9] |

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| **Text Books:** | |
| 1 | “Java Fundamentals - A comprehensive Introduction”, Illustrated Edition by DaleSkrien, Herbert  Schildt, McGraw-Hill Education. |
| 2 | “Java for Programmers”, 2nd Edition by Paul Deitel and Harvey Deitel, Pearson Education. |
| **Reference Books:** | |
| 1 | “Thinking in Java”, Low Price Edition by Bruce Eckel, Pearson Education |

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| **Software Engineering** | | **ECS43101** | **3-0-0** | **3 Credits** | |
| **Module Introduction:**  Software - Evolving role of it, a crisis on the Horizon and its Myths, Software process models: linear sequential model, prototyping model, RAD model, Evolutionary model, Formal methods model, Component based development, Fourth generation techniques,  Software development and requirement analysis using Agile, Scrum framework. | | | | | **[9]** |
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| **Module 2:**  Management spectrum, people, problem, process, project and few Critical approach, **Software Process and project metrics:** Measure, Metrics and Indicators, Process and Project Domain related metrics, Software Measurement, Reconciling of Different, Metrics Approaches, Software quality metrics, Validation management, **Software project**  **planning:** Observations on estimation, Objectives of Project planning. | | | | | **[9]** |
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| **Module 3:**  Resources: Software project estimation, Empirical models for estimation, Automated estimation tools, Risk management and Software risks: Identification, Risk projection, safety risks and hazards; RMMM plans, Risk management. | | | | | **[8]** |
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| **Module 4:**  **Project scheduling and tracking:** Definition of task set and task network, Scheduling, Earned value analysis, Tracking of Errors, Project planning, **Software quality assurance:** Concepts of Software Quality, Quality movement, Review of software quality assurance, Software reliability, Software quality metrics (MTTF, MTTR, MTBF ETC.) | | | | | **[9]** |
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| **Module 5:**  S**oftware configuration management:** Object identification in software configuration, Configuring audit-SCM standards, **Analysis concepts and principles:** Requirement analysis, Software prototyping, Specification Review Analysis modeling, Data modeling ,Functional modeling, Behavioral modeling, **Software design, Software testing techniques:** White box and black box testing, Software testing strategies - Unit testing, Integrating testing, System testing.  **Agile Software Development Model:**  Agile Fundamentals, agile estimation and planning techniques, Scrum, compare Scrum to XP | | | | | **[10]** |
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| **Text Books:** | |
| 1 | Software Engineering: A practitioner's approach, 8th Edition, Roger S. Pressman, McGraw Hill |
| 2 | An integrated approach to Software Engineering, Springer/Narosa Edition, PankajJalote |
| **Reference Books:** | |
| 1 | Fundamentals of Software Engineering, 4th Edition, Rajib Mall, Prentice Hall, India |
| 2 | Fundamentals of Software Engineering, 4th Edition, Rajib Mall, Prentice Hall, India |

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| **Computer Architecture** | | **ECS43103** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Functional blocks of a computer:** CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU – registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Case study – instruction sets of some common CPUs.  **Data representation:** signed number representation, fixed and floating point representations, character representation. Computer arithmetic – integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication – shift-and-add, Booth multiplier, carry save  multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic. | | | | | **[12]** |
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| **Module 2:**  **Introduction** to x86 architecture.  **CPU control unit design:** hardwired and micro-programmed design approaches, Case study – design of a simple hypothetical CPU.  **Memory system design:** semiconductor memory technologies, memory organization. **Peripheral devices and their characteristics:** Input-output subsystems, I/O device interface, I/O transfers – program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes – role of interrupts in  process state transitions, I/O device interfaces – SCII, USB | | | | | **[10]** |
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| **Module 3:**  **Pipelining:** Basic concepts of pipelining, throughput and speedup, pipeline hazards. | | | | | **[08]** |
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| **Module 4:**  **Memory organization:** Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write  policies. | | | | | **[08]** |
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| **Module 5:**  **Parallel Processors:** Introduction to parallel processors, parallel computer models, principles of scalable performances, multiprocessors and multicomputer, message passing mechanism, scalable & Multithreaded dataflow architecture, Concurrent access to memory and cache  coherency and synchronisation techniques, GPU Processors. | | | | | **[07]** |
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| **Text Books:** | |
| 1 | “Computer Organization and Design: The Hardware/Software Interface”, 5th Edition by David A.  Patterson and John L. Hennessy, Elsevier. |
| 2 | “Computer Organization and Embedded Systems”, 6th Edition by CarlHamacher, McGraw Hill  Higher Education. |
| **Reference Books:** | |
| 1 | “Computer Architecture and Organization”, 3rd Edition by John P. Hayes, WCB/McGraw-Hill |
| 2 | “Computer Organization and Architecture: Designing for Performance”, 10th Edition by William  Stallings, Pearson Education. |
| 3 | “Computer System Design and Architecture”, 2nd Edition by Vincent P. Heuring and Harry F.  Jordan, Pearson Education |

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| **Numerical Techniques Lab** | **SMA42211** | **0-0-3** | **2 Credits** |

**Experiments:**

Write a C / MATLAB program to execute the following:

1. The root of non-linear equation using Bisection method.
2. The root of non-linear equation using false position method.
3. The root of non-linear equation using Newton Raphson method.
4. Solve a system of linear equation using gauss-elimination method.
5. Solve a system of linear equation using gauss-seidel method.
6. Interpolate values using Newton‘s forward Interpolation method.
7. Interpolate values using Newton‘s backward Interpolation method.
8. Interpolate values using Lagrange‘s interpolation method.
9. Evaluate the integral using Trapezoidal rule.
10. Evaluate the integral using Simpson‘s rules.
11. Solve an ordinary differential equation using Euler’s method.
12. Solve an ordinary differential equation using Modified Euler’s method.
13. Solve an ordinary differential equation using Runge- Kutta methods.

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| **Design & Analysis of Algorithm Lab** | **ECS42212** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Implementation based on Divide and Conquer: Binary Search using Divide and Conquer approach, Quick sort and Merge Sort
2. Implementation based on Dynamic Programming :Implement all pair of Shortest path for a graph ( Floyed-Warshall Algorithm ), Dijkstra’s , Bellman Ford Algorithm and Implement Traveling Salesman Problem
3. Implementation based on Branch and Bound :Implement 15 Puzzle Problem
4. Implementation based on Backtracking :Implement 8 Queen problem, Graph Coloring Problem, Hamiltonian Problem
5. Implementation based on Greedy method**:** Knapsack Problem and Job sequencing with deadlines, Minimum Cost Spanning Tree by Prim's Algorithm and Minimum Cost Spanning Tree by Kruskal's Algorithm
6. Implementation based on Graph Traversal Algorithm **:**Implement Breadth First Search (BFS) and Implement Depth First Search (DFS)

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| **Object Oriented Programming Lab** | ECS42214 | **0-0-3** | **2 Credits** |

**Experiments:**

1. Assignments based on class, constructor.
2. Assignments based on overloading.
3. Assignments based on inheritance, overriding.
4. Assignments based on wrapper class, arrays.
5. Assignments based on developing interfaces- multiple inheritances, extending interfaces
6. Assignments based on creating and accessing packages
7. Assignments based on multithreaded programming
8. Assignments based on applet programming

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| Interdisciplinary Project Work | SET42406 | **0-0-5** | **2 Credits** | |
| **Typical Progress Roadmap**   * After discussion with the Project Advisor(s), each student shall prepare an initial outline of their assigned project indicating the major sections of discussion, list the principal research sources for each section, and explain the overall objective of the project, including a justification of the interdisciplinary nature of the work. * Each student shall meet with the Project Advisor(s) regularly as per the weekly Time- Table. Other meetings may be scheduled at the discretion of the Project Advisor(s) at mutually agreed upon timings. * Typically, the progress will include a combination of industrial and academic mentoring , self study sessions, case studies, trend studies, presentation by students, interactive sessions, industrial visits etc.   Regular submission of progress reports shall be required of each student-group as notified through the Project Advisor(s) from time to time. | | | |  |

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| **Capstone Project B** | SET42404 | **0-0-3** | **2Credits** |

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| **Module 1:**  **Geometry and Mechanics:** Transformations, Rotations, Euler Angles, Axis/Angle Representations for Rotations, Angular Velocity, Rigid-Body Displacements, Properties of Functions, Symbolic Calculations in Matlab, The atan2 Function, Eigenvalues and Eigenvectors of Matrices, Quaternions, Matrix Derivative, Skew-Symmetric Matrices and the Hat Operator, Formulation, Newton-Euler Equations, Principal Axes and Principal Moments of Inertia, Quadrotor Equations of Motion, State-Space Form, Getting Started With the First Programming Assignment. | | **[10]** |
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| **Module 2:**  **EV System, Parameters and Propulsion:**  **EV Configuration:** Fixed & variable gearing, single & multiple motor drive, In-wheel drives, Weight, size, force, energy & performance parameters.  **Electric Motor:** Choice of electric propulsion system, block diagram of EV propulsion system, concept of EV Motors, single motor and multi-motor configurations, fixed & variable geared transmission, In-wheel motor configuration, classification of EV motors, Electric motors used in current vehicle applications, Recent EV Motors, Comparison of Electirc Motors for EV applications. **Required Power Electronics & Control:** Comparison of EV power devices, introduction to power electronics converter, four quadrant DC chopper, three-pase full bridge voltage-fed inverter, soft switching EV converters, comparison of hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter, Basics of Microcontroller & Control Strategies. | | **[10]** |
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| **Module 3:**  **Smart Urban Energy System:** Energy infrastructure layer, energy services layer, planning, maintenance, operations, Emerging Information and communication Technology (ICT), Innovation stages and innovation in energy technologies, Energy Innovation: from Shale gas to solar power, Role of regulation and policies in smart energy technologies. | | **[10]** |

**SEMESTER – V**

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| **Compiler Design** | | **ECS43105** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Introduction:** Phases of compilation and overview, Grouping of Phases  **Lexical Analysis:** Regular language, finite automata, regular expression, from regular expression to finite automata, scanner generator (lex, flex). | | | | | **[9]** |
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| **Module 2:**  **Parsing:** Context-free language and grammar, push-down automata, LL(1) grammar and top-  down parsing, operator grammar, LR(O), SLR(1), LR(1), LALR(1) grammars and bottom-up parsing, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison) | | | | | **[9]** |
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| **Module 3:**  **Semantic Analysis**: Attribute grammar, syntax directed definition, evaluation and flow of attribute in a syntax tree. Type systems.  **Symbol Table**: Its structure, symbol attributes and management | | | | | **[10]** |
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| **Module 4:**  **Run-time environment**: Procedure activation, parameter passing, value return, memory allocation, and scope.  **Intermediate Code Generation:** Translation of different language features, different types of  intermediate forms. | | | | | **[9]** |
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| **Module 5:**  **Code Improvement (optimization):** Analysis: control-flow, data-flow dependence etc.; Code improvement local optimization, global optimization, loop optimization, peep-hole optimization etc. Architecture dependent code improvement: instruction scheduling (for pipeline), loop optimization (for cache memory) etc.  Register allocation and target code generation. | | | | | **[8]** |

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| **Text Books:** |
| Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools, Addison-  Wesley. |
| **Reference Books:** |
| Michael L. Scott, Programming Language Pragmatics, Elsevier |
| Randy Allen and Ken Kennedy, Optimizing Compilers for Modern Architectures, Elsevier. |

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| **Database Management Systems** | | **ECS43107** | **3-0-0** | **3 Credits** | |
| **Module 1**  **Database system architecture:** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML).  **Data models:** Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.  **ER models:** Entity Set, Relation Ship Set, Cardinality Properties, Type of Entities, Type of  Keys, Aggregation, Specialization and Generalization. | | | | | **[8]** |
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| **Module 2:**  **Relational query languages:** Relational algebra, Fundamental Operations, Additional Operations. Select, Project, Cartesian Product, UNION, Set difference, Rename. Types of joining operations, Division, Intersection, Aggregate. Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE,  DB2, SQL server. | | | | | **[9]** |
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| **Module 3:**  **Relational database design:** Integrity Constraint, Domain Constrain, Referential Integrity, Functional Dependencies, Closure of Set, Cover and Canonical Cover, Types of Anomalies, Armstrong's axioms, Extended Armstrong's axioms, Assertions and Demons.  **Data Base Decomposition:** Domain and data dependency, Normal forms: 1NF, 2 NF, 3 NF,  BCNF, Dependency preservation, Lossless design. | | | | | **[10]** |
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| **Module 4:**  **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.  **Storage strategies:** Indices, B-trees, B+-trees, hashing, File System, Disk Organization,  Physical Storage, Buffer management. | | | | | **[9]** |
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| **Module 5:**  **Transaction processing:** Failure, Recovery from Failure, Different States of Transaction, Transaction Isolation, ACID property, Serializability of scheduling, Multi-version and optimistic Concurrency Control schemes.  **Concurrency control:** Locking and timestamp based schedulers, 2-Phase Locking Protocol, Dead Lock,  **Database Security:** Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.  **Advanced topics:** Distributed databases, Data warehousing and data mining. | | | | | **[9]** |
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| **Text Books:** | |
| 1 | “Database System Concepts”, 6th Edition by Abraham Silberschatz, Henry F. Korth, S. Sudarshan,  McGraw-Hill |
| 2 | “Principles of Database and Knowledge – Base Systems”, Vol 1 by J. D. Ullman, Computer  Science Press. |
| **Reference Books:** | |
| 1 | “Fundamentals of Database Systems”, 5th Edition by R. Elmasri and S. Navathe, Pearson Education |

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| **Operating Systems** | **ECS43102** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Introduction:** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and  WINDOWS Operating System. | **[8]** |
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| **Module 2:**  **Processes:** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching.  **Thread:** Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads,  **Process Scheduling**: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor  scheduling: Types and performance evaluation. | **[12]** |
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| **Module 3:**  **Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Strict Alternation , Peterson’s Solution, The Producer Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader’s  &Writer Problem, Dinning Philosopher Problem etc. | **[4]** |
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| **Module 4: Deadlocks:**  **Deadlocks:** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, and Deadlock Avoidance: banker’s algorithm, Deadlock detection and Recovery. | **[7]** |
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| **Module 5:**  **Memory Management:** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition – Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging.  **Virtual Memory:** Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used  (NRU)and Least Recently used (LRU). | **[8]** |
| **Module6:**  **I/O Hardware:** I/O devices, Device controllers, Direct memory access Principles of I/OSoftware: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms  **File Management:** Concept of File, Access methods, File types, File operation, Directory | **[6]** |

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| structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list,  hashtable),efficiency and performance. |  |

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| **Text Books:** | |
| 1 | Operating System Concepts Essentials, 9th Edition by Avi Silberschatz, Peter Galvin, Greg Gagne,  Wiley Asia Student Edition. |
| 2 | Operating Systems: Internals and Design Principles, 5th Edition, William Stallings, Prentice Hall  of India. |
| **Reference Books:** | |
| 1 | Operating System: A Design-oriented Approach, 1st Edition by Charles Crowley, Irwin  Publishing. |
| 2 | Operating Systems: A Modern Perspective, 2nd Edition by Gary J. Nutt, Addison-Wesley. |
| 3 | Design of the Unix Operating Systems, 8th Edition by Maurice Bach, Prentice-Hall of India. |
| 4 | Understanding the Linux Kernel, 3rd Edition, Daniel P. Bovet, Marco Cesati, O'Reilly and  Associates. |

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| **Applied Graph Theory** | | **ECS43111** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Basics:** Graph – definition; Degree sequences, Different distance measures in graphs, Special types of graphs – complete graph, regular graph, bipartite graph and their properties. | | | | | **[8]** |
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| **Module 2:**  **Structure and Symmetry:** Cut vertices, bridges and blocks, auto-morphism groups, reconstruction problem  **Trees and Connectivity:** Properties of trees, Arboricity, vertex and edge connectivity, Mengers  theorem | | | | | **[9]** |
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| **Module 3:**  **Eulerian and Hamiltonian Graphs:** Characterization of Eulerian graphs, Sufficient Conditions for Hamiltonian graphs.  **Colouring and Planar Graphs:** Vertex and edge colouring, perfect graphs, planar  graphs, Euler's theorem, Kuratowski's theorem, Colouring of planar graphs, Crossing number and thickness. | | | | | **[10]** |
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| **Module 4:**  **Query processing and optimization:** Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.  **Storage strategies:** Indices, B-trees, B+-trees, hashing, File System, Disk Organization,  Physical Storage, Buffer management. | | | | | **[9]** |
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| **Module 5:**  Matching, factors, decomposition and domination  **External Graph Theory:** Turan's theorem, Ramsay's theorem, Szemeredi's regularity lemma and their applications. | | | | | **[9]** |

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| **Text Books:** | |
| 1 | “Graph Theory”, J. A. Bondy and U. S. R. Murthy, SringerVerlag, 2008. |
| 2 | “Introduction to Graph Theory”, D. B. West, PHI, 2004. |
| **Reference Books:** | |
| 1 | “Graph Theory”, R. Diestel, SringerVerlag, 2003. |

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| **Communication Network** | | **ECS43113** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **Introduction to computer communication**  Transmission modes - serial and parallel transmission, asynchronous, synchronous, simplex, half duplex, full duplex communication. Switching: circuit switching and packet switching Networks: Network criteria, physical structures, network models, categories of networks, Interconnection of Networks: Internetwork  Network models: Layered tasks, OSI model, Layers in OSI model, TCP/IP protocol suite | | | | | **[6]** |
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| **Module 2:**  **Physical and Data link Layers**  Physical Layer: Guided and unguided transmission media (Co-axial cable, UTP,STP, Fiber optic cable)  Data Link Layer: Framing, Flow control (stop and wait , sliding window flow control)  Error control, Error detection( check sum, CRC), Bit stuffing, HDLC ; Media access control: Ethernet (802.3), CSMA/CD, Logical link control, Wireless LAN (802.11), CSMA/CA | | | | | **[10]** |
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| **Module 3:**  Network Layer Logical addressing : IPv4 & IPV6; Address Resolution protocols (ARP, RARP),Subnetting, Classless Routing(CIDR), ICMP, IGMP, DHCP, Virtual LAN, Networking devices ( Hubs, Bridges & Switches); Routing: Routing and Forwarding, Static routing and Dynamic routing ;  Routing Algorithms: Distance vector routing algorithm, Link state routing (Dijkstra’s algorithm)  Routing Protocols: Routing Information protocol (RIP), Open Shortest Path First (OSPF), Border Gateway Protocol (BGP), MPLS | | | | | **[14]** |
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| **Module 4:**  Transport Layer –UDP, TCP ; Congestion Control & Quality of Service – Data traffic, Congestion, Congestion Control, QoS and Flow Characteristics  Application Layer – DNS, Remote Logging (Telnet), SMTP, FTP, WWW, HTTP, POP3,  MIME, SNMP | | | | | **[9]** |
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| **Module 5:**  **Security in Computer Communication**  Introduction to information system security, common attacks  Security at Application Layer (E-MAIL, PGP and S/MIME). Security at Transport Layer (SSL and TLS).  Security at Network Layer (IPSec).  Defense and counter measures: Firewalls and their types. DMZ,Limitations of firewalls, Intrusion Detection Systems -Host based,  Network based, and Hybrid IDSs | | | | | **[6]** |
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| **Text Books:** | |
| 1 | Data Communications and Networking- Behrouz A. Forouzan-McGraw-Hill 2007, fourth  Edition |
| 2 | Computer Networking -Top Down Approach- James F. Kurose and Keith W. Ross--  Pearson 2013, sixth Edition |
| **Reference Books:** | |
| 1 | Larry Peterson and Bruce S Davie: Computer Network- A System Approach, 4/e, Elsevier  India, 2011 |
| 2 | AchyutS.Godbole, Data Communication and Networking, 2e, McGraw Hill Education  New Delhi, 2011 |

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| **Big Data Analytics** | | **ECS43115** | **3-0-0** | **3 Credits** | |
| **Module 1:**  **INTRODUCTION TO BIG DATA**  Big Data Definition, Characteristic Features, Structure, Applications - Big Data vs Traditional Data - Risks of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs  Reporting - Modern Data Analytic Tools. | | | | | **[09]** |
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| **Module 2:**  **HADOOP FRAMEWORK**  Distributed File Systems - Transparencies - Large-Scale File System Organization – **Master**- Slave/**Master**-Worker Architecture– HDFS concepts – MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN. | | | | | **[09]** |
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| **Module 3:**  **DATA ANALYSIS**  Statistical Methods: Regression modelling, Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Predictive Analytics – Data  analysis using R. | | | | | **[10]** |
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| **Module 4:**  **MINING DATA STREAMS**  Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and  Mining Time-Series data - Real Time Analytics Platform (RTAP) Applications - Real Time Sentiment Analysis, OLAP, Data warehousing concepts. | | | | | **[08]** |
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| **Module 5:**  Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations –  .Cassandra: Data Model – Hadoop Integration. Pig Models developing and testing Pig Latin scripts. Hive Data Types and File Formats – HiveQL Data Definition – HiveQL Data  Manipulation – HiveQL Queries. | | | | | **[09]** |

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| **Text Books:** | |
| 1 | Michael Berthold, David J. Hand, ―Intelligent Data Analysis, Springer, Second Edition, 2007 |
| 2 | P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012. |
| **Reference Books:** | |
| 1 | David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013. |
| 2 | Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with  Advanced Analyticsǁ, Wiley and SAS Business Series, 2012. |

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| **Compiler Design Lab** | **ECS43205** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Implement lexical analyser using JLex, flex or other lexical analyzer generating tools. Practice of Lex/Yacc of Compiler writing.
2. Implement syntax analysis using context free grammar, Pushdown automata.
3. Demonstrate different types of parsing technique for example LL (1), LALR, operator precedence parsing and recursive descent parsing.
4. Implementation of program semantic rules to generate syntax tree
5. Implementation of program semantic rules to calculate the value of expression that takes an expression with digits, + and \*.
6. Generation of machine code from abstract syntax tree generated by the parser.

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| **Database Management Systems Lab** | **ECS43207** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Familiarization of structured query language.
2. Table Creation.
3. Insertion, Updation, Deletion of tuples.
4. Executing different queries based on different functions.
5. Performing joining operations.
6. Nested Queries.
7. Use of aggregate functions.
8. Use of group functions.
9. Use of order by functions.
10. Arithmetic operations.
11. Trigger using SQL.
12. Introduction to PL/SQL.
13. Report generation of various queries.
14. Merging Data Bases with front end using ODBC connection.
15. SQL Injection on a non-harmful test page.

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| **Operating Systems Lab** | **ECS43202** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Introduction to Linux Operating System, Interfaces, X-Window System, Structure of Linux Operating System.
2. Various Commands in Linux – i) Basic Commands, ii) System Administrative Commands.
3. Introduction to Linux SHELL, Various versions of Linux Shell.
4. Shell Scripting – 1 – Basic Constructs - i) Input/Output, ii) Variables, Constants, iii) System Variables, iv) Basic Programs
5. Shell Scripting – 2 – i) Conditional Structure, ii) Iterative Structure, iii) Practicing Problems.
6. Shell Scripting – 3 – Array in Shell Scripting
7. Shell Scripting – 4 – File Handling through Shell Scripting
8. Shell Scripting – 5 – Creating Commands through Shell Scripting
9. System Programming – 1 – i) System Call, ii) Process Creation and Manipulation
10. System Programming – 2 – Inter Process Communication – i) Basic Communication Through Message Passing, Shared Memory, ii) Implementation of Semaphores

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| **Venture Ideation** | |  | **0-0-2** | **1 Credit** | |
| **Module 1:**  **Introduction**  Preview of the Course, Introduction to the Course, Guest Lecture with U.S. Secretary of Commerce Penny Pritzker – Meaning of Innovation, Entrepreneurial opportunities, Factors influencing the feasibility of an innovation, Innovation strategy: technology-push or market-pull,  Product-market fit, How to develop a business model, Walkthrough of the business model canvas, Welcome to Innovation for Entrepreneurs: From Idea to Marketplace. | | | | | **[6]** |
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| **Module 2:**  **Customer Discovery and Validation**  Customer types, Customer archetypes, Customer segments and business models, Customer  segments, value propositions, product features, value mapping, interviewing customer, insights of your customers. | | | | | **[6]** |
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| **Module 3:**  **Product Understanding and Marketing.**  Customer value, The DNA of customer-centricity, Crossing the chasm, Qualitative and quantitative marketing research, importance and methods of market segmentation, Focusing on the target market, Beyond the chasm, Strategic implications of beyond the chasm, E-commerce: The  internet as a selling platform. | | **[6]** |
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| **Module 4:**  **Prototyping and Testing.**  Planning for prototyping, Rapid prototyping and development, Lean startup MVPs, Choosing a wire framing/UX prototyping tool, Anatomy of an experience map, What you'll learn from user testing, Analytics and insight, Troubleshooting your customer discovery, Levels of a product/service. | | **[6]** |

**SEMESTER – V**

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| **Computer Networks** | | **ECS43104** | **3-0-0** | **3 Credits** | |
| **Module 1: Computer Networks and the Internet**  What Is the Internet?, Network Edge, Network Core, Delay, Loss, and Throughput in Packet- Switched Networks, Protocol Layers and Their Service Models, Networks Under Attack | | | | | **[05]** |
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| **Module 2:Application Layer**  Principles of Network Applications, Web and HTTP, Electronic mail in Internet, DNS—The Internet’s Directory Service, Peer-to-Peer Applications, | | | | | **[08]** |
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| **Module 3:Transport Layer**  Introduction and Transport-Layer Services, Multiplexing and De-multiplexing, Connectionless Transport: UDP, Connection-Oriented Transport: TCP, Principles of Congestion Control, TCP  Congestion Control | | | | | **[09]** |
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| **Module 4: Network Layer**  Introduction, Virtual Circuit and Datagram Networks, Internet Protocol (IP): Forwarding and  Addressing in the Internet, Routing Algorithms, Routing in the Internet, Routing in the Internet, Broadcast and Multicast Routing | | | | | **[09]** |
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| **Module 5: Link Layer**  Introduction to the Link Layer, Error-Detection and -Correction Techniques, Multiple Access Links and Protocols, Switched Local Area Networks, Link Virtualization. | | | | | **[09]** |
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| **Module 6: Security in Computer Networks**  What Is Network Security? Principles of Cryptography | | | | | **[03]** |
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| **Module 7: Network Management**  What Is Network Management? Internet-Standard Management Framework | | | | | **[02]** |

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| **Text Books:** | |
| 1 | Computer Networking -Top Down Approach- James F. Kurose and Keith W. Ross-- Pearson 2013, sixth Edition |
| 2 | Data Communications and Networking- Behrouz A. Forouzan-McGraw-Hill 2007, fourth  Edition |
| **Reference Books:** | |
| 1 | Data Networks- DimitriBertsekas and Robert Gallager- Prentice Hall, 1992 |
| 2 | Computer Networks (5th Edition) – Andrew S. Tanenbaum, Pearson 2011 |

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| **Artificial Intelligence and Machine Learning** | **ECS43106** | **3-0-0** | **3 Credits** |

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| **Artificial Intelligence**  **Module 1:**  Introduction, Agents, Problem formulation, Uninformed search strategies, Heuristics, Informed search strategies, Satisfying constraints  Logical agents, Propositional logic, Inference rules, First-order logic, Inferences in first order  logic | | [10] |
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| **Module 2:**  Planning with state-space search, Partial-order planning, Planning graphs, Planning and acting in the real worldForward and backward chaining, Unification, Resolution | | [8] |
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| **Machine Learning**  **Module 3:**  **Introduction:** Overview of machine learning, related areas, applications, software tools, course objectives.  **Regression:** Linear Regression, Polynomial Regression, Gradient Descent, Logistic  Regression, Case Study on Logistic Regression | | [9] |
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| **Module 4:**  **Neural networks**: the perceptron algorithm, various activation functions and their differentiability, multilayer perceptrons, back-propagation, nonlinear regression, multiclass discrimination, training procedures, Case Study  Bayesian Learning, Decision Tree | | [9] |
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| **Module 5:**  **Support vector machines**: Functional and geometric margins, optimum margin classifier, constrained optimization, Lagrange multipliers, KKT conditions, soft margins, kernels.  **Dimensionality Reduction:** Feature Selection, Principle Component Analysis (PCA). | | [9] |
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| **Text Books:** | |
| 1 | Artificial Intelligence – A Modern Approach, Second Edition, S. Russel and P. Norvig Pearson  Education, 2003. |
| 2 | Artificial Intelligence, Ritch& Knight, TMH |
| 3 | “Machine Learning”, 1st Edition, Tom M. Mitchell, McGraw-Hill Series In Computer Science |
| 4 | “Neural Networks andLearning Machines”, 3rd Edition, Simon O. Haykin, Prentice Hall |
| 5 | “Introduction to Machine Learning”, 2nd Edition, EthemAlpaydın, The MIT Press |
| **Reference Books:** | |
| 1 | Artificial Intelligence; Structures for Complex Problem Solving, Fourth edition, G. Lugar, Pearson Education, 2002 |
| 2 | Artificial Intelligence: A New Synthesis, Nils J. Nilsson, Morgan Kaufmann Publishing, Inc., Year  1998 |
| 3 | “INTRODUCTIONTOMACHINE LEARNING”, 2005 Edition, Nils J Nillsson, Morgan  Kaufmann |
| 4 | “Foundations of Machine Learning”, 2012 Edition, MehryarMohri, AfshinRostamezadeh,  AmeetTalwalkar, The MIT Press |
| 5 | “Python Data Science HandbookEssential Tools for Working with Data”, 1st Edition, Jake  VanderPlas, O’Reilly |

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| **High Performance Computer Architecture** | **ECS43110** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Introduction:** Review of basic computer architecture, Quantitative techniques in Computer design, measuring and reporting performance. CISC and RISC processors. | | **[5]** |
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| **Module 2:**  **Pipelining:** Basic concepts, instruction and arithmetic pipeline, data hazards, control hazards, and structural hazards, techniques for handling hazards. Exception handling. Pipeline optimization techniques. Compiler techniques for improving performance. Hierarchical memory technology: Inclusion, Locality properties; Cache memory organizations, Techniques for reducing cache misses; Virtual memory organization, Mapping and management  techniques, Memory replacement policies. | | **[10]** |
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| **Module 3:**  **Instruction-level parallelism:** Basic Concepts, Techniques for increasing ILP, Dynamic scheduling (Tomasulo's Algorithm), Reorder buffer and instruction commit, Branch prediction and advanced instruction delivery, Speculative execution. Superscalar, Super pipelined and  VLIW processor architectures. Array and vector processors. | | **[12]** |
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| **Module 4:**  **Multiprocessor architecture:** Taxonomy of parallel architectures. Centralized shared memory Architecture. Synchronization, Memory consistency, Interconnection networks. Distributed | | **[10]** |

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| shared memory architecture. Model of memory consistency, Cache coherency, Multiprocessing  snooping protocol, Multiprocessing directory protocol. Cluster computers. |
| **Module 5:**  **Non von Neumann architectures:** Data flow computers, Reduction computer Architectures, Systolic architectures. Multicore Architectures. |

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| **Text Books:** | |
| 1 | “Computer Architecture: A Quantitative Approach”, John L. Hennessy and David A. Patterson,  Morgan Kaufmann. |
| 2 | “Modern Processor Design: Fundamentals of Superscalar Processors”, John Paul Shen and Mikko  H. Lipasti, Tata McGraw-Hill. |
| **Reference Books:** | |
| 1 | “Computer Architecture: Pipelined and Parallel Processor Design”, M. J. Flynn, Narosa  Publishing. |
| 2 | “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, Kai Hwang,  McGraw-Hill. |

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| **Pattern Recognition** | **ECS43112** | **3-0-0** | **3 Credits** |

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| **Module 1**  **Introduction:** Paradigms for pattern recognition, Statistical and Syntactic pattern  Recognition, Soft and Hard computing schemes for pattern recognition. Statistical Pattern Recognition: Patterns and classes, Supervised, Semi-supervised, and Unsupervised classification. | | **[6]** |
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| **Module 2:**  **Representation:** Vector space representation of patterns and classes, patterns and  Classes as strings, Tree-based representations, Frequent item sets for representing classes and clusters, Patterns and classes as logical formulas. | | **[8]** |
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| **Module 3:**  **Proximity Measures:** Dissimilarity measures, metrics, similarity measures, Edit  Distance, Hausdorff metric between point sets, Kernel functions, Contextual and conceptual similarity between points. | | **[8]** |
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| **Module 4:**  **Dimensionality Reduction:** Feature selection: Branch and bound, Sequential feature election, Feature extraction: Fisher's linear discriminant, Principal components as features; Nearest Neighbour Classifiers: Nearest neighbour classifier, Soft nearest neighbour classifiers, Efficient algorithms for nearest neighbour classification, K-Nearest Neighbour classifier, minimal  distance classifier, condensed nearest neighbour classifier and its modifications. | | **[10]** |
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| **Module 5:**  **Bayes Classifier:** Bayes classifier, naïve Bayes classifier, Bayesian Network, Belief network, Decision Trees Axis parallel and oblique decision trees, Learning decision trees, Information gain and Impurity measures.  **Linear Discriminant Functions**: Characterization of the decision boundary,  Weight vector and bias, Learning the discriminant function, Perceptron’s; Support Vector Machines Maximizing the margin, Training support vector machines, Kernel functions. | | **[8]** |
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| **Module 6:**  **Clustering:** Clustering process, Clustering algorithms, and Clustering large datasets.  **Combination of Classifiers:** AdaBoost for classification, Combination of Homogeneous classifiers, Schemes for combining classifiers. | | **[5]** |
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| **Text Books:** | |
| 1 | Pattern Recognition Principles, Julius T. Tou, Rafael C. González, Addison-Wesley Pub. Co.,  1974. |

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| **Computational Geometry** | **ECS43114** | **3-0-0** | **3 Credits** |

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| **Module 1:**  Introduction ,Visibility Problems,2D Maxima, Line Sweep Method, Segment Intersection Problem | | **[07]** |
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| **Module 2:**  Line Sweep: Rectangle Union, Convex Hull, Quick Hull, More Convex Hull Algorithms, Intersection of Half Planes and Duality, Lower Bounds, Planar Point Location, Point Location  and Triangulation ,Triangulation of Arbitrary Polygon. | | **[10]** |
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| **Module 3:**  Voronoi Diagrams- Properties and applications in the plane. Voronoi Diagram Construction, Proofs of properties related to vertices and edges of voronoi Diagrams. Algorithm for  constructing voronoi diagram. Delaunay Triangulation. | | **[08]** |
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| **Module 4:**  Quick sort and Backward Analysis, Generalized RIC, Arrangements, Zone Theorem and Application, Levels. | | **[08]** |
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| **Module 5:**  Range Searching : Introduction, Orthogonal Range searching, Priority Search Trees, Non - Orthogonal Range Searching, Half - Plane Range Query, Well Separated Partitioning, Quad trees, Epsilon –WSPD Construction of Epsilon – WSPD, Epsilon - WSPD to Geometric  Spanner. | | **[12]** |

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| Epsilon-Nets & VC Dimension, Geometric Set Cover, Geometric Set Cover (with Bounded VC  Dimension).Shape Representation, Shape Comparison. | |  |
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| **Text Books:** | |
| 1 | M. de Berg, M. van Kreveld, M. Overmars, and O. Schwarzkopf. Computational Geometry:  Algorithms and Applications*.* Springer-Verlag, 3rd edition, 2008 |

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| **High Performance Computer Architecture Lab** | **ECS43210** | **0-0-3** | **2 Credits** |

**Experiment 1:**

Implementation based on basic Logic Gates (AND, OR, NOT, NAND, NOR, XOR, XNOR)

**Experiment 2:**

Implementation based on Half adder and Full adder (using data flow, behavioral, structural modeling)

**Experiment 3:**

Implementation based on Half subtractor and Full subtractor (using data flow, behavioral, structural modeling)

**Experiment 4:**

Implementation based on Full adder using two half adders and Full subtractor using two half subtractors

**Experiment 5:**

Implementation based on multiplexer, demultiplexer, Encoder and Decoder

**Experiment 6:**

Implementation based on D Flip Flop, SR Flip Flop, JK Flip Flop, T Flip Flop

**Experiment 7:**

Implementation based on 4 Bit Register (using Structural modeling)

**Experiment 8:**Implementation based on 4 Bit Comparator (using Behavioral modeling)

**Experiment 9:**

Implementation based on 4 Bit ALU

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| **Pattern Recognition Lab** | **ECS43212** | **0-0-3** | **2 Credits** |

**Unit I:**

Simulation of various Statistical measurements using Python.

**Unit II:**

Implementation of vector and tensor representation of data and classes using Python.

**Unit III:**

**Unsupervised feature extraction –** PCA, LDA, SVD, EVD.

**Unit IV:**

**Clustering –** K-Means, Fuzzy C-Means, K-Medoids, Agglomerative, Spectral Clustering, DBScan, Cluster validity index

**Unit V:**

**Expectation maximization.**

**Unit VI:**

**Supervised –** K-NN, Artificial Neural Network, Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization.

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| **Computational Geometry Lab** | **ECS43214** | **0-0-3** | **2 Credits** |

**List of Experiments:**

**Experiment 1:**

Implement the concept of multiplicatively weighted Voronoi Diagrams.

**Experiment 2:**

Implement the concept of backward analysis in quicksort.

**Experiment 3:**

Implement the concept of line segmentation using any language.

**Experiment 4:**

Detect the circles present in any circle-based images.

**Experiment 5:**

Find the exact sign of 2×2 and 3×3 integer matrix determinants.

**Experiment 6:**

Using convex hull program computer Voronoi diagram; the cells of a Voronoi diagram

are the regions of space closest to one of the given points.

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| **Computational Geometry** | **ECS43114** | **3-0-0** | **3 Credits** |

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| **Module 1:**  Introduction ,Visibility Problems,2D Maxima, Line Sweep Method, Segment Intersection Problem | | **[07]** |
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| **Module 2:**  Line Sweep: Rectangle Union, Convex Hull, Quick Hull, More Convex Hull Algorithms, Intersection of Half Planes and Duality, Lower Bounds, Planar Point Location, Point Location  and Triangulation ,Triangulation of Arbitrary Polygon. | | **[10]** |
|  |  | |
| **Module 3:**  Voronoi Diagrams- Properties and applications in the plane. Voronoi Diagram Construction, Proofs of properties related to vertices and edges of voronoi Diagrams. Algorithm for  constructing voronoi diagram. Delaunay Triangulation. | | **[08]** |
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| **Module 4:**  Quick sort and Backward Analysis, Generalized RIC, Arrangements, Zone Theorem and Application, Levels. | | **[08]** |
|  |  | |
| **Module 5:**  Range Searching : Introduction, Orthogonal Range searching, Priority Search Trees, Non - Orthogonal Range Searching, Half - Plane Range Query, Well Separated Partitioning, Quad trees, Epsilon –WSPD Construction of Epsilon – WSPD, Epsilon - WSPD to Geometric  Spanner. | | **[12]** |

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| **Text Books:** | |
| 1 | M. de Berg, M. van Kreveld, M. Overmars, and O. Schwarzkopf. Computational Geometry:  Algorithms and Applications*.* Springer-Verlag, 3rd edition, 2008 |

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| **Artificial Intelligence** | **ECS43116** | **3-0-0** | **3 Credits** |

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| **Module 1:**  Introduction, Agents, Problem formulation, Uninformed search strategies, Heuristics, Informed search strategies, Satisfying constraints. Logical agents, Propositional logic, Inference rules, First-order logic, Inferences in first order logic, Forward and backward chaining, Unification, Resolution. | | **[10]** |
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| **Module 2:**  Planning with state-space search, Partial-order planning, Planning graphs, Planning and acting in the real world, Forward and backward chaining, Unification, Resolution | | **[8]** |
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| **Module 3:**  **Introduction:** Overview of machine learning, related areas, applications, software tools, course objectives. **Regression:** Linear Regression, Polynomial Regression, Gradient Descent, Logistic Regression, Case Study on Logistic Regression | | **[9]** |
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| **Module 4:**  **Neural networks**: the perceptron algorithm, various activation functions and their differentiability, multilayer perceptrons, back-propagation, nonlinear regression, multiclass discrimination, training procedures, Case Study Bayesian Learning, Decision Tree. | | **[9]** |
|  |  | |
| **Module 5:**  **Support vector machines**: Functional and geometric margins, optimum margin classifier, constrained optimization, Lagrange multipliers, KKT conditions, soft margins, kernels. **Dimensionality Reduction:** Feature Selection, Principle Component Analysis (PCA). | | **[9]** |

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| **Text Books:** | |
| 1 | Artificial Intelligence – A Modern Approach, Second Edition, S. Russel and P. Norvig Pearson Education, 2003. |
| 2 | Machine Learning, 1st Edition, Tom M. Mitchell, McGraw-Hill Series. In Computer Science |
| 3 | Neural Networks and Learning Machines, 3rd Edition, Simon O. Haykin, Prentice Hall |
| 4 | Introduction to Machine Learning, 2nd Edition, Ethem Alpaydın, The MIT Press. |
| **Reference Books:** | |
| 1 | Computational Intelligence: a logical approach”, David Poole, Alan Mack worth, Randy Goebel, First edition; Oxford University Press, 2004 |
| 2 | Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, G. Luger, Pearson Education, 2002. |
| 3 | Minsky, Marvin. "Society of Mind: a response to four reviews." Artificial Intelligence 48.3 (1991): 371-396. |
| 4 | Computational Intelligence: a logical approach”, David Poole, Alan Mack worth, Randy Goebel, First edition; Oxford University Press, 2004 |

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| **Computer Networks Lab** | **ECS43204** | **0-0-3** | **2 Credits** |

**Experiments:**

* 1. Configuring, testing and measuring Network devices and parameters/policies; Network management experiments. Exercises in Network programming.
  2. Implementation of Topologies: Star, Bus, Ring.
  3. NIC Installation & Configuration: Familiarization with Networking cables (CAT5, UTP) Connectors (RJ45, T-connector), Hubs and Switches.
  4. Implementation based on TCP/UDP Socket: Multicast & Broadcast Sockets
  5. Implementation based on Data Link Layer Error Detection Mechanism (Cyclic Redundancy Check) and Data Link Layer Flow Control Mechanism (Stop & Wait, Sliding Window).

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| **Artificial Intelligence and Machine Learning Lab** | **ECS43206** | **0-0-3** | **2 Credits** |

**Experiments:**

1. Implementation of search strategies (Informed/Heuristics) in PROLOG/C/PYTHON
2. Introduction to various libraries and the most frequently used functions, methods, constants required for the implementation of any machine learning algorithm.
3. Loading of Dataset. Splitting into Test and Train set using Pandas. Visualizing Data SetusingMatplotLib.
4. Implementation of Regression:
   1. Linear
   2. Logistic
5. Implementation of K-Nearest Neighbour (KNN).
6. Implementation of K-Means Clustering.
7. Implementation of various weight update methods of Artificial Neural Network using CIFAR10/MNIST Dataset.
8. Implementation of Decision Tree algorithm
9. Implementation of Linear Separator (Linear SVM).

**SEMESTER – VI**

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| **HSSM –V (Industrial Management)** | **MBA43144** | **3-0-0** | **3 Credits** |

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| **Module- 1:**  Industrial management - Introduction: Concept, Development, application and scope of Industrial Management. Productivity: Definition, measurement, productivity index, types of  production system, Industrial Ownership. | | | **[6]** |
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| **Module 2:**  Management Function: Principles of Management – Time and motion study, work  simplification – process charts and flow diagrams, Production Planning. Inventory Control: Inventory, Cost, Deterministic Models, Introduction to supply chain management. | | | **[10]** |
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| **Module 3:**  Quality Control: Process control, SQC, Control charts, Single, Double and Sequential Sampling, Introduction to TQM. | | | **[6]** |
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| **Module 4:**  Fundamentals of Materials Management; Material cycle; Forecasting; Material Classification-need and usage, Single and Multidimensional classifications; Materials  Codification-Usage, Codification types; | | | **[8]** |
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| **Module 5:**  Production Planning and Materials Requirements, Materials Procurement; Tendering; Types  of Tenders, Storage and warehousing concepts, Receipt, Warehouse type, Layout, issue of materials and Updation of records; Manpower and equipment; | | | **[8]** |
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| **Module 6:**  Project Management concept, Project Feasibility Studies, Project Identification, Market and Demand Analysis, Technical Analysis, Project Scheduling with PERT/CPM, Project Cost Estimate, Financial Appraisal of Single Project, Financial Appraisal of Multiple  Projects, Project Cost Control (PERT/Cost). | | | **[7]** |
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| **Text Books:** | | | |
| 1 | Arnold, Chapman: Introduction to Materials Management: Pearson, 5th edition, 2008 | | |
| **Reference Books:** | | | |
| 1 | Gopal Krishnan & Sundarsan: Material Management: An Integrated Approach, Prentice Hall of  India Private Limited, New Delhi, 2003 | | |
| 2 | Industrial Engineering and Management by OP Khanna, DhanpatRai Publications, Delhi. | | |
| 3 | Industrial Management by VK Sharma, OP Harkut. | | |

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| **Image Processing** | **ECS44101** | **0-0-3** | **3 Credits** |

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| **Module 1:**  **Fundamentals of Image processing and Image Transforms:**  Basic steps of Image processing system sampling and quantization of an Image: Basic relationship between pixels Image Transforms: 2D Discrete Fourier Transform, Discrete Cosine Transform (DCT), Discrete Wavelet transforms. | | **[8]** |
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| **Module 2:**  **Image Processing Techniques:** Image Enhancement, Spatial Domain methods: Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial filters, Sharpening Spatial filters, Frequency Domain methods - Basics of filtering in frequency domain, image smoothing, image sharpening, selective filtering Image Segmentation: Segmentation  concepts, point, line and Edge detection, Thresholding, region based segmentation. | | **[15]** |
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| **Module 3:**  **Image Compression:** Image compression fundamentals: coding Redundancy, spatial and temporal redundancy. Compression models: Lossy and Lossless, Huffman coding, Arithmetic coding, LZW coding, run length coding, Bit Plane coding, transform coding, predictive  coding , wavelet coding, JPEG standards. | | **[10]** |
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| **Module 4:**  **Basic Steps of Video Processing:** Analog video, Digital Video, Time varying Image Formation models, 3D motion models, Geometric Image formation, Photometric Image formation, sampling of video signals, filtering operations.  **2-D Motion Estimation:** Optical flow, general methodologies, pixel based motion estimation, Block matching algorithm, Mesh based motion Estimation, global Motion Estimation, Region based motion estimation, multi resolution motion estimation. Waveform based coding, Block  based transform coding, predictive coding, Application of motion estimation in video coding. | | **[12]** |
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| **Text Books:** | |
| 1 | “Digital Image Processing”, Gonzaleze and Woods, 3 rdedition , Pearson. |
| 2 | “Handbook of image and video processing”, Bovik, Alan C. Academic press, 2010. |
| **Reference Books:** | |
| 1 | “Digital video Processing”, M. Tekalp, Prentice Hall International. |
| 2 | “Fundamentals of Digital Image Processing A Practical Approach with Examples in Matlab”, Chris  Solomon, Toby Breckon, John Wiley & Sons. |

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| **Cloud Computing** | **ECS44103** | **0-0-3** | **3 Credits** |

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| **Module 1:Introduction**  Definition and evolution of Cloud Computing; Enabling Technologies, Service and Deployment Models Popular Cloud Stacks and Use Cases; Benefits, Risks, and Challenges of Cloud Computing Economic Models and SLAs.Topics in Cloud Security; Common cloud providers and their associated cloud stacks and popular cloud use case scenarios | | | | **[9]** |
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| **Module 2: Cloud Infrastructure**  Historical Perspective of Data Centers; Datacenter Components: IT Equipment and Facilities; Design Considerations: Requirements, Power, Efficiency, & Redundancy , Power calculations, PUE (Power usage effectiveness) and Challenges in Cloud Data Centers; Cloud  Management and Cloud Software Deployment Considerations | | | | **[12]** |
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| **Module 3: Virtualization**  Virtualization (CPU, Memory, I/O);Case Study: Amazon EC2;Software Defined Networks (SDN);Software Defined Storage (SDS) | | | | **[10]** |
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| **Module 4: Cloud Storage**  Introduction to Storage Systems; Cloud Storage Concepts  Distributed File Systems (HDFS, Ceph FS); Cloud Databases (HBase, MongoDB, Cassandra, DynamoDB) ; Cloud Object Storage (Amazon S3, OpenStack Swift, Ceph) | | | | **[09]** |
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| **Module 5: Programming Models**  Distributed Programming for the Cloud; Data-Parallel Analytics with Hadoop; MapReduce (YARN); Iterative Data-Parallel Analytics with Apache Spark ; Graph-Parallel Analytics  with GraphLab 2.0 (PowerGraph) | | | | **[5]** |
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| **Text Books:** | | | | |
| 1 | Enterprise Cloud Computing - Technology, Architecture, Applications, GautamShroff, Cambridge  University Press, 2010 | | | |
| 2 | Cloud Computing: Principles and Paradigms, Editors: RajkumarBuyya, James Broberg, Andrzej M.  Goscinski, Wiley,2011 | | | |
| **Reference Books:** | | | | |
| 1 | Cloud Computing: Concepts and Practices, Naresh Kumar Sehgal, Pramod Chandra P. Bhatt,  Springer 2018. | | | |
| 2 | AWS System Administration: Best Practices for Sysadmins in the Amazon Cloud, Federico  Lucifredi and Mike Ryan, "O'Reilly Media, Inc, 2018. | | | |

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| **Information Retrieval** | **ECS44105** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Introduction:** Basics of Information Retrieval and Introduction to Search Engines;Boolean Retrieval: Boolean queries, Building simple indexes, Processing Booleanqueries | | | **[5]** |
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| **Module 2:**  **Term Vocabulary and Posting Lists:** Choosing document units, Selection of terms, Stop word elimination, Stemming and lemmatization, Skip lists, Positional postings and Phrase queries; Dictionaries and Tolerant Retrieval: Data structures for dictionaries, Wildcard  queries, Permuterm and K-gram indexes, Spelling correction, Phonetic correction. | | | **[10]** |
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| **Module 3:**  Index Construction – Single pass scheme, Distributed indexing, Map Reduce,  Dynamic indexing; Index Compression Statistical properties of terms, Zipf's law, Heap's law, Dictionary compression, Postings file compression, Variable byte codes, Gamma codes. | | | **[8]** |
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| **Module 4:**  Vector Space Model – Parametric and zone indexes, Learning weights, Termfrequency and weighting, Tf-Idf weighting, Vector space model for scoring, variant tf-idf functions.  Computing Scores in a Complete Search System – Efficient scoring Inexact retrieval,  Champion lists, Impact ordering, Cluster pruning, Tiered indexes, Query term proximity, Vector space scoring and query operations. | | | **[12]** |
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| **Module 6:**  Evaluation in Information Retrieval: Standard test collections, unranked retrieval sets, Ranked retrieval results, Assessing relevance, User utility, Precision and Recall,  Relevance feedback, Rocchio algorithm, Probabilistic relevance feedback, Evaluation of  relevance feedback. | | | **[10]** |
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| **Text Books:** | | | |
| 1 | “An Introduction to Information Retrieval”, C. D. Manning, P. Raghavan, H. Schutze, Cambridge  University Press, 2009. | | |
| **Reference Books:** | | | |
| 1 | “Modern Information Retrieval”, R. Baeza and B. Ribeiro-Neto, Pearson Education, 1999. | | |

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| **Computer Graphics** | **ECS44107** | **3-0-0** | **3 Credits** |

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| **Module 1:**  Primitive Output Design: Algorithms for Line, Circle and Ellipse drawing; Attributes of output primitives: Two dimensional Geometric transformation, 2D viewing: Line, Polygon, Curve and  Text clipping algorithms. | | **[8]** |
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| **Module 2:**  Parallel and Perspective projections, Three dimensional object representation, Polygons,  Curved lines, Splines, Quadric Surfaces, Data set visualization, 3D transformations and viewing, Identification of visible surface. | | **[9]** |
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| **Module 3:**  Different Color Models – RGB, CMY, YIQ, HSV; General Computer Animation, Raster, Key-frame, Graphics programming using OPENGL, Graphics primitives, Drawing three  dimensional objects and scenes. | | **[10]** |
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| **Module 4:**  Fundamentals of Shading model, Flat and Smooth shading, Adding texture on faces, Adding  shadow of an object, Building camera in a program, Creating shaded objects, Rendering texture and Drawing Shadows. | | **[8]** |
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| **Module 5:**  Self-similarity and Fractals, Random Fractals, Piano curves, Image creation by iterative functions, Mandelbrot sets, Julia Sets, Overview of Ray Tracing, Ray intersection, Adding  Surface texture, Transparency and Reflections, Boolean operations on Objects. | | **[10]** |
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| **Text Books:** | |
| 1 | Computer Graphics with Open GL, 4th Edition, Donald D. Hearn, M. Pauline Baker, Warren  Carithers, Pearson Education |
| 2 | Computer Graphics using OPENGL, Third Edition,F.S. Hill, Pearson Education. |
| **Reference Books:** | |
| 1 | Computer Graphics- Principles and Practice, Third Edition,John F. Hughes, Andries Van Dam,  James D. Foley, Steven K. Feiner, Addison-Wesley |

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| **Artificial Neural Network and Deep Learning** | **ECS44109** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Introduction:** what is a neural network? Human Brain, Models of a Neuron, Neural networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks  **Learning Process:** Error Correction learning, Memory based learning, Hebbianlearing, Competitive, Boltzmann learning, Credit Assignment Problem, Memory, Adaption, Statistical  nature of the learning process | | **[10]** |
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| **Module 2:**  **Single Layer Perceptron’s:** Adaptive filtering problem, Unconstrained Organization Techniques, Linear least square filters, least mean square algorithm, learning curves, Learning rate annealing techniques, perception –convergence theorem, Relation between perception and Bayes classifier for a Gaussian Environment.  **Multilayer Perceptron:** Back propagation algorithm XOR problem, Heuristics, Output  representation and decision rule, Computer experiment, feature detection. | | **[5]** |
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| **Module 3:**  **Back Propagation:** Back propagation and differentiation, Hessian matrix, Generalization, Cross validation, Network pruning Techniques, Virtues and limitations of back propagation learning, Accelerated convergence, supervised learning.  **Self- Organization Maps:** Two basic feature mapping models, Self organization map, SOM algorithm, properties of feature map, computer simulations, learning vector quantization, Adaptive patter classification, Hierarchal Vector quantilizer, contexmel Maps.  **Neuro Dynamics:** Dynamical systems, stability of equilibrium states, attractors, neuro-  dynamical models, manipulation of attractors’ as a recurrent network paradigm | | **[10]** |
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| **Module 4:**  **Deep Learning:** Recent developments in deep neural networks, Limiting the size of the weights, Using noise as a regularize, The ups and down of back propagation, Introduction to full Bayesian approach, The Bayesian interpretation of weight decay, Mackay's quick and dirty method of setting weight costs.  **Convolutional Neural Networks:** Invariance, stability. Variability models (deformation model, stochastic model), Scattering networks Group Formalism, Supervised Learning: classification, Properties of CNN representations: inevitability, stability, invariance, covariance/invariance: capsules and related models, Connections with other models: dictionary learning, LISTA, other tasks: localization, regression, Embedding (DrLim), inverse problems, Extensions to non-euclidean domains, Dynamical systems: RNNs, LSTM.  **Deep Unsupervised Learning:** Autoencoders (standard, Denoising, contractive, etcetc),  Variational Autoencoders, Adversarial Generative Networks, Maximum Entropy Distributions. | | **[15]** |
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| **Module 5:**  **Advance Topics:** Non-convex optimization for deep network, Stochastic optimization, Attention and Memory Models, Open Problems. | | **[5]** |

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| **Text Books:** | |
| 1 | “Neural networks A comprehensive foundations”, Simon Hhaykin, Pearson Education 2nd  Edition 2004.” |
| 2 | “Deep Learning”, Ian Goodfellow, YoshuaBengio, and Aaron Courville, MIT press, 2016. |
| **Reference Books:** | |
| 1 | “Artificial neural networks”, B.Vegnanarayana Prentice Halll of India P Ltd, 2005. |
| 2 | “Neural networks in Computer intelligence”, Li Min Fu, TMH, 2003. |
| 3 | “Neural networks”, James A., Freeman David, M. S. Kapura, Pearson Education. |

**Prof. Elective- IV**

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| **Cryptography and Cyber Security** | **ECS44111** | **3-0-0** | **3 Credits** |

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| **Module 1:**  **Symmetric Ciphers:** Overview of Services, Mechanisms and Attacks; OSI Security Architecture and Network Security Model  **Classical Encryption Techniques:** Symmetric Cipher - Substitution Techniques, Transposition Techniques; Rotor Machines, Steganography, Block Cipher and Data Encryption Standard (DES), Strength of DES, Cryptanalysis - Differential and Linear model. Symmetric Ciphers - Triple DES, Blowfish; Confidentiality using Conventional Encryption - Placement of Encryption Function, Traffic Confidentiality, Key Distribution,  Random Number Generation. | | | **[9]** |
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| **Module 2:**  Public Key Encryption, Digital Signatures, Prime Number Format’s and Euler’s Theorems, Primality testing. Public Key Cryptography and RSA - Principles of Public Key  Cryptosystems, RSA Algorithm, Key Management, Diffie-Hellman Key Exchange. | | | **[10]** |
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| **Module 3:**  Authentication Protocol, Message Authentication, Authentication Requirements,  Authentication Functions, Message Authentication Codes, Message Digest - MD5, Digital Signatures and Authentication Protocols. | | | **[10]** |
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| **Module 4:**  **Network Security:** Authentication Applications - Kerberos, X.509 DirectoryAuthentication Service; Electronic Mail Security: Pretty Good Privacy, IP Security - Overview,Architecture,AuthenticationHeader, Encapsulation SecurityPayload  **Web Security:** Basic requirements, Secure Sockets Layer and Transport Layer security,  Secure Electronic Transaction | | | **[10]** |
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| **Module 5:**  **System Security:** Intruders, Malicious Software, Viruses and Related Threats,Counter Measures, Firewalls and their Design Principles. | | | **[6]** |
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| **Text Books:** | | | |
| 1 | “Cryptography and Network Security”, William Stallings, 4th Edition, Pearson Education/PHI,  2006. | | |
| **Reference Books:** | | | |
| 1 | “Network Security: Private Communication in Public World”, Charlie Kaufman, RadiaPerman,  Mike Speciner, 2nd Edition, Pearson Education, 2011. | | |
| 2 | “Cryptography and Network Security”, Atulkahate, TMH, 2003. | | |

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| **Internet of Things (IoT)** | **ECS44113** | **3-0-0** | **3 Credits** |

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| **Module 1: Introduction**  Introduction: What is IoT and the connected world? Architecture of IoT, Security issues, Opportunities for IoT | | | **[02]** |
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| **Module 2: Wireless Communication**  Wireless Communication –Basic, 1G and 2G, 3G, 3.5G, 4G (LTE) and 5G | | | **[04]** |
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| **Module 3: Wireless Sensor Networks**  Concept of wireless sensor network, Chronology of sensor node, Senor network architecture, Taxonomy, System Model. | | | **[02]** |
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| **Module 4: Architecture**  IoT built from smart objects, Network Convergence, IoT-Standard and Characteristic, Outline of Architecture, Opportunities in IoT, Architectural Components and its mapping  into protocols. | | | **[6]** |
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| **Module 5: Wireless Standards**  What are Wireless Standards? Network and Device Layer Protocol, Routing Protocol for Low Power and Lossy Networks (RPL), 6LowPAN, IEEE 802.15.4,Bluetooth Low Energy  (BLE),LTE. | | | **[8]** |
|  |  | | |
| **Module 6: Middleware layer Protocol**  multicast DNS (mDNS), DNS Service Discovery (DNS-SD) | | | **[02]** |
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| **Module 7: Application Layer Protocol**  Constrained Application Protocol (CoAP), Message Queuing Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP). | | | **[08]** |
|  |  | | |
| **Module 8: Localization, Data Storage (Big Data), Web of Things (WoT) and Security**  Localization:  Localization algorithms, Indoor localization, Localization for mobile systems, Applications, Data Storage (Big Data): Managing high rate sensor data, Processing data streams, Data consistency in an intermittently connected or disconnected environment, Identifying outliers and anomalies.  Security:Why is security for IoT so hard?; Threat models; Defensive strategies and examples | | | **[07]** |
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| **Module 9: Applications**  Smart health; Home automation; Location tracking | | | **[06]** |
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| **Text Books:** | |
| 1 | The Internet of Things, S. Greengard, MIT Press, 2015, 1st Edition |
| 2 | Internet of Things (IoT): Technologies, Applications, Challenges and Solutions- BK Tripathy  (Editor), J Anuradha (Editor), CRC press, 2018 |
| **Reference Books:** | |
| 1 | L. Atzori, et al., " The Internet of Things: A survery, Computer Networks 54 (2010) 2787-05 |
| 2 | Ala Al-Fuqaha et al., "Internet of Things: A Survey on Enabling Technologies, Protocols, and  Applications", IEEE Communication Surveys & Tutorials, Vol. 17, No. 4, Fourth Quarter 2015, pp 2347-76 |
| 3 | S. M. RIAZUL ISLAM et al., "The Internet of Things for Health Care: A Comprehensive  Survey", IEEE Access, Jun 2015, pp678-08 |

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| **5G Wireless Communication** | **ECS44117** | **3-0-0** | **3 Credits** |

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| **Module 1: Overview of 5G Networks**  An Overview of 5G Requirements, Spectrum Analysis and Regulations for 5G, Spectrum Sharing for 5G | | **[08]** |
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| **Module 2:Transmission**  Massive MIMO Communications, Millimeter-Wave Mobile Communications, New Multicarrier Modulations for 5G, Full-Duplex Wireless Communications for 5G | | **[10]** |
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| **Module 3:Design Techniques for 5G Networks**  Generalized Frequency Division Multiplexing, Device-to-Device Communications over 5G Systems, M2M Communications in 5G | | **[08]** |
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| **Module 4: Networking Techniques**  Ultra-Dense Network Architecture and Technologies for 5G, 5G RAN Architecture: C-RAN with NGFI, User-Centric Wireless Network for 5G, Energy Harvesting Based Green Heterogeneous Wireless Access for 5G, Resource Management in Sustainable Green HetNets,  Resource Allocation for Cooperative D2D Communication Networks | | **[09]** |
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| **Module 5: Applications for 5G Networks**  Fog Computing and Its Applications in 5G, 5G Vehicular Networking Architecture, Communications Protocol Design for 5G Vehicular Networks, Shaping 5G for the Tactile  Internet | | **[08]** |

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| **Text Books:** | | | |
| 1 | 5G Mobile and Wireless Communications Technology- Edited by AfifOsseiran, Jose F. Monserrat, Patrick Marsch, Cambridge University Press, 2016 | | |
| 2 | Fundamentals of 5G mobile networks- Edited by Jonathan Rodriguez, 2015 John Wiley | |  |
| **Reference Books:** | | |  |
| 1 | | 5G System Design- Edited by Patrick Marsch, ÖmerBulakçI, Olav Queseth, Mauro Boldi, 2018 John Wiley |  |
| 2 | | 5G Mobile Communications - Edited by Wei Xiang • KanZhengXuemin (Sherman) Shen,  Springer 2017 |  |

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| **Machine Learning** | **ECS44117** | **3-0-0** | **3 Credits** |

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| **Module 1:**  Mathematical Preliminaries for Machine Learning: Basic over view of Linear Algebra, Intercepts and Slope, Probability, Random Variable, Matrix Theory, Vectors, Optimization, Multivariate Normal Distribution, Multivariate Calculus, Brief Introduction on MATLAB/Python. | | **[09]** |
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| **Module 2:**  Supervised Learning: Learning by Computing Distances: Distance from Means and Nearest Neighbours; Learning by Asking Questions: Decision Tree based Classification and Regression, Linear Regression: optimization and gradient descent; Logistic Regression: K-Nearest Neighbour Classifier; Naïve Bayes Classifier; Support Vector Machines: Linear case and Non-linear case; Random Forest Classifier. | | **[09]** |
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| **Module 3:**  Unsupervised Learning: Uses of Unsupervised Learning; Data Clustering: K-means and Kernel K-means; Linear Dimensionality Reduction: Principal Component Analysis, Multiple Discriminant Analysis; Nonlinear Dimensionality Reduction via Kernel PCA; Matrix Factorization and Matrix Completion; Introduction to Generative Models; Generative Models for Clustering: GMM and Intro to EM; Expectation Maximization and Generative Models for Dimensionality Reduction. | | **[09]** |
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| **Module 4:**  **Learning Theory:** Introduction to Learning Theory, VC Dimension; Ensemble Methods: Boosting: Basic, Illustrations and Equations; Boosting versus Bagging; Semi-supervised Learning. | | **[09]** |
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| **Module 5:**  Bayesian Classifier, Belief Network, Probabilistic Graphical Model: Bayesian Network Representations and Semantics; Decision Making under uncertainty; Knowledge Engineering; | | **[09]** |

**ECS44113**

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| **Text Books:** | | |
| 1 | Machine Learning, T.M. McGraw-Hill, Tom M. Mitchell, McGraw-Hill, 1997 | |
| 2 | Pattern Recognition and Machine Learning, C. Bishop, Springer, 2006. | |
| 3 | Pattern Classification, R. Duda, E. Hart, and D. Stork, Willey-Interscience, 2000. | |
| 4 | Machine learning: a probabilistic perspective, Kevin R. Murphy, MIT Press, 2012. | |
| **Reference Books:** | | |
| 1 | | Machine Learning, E. Alpaydin, MIT Press, 2010. |
| 2 | | Introduction to statistical pattern recognition, K. Fukunaga, Academic press, 2013 |

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| **Internet of Things (IoT)** | **ECS44113** | **3-0-0** | **3 Credits** |

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| **Module 1: Introduction**  Introduction: What is IoT and the connected world? Architecture of IoT, Security issues, Opportunities for IoT | | | **[02]** |
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| **Module 2: Wireless Communication**  Wireless Communication –Basic, 1G and 2G, 3G, 3.5G, 4G (LTE) and 5G | | | **[04]** |
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| **Module 3: Wireless Sensor Networks**  Concept of wireless sensor network, Chronology of sensor node, Senor network architecture, Taxonomy, System Model. | | | **[02]** |
|  |  | | |
| **Module 4: Architecture**  IoT built from smart objects, Network Convergence, IoT-Standard and Characteristic, Outline of Architecture, Opportunities in IoT, Architectural Components and its mapping  into protocols. | | | **[6]** |
|  |  | | |
| **Module 5: Wireless Standards**  What are Wireless Standards? Network and Device Layer Protocol, Routing Protocol for Low Power and Lossy Networks (RPL), 6LowPAN, IEEE 802.15.4,Bluetooth Low Energy  (BLE),LTE. | | | **[8]** |
|  |  | | |
| **Module 6: Middleware layer Protocol**  multicast DNS (mDNS), DNS Service Discovery (DNS-SD) | | | **[02]** |
| ` |  | | |
| **Module 7: Application Layer Protocol**  Constrained Application Protocol (CoAP), Message Queuing Telemetry Transport (MQTT), Extensible Messaging and Presence Protocol (XMPP), Advanced Message Queuing Protocol (AMQP). | | | **[08]** |
|  |  | | |
| **Module 8: Localization, Data Storage (Big Data), Web of Things (WoT) and Security**  Localization:  Localization algorithms, Indoor localization, Localization for mobile systems, Applications, Data Storage (Big Data): Managing high rate sensor data, Processing data streams, Data consistency in an intermittently connected or disconnected environment, Identifying outliers and anomalies.  Security:Why is security for IoT so hard?; Threat models; Defensive strategies and examples | | | **[07]** |
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| **Module 9: Applications**  Smart health; Home automation; Location tracking | | | **[06]** |
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| **Text Books:** | |
| 1 | The Internet of Things, S. Greengard, MIT Press, 2015, 1st Edition |
| 2 | Internet of Things (IoT): Technologies, Applications, Challenges and Solutions- BK Tripathy  (Editor), J Anuradha (Editor), CRC press, 2018 |
| **Reference Books:** | |
| 1 | L. Atzori, et al., " The Internet of Things: A survery, Computer Networks 54 (2010) 2787-05 |
| 2 | Ala Al-Fuqaha et al., "Internet of Things: A Survey on Enabling Technologies, Protocols, and  Applications", IEEE Communication Surveys & Tutorials, Vol. 17, No. 4, Fourth Quarter 2015, pp 2347-76 |
| 3 | S. M. RIAZUL ISLAM et al., "The Internet of Things for Health Care: A Comprehensive  Survey", IEEE Access, Jun 2015, pp678-08 |

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| **Image Processing Lab** | **ECS44203** | **0-0-3** | **2 credits** |

**Experiments:**

* 1. Implement the noise reduction for various types of noise
  2. Implement the histogram equalization method
  3. Restore the original images from the inputs given in lab
  4. Extract the gradient parts from the input image.
  5. Extract the rice objects from the input image.
  6. Separate the two types of blobs in the input image.
  7. Detecting a Cell Using Image Segmentation
  8. Cell counting
  9. Detecting Cars in a Video of Traffic
  10. Edge detection: Sobel, Prewitt, Canny and Laplacian

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| **Cloud Computing Lab** | **ECS44205** | **0-0-3** | **2 credits** |

**Experiments:**

Logging on to Tivoli Service Automation Manager Uis Logging in to VMware vSphere client Opening the email application Submitting a new VMware deployment request using the quick path Monitoring the deployment status Logging in to the virtual server (optional) Modifying the virtual server by adding additional memory Adding a VMware server with a monitoring agent to an existing project Customizing the service catalog Creating a future reservation request Displaying projects and servers in the self-service UI Monitoring a virtual server in the IBM Tivoli Monitoring Tivoli Enterprise Portal (optional) Creating a backup image of the virtual machine Deleting a virtual server Canceling a project Creating a project with a virtual server restored from a saved backup image Requesting a new project with additional software as a different customer Monitoring the deployment status (optional) Disabling automatic approval Submitting a service request to restart a virtual machine Viewing Tivoli Service Automation Manager reports Logging into the standalone VMware ESX server Exploring general hypervisor information Monitoring hypervisor's performance Managing data stores Exploring Virtual Machine files

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| **Information Retrieval Lab** | **ECS44207** | **0-0-3** | **2 credits** |

**Experiments:**

1. Prepare and build a model to extract keywords from any documents.
2. Prepare and build a search engine.
3. Build a sentiment classification model for user reviews Pizza Hut. Each user review should be classified as positive or negative.
4. Build a Twitter tweets classifier model for Sports or Entertainment. Train the classifier and predict the category of incoming tweets.
5. Build a model to detect summarized points from a huge or multiple paragraphs. The model will extract keywords which occur often and will detect summarized point from a collection of documents.

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| **Computer Graphics Lab** | **ECS44209** | **0-0-3** | **2 credits** |

01. Implement Bressenham’s line drawing algorithm for all types of slope

02.. Create and rotate a triangle about the origin and a fixed point

03 Draw a color cube and spin it using OpenGL transformation matrices

04. Draw a color cube and allow the user to move the camera suitably to experiment with perspective viewing

05. Clip a lines using Cohen-Sutherland algorithm

06. To draw a simple shaded scene consisting of a tea pot on a table. Define suitably the position and properties of the light source along with the properties of the surfaces of the solid object used in the scene

07. Design, develop and implement recursively subdivide a tetrahedron to form 3D sierpinski gasket. The number of recursive steps is to be specified by the user

08. Develop a menu driven program to animate a flag using Bezier Curve algorithm

09. Develop a menu driven program to fill the polygon using scan line algorithm

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| **Artificial Neural Network and Deep Learning Lab** | **ECS44211** | **0-0-3** | **2 credits** |

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| 1. | Build and implement CNN for image classification. |
| 2. | Implement the concept of neural network to detect whether any given dataset of an employee is application for loan or not. |
| ­­­ 3. | Implement the concept of back propagation for updating weights. |
| 4. | Implement the concept of object detection using deep CNN. |
| 5. | Build computer vision-based application using deep neural networks. |
| 6. | Implementation of neural network in different domains |

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| **Summer Internship** |  | **0-0-3** | **2 credits** |

An internship enables you to gain first-hand exposure of working in the real world. It also allows students to harness the skill, knowledge, and theoretical practice they learnt in university. You can acquire endless amounts of education in your life, however, that knowledge doesn’t always translate to the working life. The great thing about internships is that it teaches young professionals about the specific industries and companies they are interested in.

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| **Minor Project** | **ECS44401** | **0-0-3** | **2 credits** |

The Evaluation of the project work are to be carried out in the following way:

1. In-depth study of a topic proposed by the supervisor

2. Continuous Evaluation through guide.

3. An open pre-submission seminar by the student.

4. End-semester University Examination (An open seminar followed by a Viva voce)