# Proposed Scheme & Syllabus

# For

# Bachelor of Technology

# Electrical and Electronics Engineering Department

# National Institute of Technology Delhi

# Teaching Scheme

## Semester I

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | PHL 100 | Electromagnetics and Quantum Physics | 3 | 1 | 0 | 4 |
| 2. | CSB 101 | Problem Solving and Computer Programming | 3 | 0 | 2 | 4 |
| 3. | MAL 101 | Advanced Calculus | 3 | 1 | 0 | 4 |
| 4. | EEB 100 | Introduction to Electrical and Electronics Engineering | 3 | 0 | 2 | 4 |
| 5. | HMB 100 | Professional Communication | 3 | 0 | 2 | 4 |
| 6. | MEL 101 | Environmental Studies | 3 | 0 | 0 | 3 |
| 7. | PHP 100 | Physics Laboratory | 0 | 0 | 3 | 2 |
| 8. | MEP 103 | Product Design and Realization Laboratory I | 0 | 0 | 2 | 1 |
| 9. | EAP 101 | Extra-Academic Activity | 0 | 0 | 2 | 1 |
| | Total Credits | | 18 | 2 | 13 | 27 |

## Semester II

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | CYL 100 | Chemical Structures & Reactivity | 3 | 1 | 0 | 4 |
| 2. | CSB 102 | Data Structures | 3 | 0 | 2 | 4 |
| 3. | MAL 151 | Linear Algebra and Complex Analysis | 3 | 1 | 0 | 4 |
| 4. | MEB 100 | Engineering Visualization | 3 | 0 | 2 | 4 |
| 5. | HMB 101 | Human Values and Ethics | 3 | 0 | 2 | 4 |
| 6. | MEL 102 | Engineering Mechanics | 3 | 0 | 0 | 3 |
| 7. | CYP 100 | Chemistry Laboratory | 0 | 0 | 3 | 2 |
| 8. | MEP 104 | Product Design and Realization Laboratory II | 0 | 0 | 2 | 1 |
| 9. | EAP 102 | Extra-Academic Activity | 0 | 0 | 2 | 1 |
| | Total Credits | | 18 | 2 | 13 | 27 |

## Semester III

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 201 | Network Analysis & Synthesis | 3 | 1 | 0 | 4 |
| 2. | EEB 202 | Electrical & Electronic Measurements | 3 | 0 | 2 | 4 |
| 3. | EEL 203 | Electro Magnetic Field Theory | 3 | 1 | 0 | 4 |
| 4. | ECB 206 | Analog Electronics | 3 | 0 | 2 | 4 |
| 5. | ECB 204 | Signals & Systems | 3 | 0 | 2 | 4 |
| 6. | MAL 201 | Ordinary Differential Equations and Transforms | 3 | 1 | 0 | 4 |
| 7. | EEP205 | Colloquium/ Industrial Lecture/ Seminar | 0 | 0 | 2 | 1 |
| | Total Credits | | 18 | 03 | 08 | 25 |

## Semester IV

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEB 251 | Electrical Machines-I | 3 | 0 | 2 | 4 |
| 2. | EEB 252 | Control Systems | 3 | 0 | 2 | 4 |
| 3. | EEL253 | Power Systems | 4 | 0 | 0 | 4 |
| 4. | CSB 254 | Digital Electronics and Logic Design | 3 | 0 | 2 | 4 |
| 5. | MAL251 | Partial Differential Equations and Numerical Analysis | 3 | 1 | 0 | 4 |
| 6. | EELXXX | Elective-I | 3 | 0 | 0 | 3 |
| 7. | EEP305 | Summer Internship/ Summer Project-I (Credits will be counted in next Semester) | - | - | - | - |
| | Total Credits | | 19 | 01 | 06 | 23 |

## Elective-I

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 261 | Transducers & Signal Conditioning | 3 | 0 | 0 | 3 |
| 2. | EEL 262 | Biomedical Instrumentation | 3 | 0 | 0 | 3 |
| 3. | EEL 263 | Electrical Engineering Materials | 3 | 0 | 0 | 3 |
| 4. | EEL 264 | Electrical Distribution systems | 3 | 0 | 0 | 3 |
| 5. | EEL 265 | Power station Practice | 3 | 0 | 0 | 3 |
| 6. | EEL 266 | Finite Element Methods and Applications | 3 | 0 | 0 | 3 |
| 7. | EEL 267 | Instrumentation & Measurement | 3 | 0 | 0 | 3 |

## Semester V

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEB301 | Electrical Machines-II | 3 | 0 | 2 | 4 |
| 2. | EEL302 | Power System Analysis | 3 | 1 | 0 | 4 |
| 3. | EELXXX | Elective-II | 3 | 0 | 0 | 3 |
| 4. | EEB303 | Introduction to Microprocessors and Interfacing | 3 | 0 | 2 | 4 |
| 5. | ECB304 | IC Applications | 3 | 0 | 2 | 4 |
| 6. | EEP304 | Colloquium/ Industrial Lecture/ Seminar | 0 | 0 | 2 | 1 |
| 7. | EEP305 | Summer Internship/ Summer Project-I | - | - | - | 1 |
| | Total Credits | | 15 | 01 | 08 | 21 |

**Elective-II**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 311 | Digital Image Processing | 3 | `0 | 0 | 3 |
| 2. | EEL 312 | Distribution System Planning & Automation | 3 | 0 | 0 | 3 |
| 3. | EEL 313 | Micro Electro Mechanical systems | 3 | 0 | 0 | 3 |
| 4. | EEL 314 | Advanced Control Systems | 3 | 0 | 0 | 3 |
| 5. | EEL 315 | Energy Audit & Management | 3 | 0 | 0 | 3 |
| 6. | EEL 316 | Renewable Energy Systems | 3 | 0 | 0 | 3 |
| 7. | EEL 317 | Restructuring in Power Systems | 3 | 0 | 0 | 3 |
| 8. | EEL 318 | Digital Control | 3 | 0 | 0 | 3 |

## Semester VI

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | HML351 | Engineering Economics and Accountancy | 3 | 0 | 0 | 3 |
| 2. | EEB351 | Power Electronics | 3 | 0 | 2 | 4 |
| 3. | EEL352 | Switchgear & Protection | 3 | 1 | 0 | 4 |
| 4. | EELXXX | Elective-III | 3 | 0 | 0 | 3 |
| 5. | | Open Elective-I | 3 | 0 | 0 | 3 |
| 6. | EEP353 | Simulation tools for Electrical Engineering | 0 | 0 | 3 | 2 |
| 7. | EEP405 | Summer Internship-II (Credits will be counted in next Semester) | - | - | - | - |
| 8. | EEP354 | Minor Project Work | 0 | 0 | 4 | 2 |
| 9. | HMP352 | Technical Communications | 0 | 0 | 2 | 1 |
| | Total Credits | | 15 | 01 | 11 | 22 |

**Elective-III**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 361 | Integrated Circuits & Applied Instrumentation(ICAI) | 3 | 0 | 0 | 3 |
| 2. | EEL 362 | Real Time Control in Power System | 3 | 0 | 0 | 3 |
| 3. | EEL 363 | Process Control | 3 | 0 | 0 | 3 |
| 4. | EEL 364 | High Voltage Engineering | 3 | 0 | 0 | 3 |
| 5. | EEL 365 | Power System Planning and Automation | 3 | 0 | 0 | 3 |
| 6. | EEL 368 | Electro-Magnetics for Electrical Machines | 3 | 0 | 0 | 3 |
| 7. | EEL 369 | Special Electrical Machines-I | 3 | 0 | 0 | 3 |

## Semester VII

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEB401 | Electrical Drives | 3 | 0 | 2 | 4 |
| 2. | EEL4XX | Elective-IV | 3 | 0 | 0 | 3 |
| 3. | | Open Elective-II | 3 | 0 | 0 | 3 |
| 4. | EEP402 | Power System Lab | 0 | 0 | 2 | 1 |
| 5. | EEP403 | Project Work | 0 | 0 | 6 | 4 |
| 6. | EEP405 | Summer Internship-II | 0 | 0 | 2 | 1 |
| | Total Credits | | 09 | 0 | 12 | 16 |

**Elective-IV**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 411 | Utilization of Electrical Energy | 3 | 0 | 0 | 3 |
| 2. | EEL 412 | DSP and its Application to Power Electronics | 3 | 0 | 0 | 3 |
| 3. | EEL 413 | Power System Operation & Control | 3 | 0 | 0 | 3 |
| 4. | EEL 414 | Switched Mode Power Conversion | 3 | 0 | 0 | 3 |
| 5. | EEL 415 | Special Electrical Machines-II | 3 | 0 | 0 | 3 |

## Semester VIII

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL451 | HVDC & Flexible AC Transmission Systems | 3 | 1 | 0 | 4 |
| 2. | EEL4XX | Elective-V | 3 | 0 | 0 | 3 |
| 3. | EEL4XX | Elective-VI | 3 | 0 | 0 | 3 |
| 4. | EEL4XX | Elective-VII | 3 | 0 | 0 | 3 |
| 5. | EEP452 | Project Work | 0 | 0 | 15 | 10 |
| | Total Credits | | 12 | 1 | 15 | 23 |

**Elective-V/ Elective-VI / Elective-VII**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEL 461 | Computer Applications in Power Systems | 3 | 0 | 0 | 3 |
| 2. | EEL 462 | Power Quality | 3 | 0 | 0 | 3 |
| 3. | EEL 463 | Wind Energy Conversion Systems | 3 | 0 | 0 | 3 |
| 4. | EEL 464 | Logic and Distributed Control System | 3 | 0 | 0 | 3 |
| 5. | EEL 465 | Optimal Control | 3 | 0 | 0 | 3 |
| 6. | EEL 466 | CAD for Electrical Machines | 3 | 0 | 0 | 3 |
| 7. | EEL 467 | Intelligent Control | 3 | 0 | 0 | 3 |
| 8. | EEL 468 | System Identification and Adaptive Control | 3 | 0 | 0 | 3 |
| 9. | EEL 469 | Power Electronics For Renewable Energy Systems | 3 | 0 | 0 | 3 |
| 10. | EEL 470 | Electrical Machine Modeling and Analysis | 3 | 0 | 0 | 3 |
| 11. | EEL 471 | Basics of Robotics | 3 | 0 | 0 | 3 |
| 12. | EEL 472 | Inverters and Resonant Pulse Converters | 3 | 0 | 0 | 3 |
| 13. | EEL 473 | Cycloconverters and AC voltage controllers | 3 | 0 | 0 | 3 |
| 14. | EEL 474 | Solid State Power Controllers | 3 | 0 | 0 | 3 |
| 15. | EEL 475 | Power System Stability & Control | 3 | 0 | 0 | 3 |
| 16. | EEL 476 | EHV AC/DC Transmission | 3 | 0 | 0 | 3 |

| | Required | Offered |
|---|---|---|
| **Basic Sciences** | **≥ 24** | **28** |
| **Departmental Core** | **≥ 60** | **61** |
| **Other Engg Core** | **≥ 30** | **33** |
| **Humanities and Social Sciences** | **≥ 10** | **12** |
| **Elective** | **≥ 15** | **21** |
| **Open Elective** | **≥ 3** | **6** |
| **Project** | **≥ 14** | **14** |
| **Mandatory Courses** | **9** | **9** |

**Minimum Credits Required for Award of Degree = 175**

**Mandatory Courses:**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1 | MEL 101 | Environmental Studies | 3 | 0 | 0 | 3 |
| 2 | EAP 101 | Extra Academic Activity | 0 | 0 | 2 | 1 |
| 3 | EAP 102 | Extra Academic Activity | 0 | 0 | 2 | 1 |
| 4 | EEP305 | Summer Internship/ Summer Project – I | 0 | 0 | 2 | 1 |
| 5 | EEP405 | Summer Internship– II | 0 | 0 | 2 | 1 |
| 6 | EEP 205 | Colloquium/ Industrial Lecture/ Seminar | 0 | 0 | 2 | 1 |
| 7 | EEP 304 | Colloquium/ Industrial Lecture/ Seminar | 0 | 0 | 2 | 1 |
| | Total Credits | | | | | 09 |

**Basic Science Courses:**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | PHL 100 | Electromagnetics and Quantum Physics | 3 | 1 | 0 | 4 |
| 2. | CYL 100 | Chemical Structures & Reactivity | 3 | 1 | 0 | 4 |
| 3. | MAL 101 | Advanced Calculus | 3 | 1 | 0 | 4 |
| 4. | PHP 100 | Physics Laboratory | 0 | 0 | 3 | 2 |
| 5. | CYP 100 | Chemistry Laboratory | 0 | 0 | 3 | 2 |
| 6. | MAL 151 | Linear Algebra and Complex Analysis | 3 | 1 | 0 | 4 |
| 7. | MAL 201 | Ordinary Differential Equations and Transforms | 3 | 1 | 0 | 4 |
| 8. | MAL251 | Partial Differential Equations and Numerical Methods | 3 | 1 | 0 | 4 |
| | Total Credits | | | | | 28 |

**Humanities and social Science Courses:**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | HMB 100 | Professional Communication | 3 | 0 | 2 | 4 |
| 2. | HMB 101 | Human Values and Ethics | 3 | 0 | 2 | 4 |
| 3. | HML351 | Engineering Economics and Accountancy | 3 | 0 | 0 | 3 |
| 4. | HMP352 | Technical Communication | 0 | 0 | 2 | 1 |
| | Total Credits | | | | | 12 |

**Other Engineering Core:**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | MEB 100 | Engineering Visualization | 3 | 0 | 2 | 4 |
| 2. | CSB 101 | Problem Solving and Computer Programming | 3 | 0 | 2 | 4 |
| 3. | CSB 102 | Data Structures | 3 | 0 | 2 | 4 |
| 4. | MEL 102 | Engineering Mechanics | 3 | 0 | 0 | 3 |
| 5. | MEP 103 | Product Design and Realization Laboratory I | 0 | 0 | 2 | 1 |
| 6. | MEP 104 | Product Design and Realization Laboratory II | 0 | 0 | 2 | 1 |
| 7. | ECB 206 | Analog Electronics | 3 | 0 | 2 | 4 |
| 8. | ECB 204 | Signals & Systems | 3 | 0 | 2 | 4 |
| 9. | CSB 254 | Digital Electronics and Logic Design | 3 | 0 | 2 | 4 |
| 10. | ECB 304 | IC Applications | 3 | 0 | 2 | 4 |
| | Total Credits | | | | | 33 |

**Departmental Core:**

| Sl. No. | Course Code | Course Title | L | T | P | Credits |
|---|---|---|---|---|---|---|
| 1. | EEB 100 | Introduction to Electrical and Electronics Engineering | 3 | 0 | 2 | 4 |
| 2. | EEB 202 | Electrical and Electronic Measurements | 3 | 0 | 2 | 4 |
| 3. | EEL 201 | Network Analysis and Synthesis | 3 | 1 | 0 | 4 |
| 4. | EEL 203 | Electromagnetic Field Theory | 3 | 1 | 0 | 4 |
| 5. | EEB 251 | Electrical Machines-I | 3 | 0 | 2 | 4 |
| 6. | EEB252 | Control Systems | 3 | 0 | 2 | 4 |
| 7. | EEL253 | Power Systems | 4 | 0 | 0 | 4 |
| 8. | EEB 301 | Electrical Machines-II | 3 | 0 | 2 | 4 |
| 9. | EEL302 | Power System Analysis | 3 | 1 | 0 | 4 |
| 10. | EEB303 | Introduction to Microprocessors and Interfacing | 3 | 0 | 2 | 4 |
| 11. | EEB 351 | Power Electronics | 3 | 0 | 2 | 4 |
| 12. | EEL352 | Switchgear & Protection | 3 | 1 | 0 | 4 |
| 13. | EEP353 | Simulation Tools for Electrical Engineering | 0 | 0 | 3 | 2 |
| | EEP354 | Minor Project Work | 0 | 0 | 4 | 2 |
| 14. | EEB401 | Electrical Drives | 3 | 0 | 2 | 4 |
| 15. | EEP402 | Power System Lab | 0 | 0 | 2 | 1 |
| 16. | EEL451 | HVDC & Flexible AC Transmission Systems | 3 | 1 | 0 | 4 |
| | Total Credits | | | | | 61 |

**CURRICULUM**

| **Course no: PHL 100** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of Course** | Theory | | | |
| **Course Title** | **ELECTROMAGNETICS AND QUANTUM MECHANICS** | | | |
| **Course Coordinator** | DR ANUJ KUMAR SHARMA | | | |
| **Course objectives:** | To understand the basic concepts of electromagnetic theory through vector analysis.<br>To understand the fundamentals of optics (interference, diffraction, and polarization), lasers, and fiber optics.<br>To understand the origin, evolution of quantum physics (mainly particle properties of light and wave properties of particles) and solid state physics<br>In the end, the course will briefly convey some important topics of nanotechnology and instrumentation. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: yes** | | **Spring: Yes** | |

| **Contact Hours** | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | Nil | | | | |
| **Equivalent course codes as per proposed course and old course** | Nil | | | | |
| **Overlap course codes as per proposed course numbers** | Nil | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Introduction to Electrodynamics |
| | Author | D. J. Griffiths |
| | Publisher | Addison Wesley |
| | Edition | 3rd ed. (1999) |
| 2. | Title | Optics |
| | Author | A. K. Ghatak |
| | Publisher | Tata McGraw-Hill Education |
| **Reference Books:** | | |
| 3. | Title | An introduction to fiber optics |
| | Author | A. Ghatak and K. Thyagarajan |
| | Publisher | Cambridge University Press |
| | Edition | 1998 |
| 4. | Title | Concepts of Modern Physics |
| | Author | A. Beiser |
| | Publisher | Tata McGraw-Hill Education |
| | Edition | 6th ed. (2008) |
| **Content** | **Unit I:** **08**<br>Vector analysis and Electrmagnetic Theory: Brief review of vector algebra, Electrostatics and magnetostatics, Maxwell's equations in | |

| | |
|---|---|
| | differential and integral forms and their interpretation, EM wave equation, transverse nature and speed of EM waves, EM energy density, Poynting vector.<br>**Unit II: 12**<br>Interference, Diffraction, and Polarization**:** Interference of EM waves**;** Division of amplitude: Uniform and wedge-shaped films; interferometers; Fresnel and Fraunhofer diffractions of EM waves; Diffraction grating; Polarization by transmission; Polarization by reflection; Double refraction.<br>**Unit III: 08**<br>Lasers and FiberOptics:Lasers: Basic principle, Types and applications. Fiber optics: Optical wave guiding, types of optical fibers, transmission losses, fiber optic communication.<br>**Unit IV: 14**<br>Quantum Physics:Dual nature of light; Compton Effect; De-Broglie waves; Davisson-Germer Experiment; Phase and group velocities; Uncertainty principle; Wave-function; Schrodinger wave equation; Particle in a finite and infinite potential well; Tunnel effect. Superposition Principle, Continuity Equation for probability density; Stationary states, Bound states, Free-particle solution, 1-D infinite potential well, Expectation values and uncertainty relations; 1-D finite potential well, Quantum mechanical tunneling and alpha-decay, Kronig-Penny model and emergence of bands.<br>**Unit V: 06**<br>Nanotechnology and Instrumentation**:** Introduction to Nanotechnology; carbon nanotubes, Optical Microscope, Biomedical Instrumentation, Holography. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: CSB 101 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | NO | NO | NO | NO |
| **Type of course** | Theory | | | |
| **Course Title** | **PROBLEM SOLVING AND COMPUTER PROGRAMMING** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering. | | | |
| **POs** | | | | |

| **Semester** | **Autumn: Yes** | | **Spring:** | | |
|---|---|---|---|---|---|
| **I** | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
| **Contact Hours** | 3 | 0 | 2 | 4 | 36 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

| **Text Books:** | | |
|---|---|---|
| 1 | Title | Programming in ANSI C |
| | Author | E. Balagurusamy |
| | Publisher | TATA McGraw Hill |
| | Edition | 6th edition, 2012 |
| **Reference Book:** | | |
| 1 | Title | Let Us C |
| | Author | YashavantKanetkar |
| | Publisher | Infinity Science Press |
| | Edition | 13th edition, 2012 |
| 2 | Title | The C Programming Language |
| | Author | Brian Kernighan & Dennis Ritchie |
| | Publisher | Prentice Hall |
| | Edition | 2nd Edition, 1988 |
| 3 | Title | Schaum's Outline of Programming with C |

| | | | |
|---|---|---|---|
| | | Author | Byron S Gottfried |
| | | Publisher | TATA Mc Graw Hill |
| | | Edition | 2nd edition, 1996 |
| **Content** | **Unit I:** **05**<br>Introduction to Computers: Hardware and Software. Basic Model of Computation, Notion of Algorithms, Flowcharts, Top down design, Bottom up approaches of problem solving, Number system.<br>**Unit II:** **09**<br>Introduction to programming language, Basics of C, Basic Data types – integer, float, double, char, Boolean, Void. Arithmetic and logical operators: precedence and associativity. Flow of Control- Conditional statements- If-else, Switch-case constructs, Loops- While, do-while, for.<br>**Unit III:** **07**<br>Function – User defined functions, library functions, Parameter passing – call by value, call by reference, recursion.<br>**Unit IV:** **07**<br>Arrays- Advantages and drawbacks, One dimensional, Multi-Dimensional Arrays and strings: Declaration, Initialization, Accessing, Passing arrays and strings as parameters to functions. Pointers, Dynamic memory allocation, Dynamic arrays – One dimensional, Multidimensional dynamic array.<br>**Unit V:** **08**<br>Structure: Declaration, Initialization, passing structure to function, Use of pointers in structure. Preprocessors, Macros, File management in C I/O – Opening, closing and editing files. Correctness & Efficiency Issues in Programming, Time & Space measures. | | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | | |

| **Course no: MAL 101** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **NO** | **N** | **N** | **N** |
| **Type of Course** | Theory | | | |
| **Course Title** | **ADVANCED CALCULUS** | | | |
| **Course Coordinator** | DR. SUNIL KUMAR | | | |
| **Course objectives:** | This course is aimed to cover differential, integral and vector calculus for functions of one and more than one variable. These mathematical tools and methods are used extensively in physical sciences, engineering, and computer graphics. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: Yes** | | **Spring:** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Load** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Thomas' Calculus |
| | Author | G. Thomas, M. Weir, J. Hass |
| | Publisher | Pearson Pub. |
| | Edition | 2010 |
| 2. | Title | Introduction to Real Analysis |
| | Author | R.G. Bartle, D.R. Sherbert |
| | Publisher | John Wiley and Sons |
| | Edition | 2011 |
| 3. | Title | |

| | | |
|---|---|---|
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Advanced Engineering Mathematics |
| | Author | E. Kreyszig |
| | Publisher | Jon Wiley and Sons |
| | Edition | 2008 |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Content** | **Unit I:** **18**<br>Differential Calculus: Limit and Continuity of functions; differentiability; Jacobian, Rolle's theorem; Mean value theorem; Taylor's and Maclaurin's theorems with remainders, Expansions; Convergence of sequences and series of real numbers; Power series; Functions of several variables, limit and continuity, Partial Derivatives and Differentiability, Maxima & Minima of two variables, Lagrange method of multiplier.<br>**Unit II:** **14**<br>Integral Calculus: Fundamentals theorem of integral calculus, Riemann Integration, Improper Integrals, Double and Triple integrals-computation of surface area and volumes-change of variables in double and triple integrals. (14 hours)<br>**Unit III:** **16**<br>Vector Calculus: Scalar and vector field; Vector differentiation; Level surfaces, Directional Derivatives, Gradient of Scalar field; Divergence and Curl of a vector field; Laplacian, Line and Surface integrals; Green's theorem in plane Gauss Divergence's theorem and Stoke's theorem. | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | |

| **Course no:**<br>**EEB 100** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **Yes** | **No** |
| **Type of Course** | Theory | | | |
| **Course Title** | **INTRODUCTION TO ELECTRICAL AND ELECTRONICS ENGINEERING** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To introduce the fundamentals of Electrical and electronics Engineering including circuit analysis, transformers, machines, analog and digital electronics. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** Yes | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Electrical and Electronic Technology |
| | Author | E Hughes |
| | Publisher | Pearson |
| | Edition | |
| 2. | Title | Fundementals of Electrical and Electronics Engineering |
| | Author | Smarajit Ghosh |
| | Publisher | PHI |
| | Edition | Second |

| | | |
|---|---|---|
| 3. | Title | Text book of Basic Electrical and Electronics Engineering |
| | Author | J.B.Gupta |
| | Publisher | S.K.Kataria |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Electrical Engineering Fundamentals |
| | Author | V. D. Toro |
| | Publisher | Prentice Hall |
| | Edition | |
| 2. | Title | Electrical Machinery |
| | Author | P.S. Bimbhara |
| | Publisher | Khanna |
| | Edition | |
| 3. | Title | Principles of Electrical Engineering and Electronics |
| | Author | V.K.Mehta |
| | Publisher | S.Chand Publications |
| | Edition | |
| 4. | Title | Basic Electrical Engineering |
| | Author | V.K.Garg |
| | Publisher | Wiley India |
| | Edition | |
| **Content** | **Unit I:** **08**<br><br>Electrical Circuit Analysis: Voltage & Current sources: dependent & independent source, source conversion. Analysis of D.C. circuits: Mesh & Loop analysis, Nodal analysis. Network Theorems: Thevenin's, Norton's, superposition theorem etc. Star- Delta circuits. 1-Φ ac Circuits: Review of 1-Φ phase ac circuits under sinusoidal steady state conditions, Resonance, Active, Reactive and Apparent power, Power factor. 3-Φ ac circuits: Balanced and Unbalanced supply, Star and Delta connections, power measurement.<br><br>**Unit II:** **06**<br><br>Transformers: Magnetic Circuits: Review of laws of electromagnetism, Flux, MMF and their relation, analysis of magnetic and electric circuit. Single phase transformer: Basic concepts, constructional features, EMF equation, voltage, current and impedance transformation, Equivalent circuits.<br><br>**Unit III:** **08**<br><br>Electrical Machines: DC Machines: Constructional features, working principle, emf equation, types of dc machines and their characteristics. Induction Machines: Constructional features, working principle, emf equation, concept of slip and torque–slip characteristics. Synchronous Machines: Constructional features, working principle and emf equation.<br><br>**Unit IV:** **08**<br><br>Digital electronics: Number systems: decimal, binary, octal, hexadecimal, their complements, operation and conversion, floating point and signed numbers. Demorgan's theorem, Logic Gates: Basic and Universal Gates, their representation, truth table and realization, Half and Full adder | |

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| | circuits, Flip-Flops etc.<br>**Unit V: 06**<br>Electronic Devices and Circuits: Introduction to semiconductors, Diodes: types of diodes and their characteristic. Bipolar Junction Transistors: working, configurations (CC, CB & CE) and mode of operation. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| **Course no: HMB 100** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | **Yes** | **No** | **No** |
| **Type of Course** | Theory | | | |
| **Course Title** | **PROFESSIONAL COMMUNICATION** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To inculcate linguistic skills in students. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: Yes** | | **Spring: No** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 2 | 4 | 60 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Technical Communication: Principles and Practice |
| | Author | Raman, Meenakshi and Sharma, Sangeeta, |
| | Publisher | Delhi: Oxford University Press |
| | Edition | 2004 |
| 2. | Title | Technical Writing and Professional Communication, |
| | Author | Thomas N Huckin and Leslie &Oslen, |
| | Publisher | McGrow Hills |
| | Edition | 2004 |
| 3. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | |
| | Author | |
| | Publisher | |

| | | |
|---|---|---|
| | Edition | |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Content** | **Unit I:** **15**<br>Theory of communication, Cycle of communication, Types of communication, Verbal and Non-verbal Communication, Oral communication, Written Communication, Body language, Paralanguage, Proxemics, Chronemics, Haptics, Flow of communication, 7Cs of communication, Barriers to communication.<br>**Unit II:** **15**<br>Reading Skills: Practice in reading a wide range of texts with a view to improving their reading comprehension, and also grammar and vocabulary. Reading Comprehension, Reading a Novel, Note Making, Interpretation of Non Verbal Data.<br>**Unit III:** **15**<br>Writing Skills: Practice in Written Communication with a view to enabling independent, original and creative writing. Construction of Sentences and Paragraphs Writing for Correspondence (letters, memos, emails, and fax) Professional Writing (Process Writing, Technical Description and Report Writing), Tips for making presentation, Curriculum Vitae etc.<br>**Unit IV:** **15**<br>Speaking and Listening Skills (Laboratory Work) Practice in Speaking and Listening Activities with a view to improving their oral and listening skills. Individual speech sounds, Stress and Intonation patterns, Personality Development Questionnaires, Role Play, Extempore, Group Discussions, Facing Interviews, Presentation Skills. | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | |

| **Course no:**<br>**MEL 101** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of Course** | Theory | | | |
| **Course Title** | **ENVIORNMENTAL STUDIES** | | | |
| **Course Coordinator** | DR. KAPIL SHARMA | | | |
| **Course objectives:** | Recognize major concepts in environmental sciences and demonstrate in-depth understanding of the environment. Develop analytical skills, critical thinking, and demonstrate problem-solving skills using scientific techniques. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: NO** | | **Spring: YES** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | Nil | Nil | | | |
| **Prerequisite Credits** | Nil | Nil | | | |
| **Equivalent course codes as per proposed course and old course** | MEL 101 | Nil | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Environmental Science and Engineering |
| | Author | J.G. Henry and G.W. Heinke |
| | Publisher | Pearson Education |
| | Edition | 2004 |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |

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|---|---|---|
| 3. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Introduction to Environmental Engineering and Science |
| | Author | G.B. Masters |
| | Publisher | Pearson Education |
| | Edition | 2004 |
| **Content** | **Unit I:** **06**<br><br>Multidisciplinary nature of environmental studies**:** Definition, scope and importance, need for public awareness<br><br>**Unit II:** **06**<br><br>Ecosystems - Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystems: - a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystems, Biogeochemical cycles<br><br>**Unit III:** **06**<br><br>Natural Resources: Concept of Renewable and non-renewable resources, Natural resources and associated problems. Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Bioenergy and biofuels<br><br>**Unit IV:** **06**<br><br>Bio diversity and its conservation: Introduction – Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels. Inida as a mega-diversity nation, Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity<br><br>**Unit V:** **06**<br><br>Environmental pollution: Definition, Cause, effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution d. Marine pollution e. Noise pollution f. Thermal pollution g. Nuclear hazards, Causes, effects and control measures of urban and industrial wastes. Pollution case | |

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|---|---|
| | studies. Solid waste Management<br><br>**Unit VI:** **06**<br><br>Social Issues and Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Climate change, global warming, acid rain, ozone layer depletion and Eutrophication, Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

<table>
<tr><td>Course no:<br>PHP 100</td><td>Open course (YES/NO)</td><td>HM Course (Y/N)</td><td>DC (Y/N)</td><td>DE (Y/N)</td></tr>
<tr><td></td><td>No</td><td>No</td><td>No</td><td>No</td></tr>
<tr><td>Type of course</td><td>Practical</td><td></td><td></td><td></td></tr>
<tr><td>Course Title</td><td colspan="4">PHYSICS LABORATORY</td></tr>
<tr><td>Course Coordinator</td><td colspan="4">DR GYANENDRA SHEORAN</td></tr>
<tr><td>Course objectives:</td><td colspan="4">The course is aimed at providing the practical knowledge of:<br>i. Basic optics experiments (Interference, diffraction, and polarization)<br>ii. Basic semiconductor devices experiments (diode, LED etc.)<br>Modern physics experiments (Hall effect, Planck’s constant, bandgap measurement, Thompson experiment)</td></tr>
<tr><td>Text Books:</td><td colspan="4"></td></tr>
<tr><td rowspan="4">1.</td><td colspan="2">Title</td><td colspan="3"></td></tr>
<tr><td>Author</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Publisher</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Edition</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="5">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td colspan="2">Title</td><td colspan="2"></td></tr>
<tr><td colspan="2">Author</td><td colspan="2"></td></tr>
<tr><td colspan="2">Publisher</td><td colspan="2"></td></tr>
<tr><td colspan="2">Edition</td><td colspan="2"></td></tr>
<tr><td>Content</td><td colspan="4">1. To study the Hall Effect and determination of hall coefficient, and charge carrier concentration.<br>2. To study interference and diffraction of light by slits (single, double, and/or multiple).<br>3. To find out wavelength of light by using plane transmission diffraction grating.<br>4. To study the interference of light by Fresnel’s biprism.<br>5. To determine the wavelength of light by Newton’s rings method.<br>6. To determine specific rotation of sugar using half shade polarimeter.<br>7. To study the polarization of light and verify Malus’ law.<br>8. To determine the energy bandgap of a semiconductor by resistivity measurement.<br>9. To determine the e/m ratio by Thomson’s method.<br>10. To study photoelectric effect and to determine the Planck’s constant.</td></tr>
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| | 11. To determine Planck's constant with LED.<br>12. To determine the refractive index and Cauchy's constants using prism and spectrometer.<br>13. To find out the Resolving power of diffraction grating using spectrometer.<br>14. To determine the fill factor and efficiency of solar cell (in series and parallel).<br>15. To study LCR circuit and to find out the resonance frequency.<br>16. To study the V-I characteristics of silicon, germanium, and Zener diodes in forward and reverse bias.<br>(**Note:** Any 8-10 experiments may be performed) |
| **Course Assessment** | Continuous Evaluation 50%<br>End Semester 50% |

| **Course no:**<br>**MEP 103** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of Course** | Laboratory | | | |
| **Course Title** | **PRODUCT DESIGN & REALIZATION LABORATORY- I** | | | |
| **Course Coordinator** | ABHISHEK GANDHI | | | |
| **Course objectives:** | This course is to introduce the basic principles 3D modeling of products. At the end of this course, the students could develop 3D models and their engineering drawings using softwares such as Solidworks, etc. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: YES** | | **Spring: NO** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total TeachingHours** |
|---|---|---|---|---|---|
| **Contact Hours** | 0 | 0 | 24 | 1 | 24 |
| **Prerequisite course code as per proposed course numbers** | Nil | Nil | | | |
| **Prerequisite Credits** | Nil | Nil | | | |
| **Equivalent course codes as per proposed course and old course** | MEP 103 | Nil | | | |
| **Overlap course codes as per proposed course numbers** | Nil | Nil | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Solidworks 2015 For Engineers And Designers |
| | Author | Sham Tickoo |
| | Publisher | Dreamtech Press |
| | Edition | 2016 |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |

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|---|---|---|
| 3. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Exploring Solidworks 2011: A Project Based Approach |
| | Author | Prof. Sham Tickoo and Sandeep Prem |
| | Publisher | Dreamtech Press |
| | Edition | 2011 |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Content** | **UNIT I: 02**<br>SolidWorks Basics and the User Interface:Design Intent, File References, Opening Files, The Solid Works User Interface<br>**UNIT II: 02**<br>Introduction to Sketching**:** 2D Sketching, Stages in the Process, Saving Files, What are We Going to Sketch, Sketching, Sketch Entities, Basic Sketching, Rules That Govern Sketches, Design Intent, Sketch Relations, Dimensions, Extrude, Sketching Guidelines<br>**UNIT III: 03**<br>Basic Part Modeling:BasicModeling, Terminology, Choosing the Best ProfileChoosing the Sketch Plane, Details of the Part, Boss Feature Sketching on a Planar Face, Cut Feature, Using the Hole Wizard, View Options, Filleting, Detailing Basics, Drawing Views, Center Marks, Dimensioning, Changing Parameters<br>**UNIT IV: 02**<br>Modeling a Casting or Forging:Case Study: Ratchet, Design Intent, Boss Feature with Draft, Symmetry in the Sketch Sketching Inside the Model, View Options, Using Model Edges in a Sketch, Creating Trimmed Sketch Geometry, Using Copy and Paste<br>**UNIT V: 02**<br>Patterning: Why Use Patterns?, Reference Geometry, Linear Pattern, Circular Patterns, Mirror Patterns, Using Pattern Seed Only, Sketch Driven Patterns<br>**UNIT VI: 02**<br>Revolved Features**:** Case Study: Handwheel, Design Intent, Revolved Features, Building the Rim, Building the Spoke, Edit Material, Mass Properties, File Properties, SolidWorks SimulationXpress, Using SolidWorks SimulationXpress,<br>**UNIT VII: 02**<br>Shelling and Ribs: Shelling and Ribs, Analyzing and Adding Draft, Other Options for Draft, Shelling, Ribs, Full Round Fillets, Thin Features<br>**UNIT VIII: 02**<br>Editing: repairs: Part Editing, Editing Topics, Sketch Issues, FilletXpert, DraftXpert<br>**UNIT IX: 02**<br>Editing: Design Changes: Part Editing, Design Changes, Information From a | |

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| | Model, Rebuilding Tools, Sketch Contours, Editing with Instant 3D<br>**UNIT X: 02**<br>Configurations: Configurations, Using Configurations, Creating Configurations, Link ValuesEquations, Configure Dimension / Feature, Modeling Strategies for Configurations, Editing Parts that Have Configurations, Design Library.<br>**UNIT XI: 02**<br>Design Drawings: More About Making Drawings, Section View, Model Views, Broken View, Detail Views, Drawing Sheets and Sheet Formats, Projected Views, Annotations<br>**UNIT XII: 02**<br>Bottom up assemble modeling: Case Study: Universal Joint, Bottom-Up Assembly, Creating a New Assembly, Position of the First Component, FeatureManager Design Tree and Symbols, Adding Components, Using Part Configurations in Assemblies, Sub-assemblies, Smart Mates Using Assemblies, Analyzing the Assembly, Checking for Clearances, Changing the Values of Dimensions, Exploded Assemblies, Explode Line Sketch, Bill of Materials, Assembly DrawingsInserting Sub-assemblies, Pack and Go. |
| **Course Assessment** | Continuous Evaluation 50%<br>End Semester 50% |

| Course no: CYL-100 | Open Course (YES/NO) YES | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of course** | Theory | | | |
| **Course Title** | **Chemical Structure and Reactivity** | | | |
| **Course Coordinator** | Dr. A. P. Singh & Dr. Suman Srivastava | | | |
| **Course objectives:** | By learning this subject, students will be able to understand:<br>i. The basic concept of atomic structure bonding and reactivity.<br>ii. Also this course will also introduce students to basics of electrochemistry, reactions kinetics.<br>iii. This course is design to impart the knowledge of structures of various molecules, their interactions, synthesis route and structural relationship.<br>iv. At the end of this session students will able to understand about the applied chemistry especially about commercial polymer, petroleum products and engineering of materials. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Inorganic Chemistry: Principles of Structure and Reactivity, |
| | Author | J. E. Huheey |
| | Publisher | Pearson India |
| | Edition | 4th Edition |
| 2 | Title | Concise Inorganic Chemistry, |
| | Author | J. D. Lee |
| | Publisher | Wiley |
| | Edition | 5th Edition |
| 3 | Title | Elements of Physical Chemistry, |
| | Author | P. W. Atkins |
| | Publisher | Oxford Univ Press |
| | Edition | 2nd Edition |
| 4 | Title | Organic Chemistry |
| | Author | R. T. Morrison |
| | Publisher | Pearson |
| | Edition | 6th Edition |
| 5 | Title | Engineering Chemistry |
| | Author | Shikha Agarwal |
| | Publisher | Cambridge University Press |
| | Edition | 1st Edition, 2015 |

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| **Content** | **UNIT 1: Fundamentals of Inorganic Chemistry 12**<br>Periodic table, atomic and ionic radii, ionization energy, electron affinity, electronegativity and periodicity.Properties and chemical behaviour of s, p, d and f block elements. Chemical Bonding: Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization and shapes of simple inorganic molecules and ions, valence shall electron pair repulsion (VSEPR) theory to $NH_3$, $H_3O^+$, $SF_4$, $CIF_3$, $ICl_2$ and $H_2O$. Crystal Field Theory (CFT), comparison of the stability of octahedral and tetrahedral complexes on the basis of crystal field stabilization energy (CFSE), factor affecting the magnitude of CFSE, application of crystal field theory. Jahan-Teller effect definition and example from $d^9$ and high spin $d^4$ systems.<br><br>**UNIT 2: Fundamentals of Organic Chemistry 08**<br>Nomenclature of organic molecules. Aromaticity: Benzenoid and non-benzenoid compounds generation and reactions. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Important name reactions and rearrangements.<br><br>**UNIT 3: Electrochemistry and Chemical Kinetics 08**<br>**Electrochemistry:** Introduction, Types of Conductors, Conductance in Electrolytic Solutions, Factor Affecting Conductance, Kohlrausch' law of Independent Migration of Ion. Conductometric titration, Electro Chemical Cell, Electrode Potential and EMF of a Galvanic Cell, Electrochemical Series., Types of Electrode, Batteries.<br>**Chemical Kinetics:** Introduction, Rate of Reaction, Average Rate and Instantaneous Rate, Rate Law Expression, Rate Constant, Factor Influencing Rate of the Reaction. Order and Molecularity of the Reaction, Zero order, First Order Chemical Kinetics, Half-life of a reaction.<br><br>**UNIT 4: Analytical Techniques in Chemistry 08** Types of Analysis. Separation Techniques, Potentiometry, pH metry, Spectroscopic techniques: UV-Visible spectroscopy, Lambert Beer's Law, principles and applications of UV-Visible spectroscopy, Infrared spectroscopy, Nuclear Magnetic Resonance Spectroscopy.<br><br>**UNIT 5: Applied Chemistry 12**<br>(i) **Petroleum Products and Technologies:** Petroleum and petrochemicals, Petroleum cracking, reforming, synthetic petrol, knocking in petrol and diesel engines.<br><br>(ii) **Industrial Polymers:** Classification of Polymers, Polymer reaction and mechanism of polymerization. Polymerization Techniques, molecular weight of polymers. Commercially important polymers: fibbers, elastomers, adhesives, plastics, vinylic and phenolics, polyesters, polyamide.<br><br>(iii) **Engineering Materials:** Cement, Gypsum ($CaSO_4.2H_2O$), Plaster of Paris ($2CaSO_4.H_2O$ or $CaSO_4.1/2H_2O$), Lime, Glass, Refractories, Insulating Material. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: CSB 102 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | NO | NO | NO | NO |
| **Type of course** | **Core** | | | |
| **Course Title** | **DATA STRUCTURES** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This course aims to provide the students with a foundation in computer programming. The goals of the course are to develop the basic programming skills in students, and to improve their proficiency in applying the basic knowledge of programming to solve problems related to their field of engineering. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| **I** | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
| **Contact Hours** | 3 | 0 | 2 | 4 | 36 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Fundamentals of Data Structures |
| | Author | E. Horowitz, S. Sahni |
| | Publisher | Computer Science Press |
| | Edition | 2nd Edition, 2008 |
| **Reference Book:** | | |
| 1. | Title | Data Structures Using C |
| | Author | E. Balagurusamy |
| | Publisher | TATA McGraw Hill |
| | Edition | 2013 |
| 2. | Title | Data Structure and Program Design |
| | Author | R.L. Kruse |
| | Publisher | Prentice Hall |
| | Edition | 2nd Edition, 1996 |

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|---|---|---|---|
| 3. | | Title | Data Structures Using C |
| | | Author | A. M. Tanenbaum, Y. Langsam, M. J. Augenstein |
| | | Publisher | Pearson Education |
| | | Edition | 1990 |
| **Content** | **Unit I:** **05**<br>Introduction: Dynamic aspects of operations on data, Characteristics of data structures, Creation and manipulation of data structures, Operations on data structures, Types of data structures – linear and nonlinear. Introduction to algorithm: Asymptotic notations, Analysis of algorithms: Time and Space complexity.<br><br>**UnitII:** **07**<br>Arrays: Dynamic memory allocation, one-dimensional arrays, multidimensional arrays, operations on arrays, storage – Row major order, Column major order. Linked lists: types of linked lists – singly, doubly and circularly linked lists, operations on linked lists.<br><br>**Unit III:** **08**<br>Stacks: Implementation of stacks– array and linked list, operations on stacks, Applications of Stacks, Notations – infix, prefix and postfix, Conversion and evaluation of arithmetic expressions using Stacks. Queues: Implementation of queues– array and linked list, operations on queues, Types of queues – queue, double ended queue and priority queue.<br><br>**Unit IV:** **08**<br>Trees: Binary tree, Binary search tree, Threaded binary tree, Height balanced trees, Tries, Heaps, Hash tables. Graph traversals: Breadth First Search, Depth First Search, Shortest path: Depth first search in directed and undirected graphs. Union-find data structure and applications. Directed acyclic graphs; topological sort.<br><br>**Unit V:** **08**<br>Searching: Linear search, Binary search and Hashing. Algorithms and data structures for sorting: Insertion Sort, Bubble sort, Selection Sort, Merge sort, Quick Sort, Heap sort, Radix sort, Bucket sort. Algorithm design techniques: Divide and conquer, Greedy approach, dynamic programming. | | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | | |

| **Course no: MAL 151** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **NO** | **N** | **N** | **N** |
| **Type of Course** | Theory | | | |
| **Course Title** | **LINEAR ALGEBRA AND COMPLEX ANALYSIS** | | | |
| **Course Coordinator** | DR. AMIT MAHAJAN | | | |
| **Course objectives:** | This course covers matrix theory and linear algebra, emphasizing topics useful in other disciplines. The concepts of linear algebra are extremely useful in physics, economics and social sciences, natural sciences, and engineering. Also, this course covers basic concepts of complex analysis, such as limit, continuity, differentiability and integration, and also related theorems. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** | | **Spring: Yes** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Load** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | Nil | Nil | | | |
| **Prerequisite Credits** | Nil | Nil | | | |
| **Equivalent course codes as per proposed course and old course** | Nil | Nil | | | |
| **Overlap course codes as per proposed course numbers** | Nil | Nil | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Linear Algebra and its Applications |
| | Author | David C. Lay |
| | Publisher | Pearson Pub. |
| | Edition | 2011 |
| 2. | Title | Complex variables and its applications |
| | Author | R. V. Churchill |
| | Publisher | McGraw Hill |
| | Edition | 1960 |
| **Reference Books:** | | |
| 1. | Title | Introduction to Linear Algebra |
| | Author | Gilbert Strang |
| | Publisher | Cambridge Press |
| | Edition | 2009 |

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|---|---|---|
| 2. | Title | Advanced Engineering Mathematics |
| | Author | E. Kreyszig |
| | Publisher | John Wiley and Sons |
| | Edition | 2008 |
| **Content** | **Unit I:** **24**<br>Linear Algebra: Elementary of row and column operations on a matrix, Rank of a matrix, Normal form, Inverse of matrix, Systems of linear equation and their solutions, Vector space and its subspaces, Spanning sets and linear independence, Determinant properties, Linear transformation, Range space and Rank, Null space and nullity, Eigenvalues and eigenvector, Diagonalization of matrices, Similarity of matrices, Inner product, Gram Schmidt process, Least square approximations.<br><br>**Unit II:** **24**<br>Complex Analysis: Complex number and elementary properties, Complex functions-Limit, continuity and differentiability, Polar form of Complex number, Cauchy Riemann Equations, Analytic and Harmonic functions, Cauchy's Theorem, Cauchy's Integral formula, Taylor and Laurent's series expansion, Zeros and singularities, Residues, Residue theorem and its applications. | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | |

| **Course no: MEB 100** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | | | | |
| **Type of Course** | THOERY | | | |
| **Course Title** | **ENGINEERING VISUALIZATION** | | | |
| **Course Coordinator** | DR. ABHISHEK MISHRA | | | |
| **Course objectives:** | 1. To impart and inculcate proper understanding of the theory of projection.<br>2. To improve the visualization skills.<br>3.To enable the students with various concepts like dimensioning, conventions andstandards related to working drawings in order to become professionally efficient.<br>4. To impart the knowledge on understanding and drawing of simple residential/officebuildings. | | | |
| **POs** | 1. Students will be able to understand the theory of projection.<br>2. Students will be able to know and understand the conventions and the methods of engineering drawing.<br>3. Students will be able to improve their visualization skills so that they can apply theseskills in developing new products.<br>4. Students will be able to prepare simple layout of factory buildings. | | | |
| **Semester** | **Autumn:** | | **Spring:** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 2 | 4 | 60 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per** | NIL | | | | |

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|---|---|---|---|---|---|
| **proposed course numbers** | | | | | |
| **Text Books:** | | | | | |
| 1. | Title | Engineering Drawing | | | |
| | Author | N. D. Bhatt | | | |
| | Publisher | CharotarPublishing House Pvt. Ltd. | | | |
| | Edition | Fifty Third 2014 | | | |
| 2. | Title | | | | |
| | Author | | | | |
| | Publisher | | | | |
| | Edition | | | | |
| 3. | Title | | | | |
| | Author | | | | |
| | Publisher | | | | |
| | Edition | | | | |
| **Reference Books:** | | | | | |
| 1. | Title | AutoCAD 2007 Bible | | | |
| | Author | E. Finkelstein | | | |
| | Publisher | Wiley Publishing Inc. | | | |
| | Edition | 2007 | | | |
| 2. | Title | | | | |
| | Author | | | | |
| | Publisher | | | | |
| | Edition | | | | |
| **Content** | **OVERVIEW:** Sketching concepts. Orthographic Projections and views: Principles of Axonometric projections and Development of Isometric, Dimensioning of Orthographic Views, Sectioning in Orthographic views and assembly drawings. Introduction: Overview of the course, Examination and Evaluation patterns.<br>**Unit I**: **09**<br>Lines Lettering and Dimensioning: Types of lines, Lettering, Dimensioning, Geometrical Constructions, Polygons. Scales: Plain scales, Diagonal scales, Scale of chords.<br>**Unit II**: **09**<br>Curves used in Engineering Practice: Ellipse, Parabola, Hyperbola, normal and tangents to these curves, Involute, Cycloid, Epi-cycloid, Hypo-cycloid, Spiral, Helix on cone and cylinder.<br>**Unit III**: **09**<br>Orthographic projection of points: Principles of Orthographic projection, Projections of points.Projections of Lines: Projections of a line parallel to one of the reference planes and inclined to the other, line inclined to both the reference planes, Traces<br>**Unit IV**: **09**<br>Projections of Planes: Projections of a plane perpendicular to one of the | | | | |

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| | reference planes and inclined to the other, Oblique planes.<br><br>**Unit V**: **08**<br><br>Projections of Solids: Projections of solids whose axis is parallel to one of the reference planes and inclined to the other, axis inclined to both the planes.<br><br>**Unit VI:** **08**<br><br>Section of Solids: Sectional planes, Sectional views - Prism, pyramid, cylinder and cone, true shape of the section.<br><br>**Unit VII:** **08**<br><br>Isometric views: Isometric axis, Isometric Planes, Isometric View, Isometric projection, Isometric views – simple objects.Assembly drawings of the machine parts.<br><br>**NOTE:** Interpretation of drawings: Introduction of CAD package to construct a simple solid model, Using a CAD package to construct solid models and generating orthographic, isometric, sectional views with dimensioning, Assembly of components and generation of corresponding drawings. Animation of single of machines in CAD. |
| **Course Assessment** | Theory (60%): Continuous Evaluation 25%, Mid Semester 25%<br><br>End Semester 50%<br><br>Laboratory (40%): Continuous Evaluation 50% |

| **Course no:**<br>**HMB 101** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of Course** | Practical | | | |
| **Course Title** | **HUMAN VALUES AND ETHICS** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To inculcate ethical understanding in students. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: Yes** | | **Spring: No** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 2 | 4 | 60 |
| **Prerequisite course code as per proposed course numbers** | Nil | | | | |
| **Prerequisite Credits** | Nil | | | | |
| **Equivalent course codes as per proposed course and old course** | Nil | | | | |
| **Overlap course codes as per proposed course numbers** | Nil | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Organizational Behaviour: Text and Cases |
| | Author | Chitale, et.al. |
| | Publisher | PHI Learning Private Limited. |
| | Edition | |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| 3. | Title | |

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|---|---|---|
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Ethics in Engineering |
| | Author | Mike W. Martin & Roland Schinzinger |
| | Publisher | McGrow Hills |
| | Edition | |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Content** | **Unit I:** **15**<br>Introduction: Organizational Systems and Resources Personality, Types of Personality, Determinants of Personality. Biographical and Personal factors. Environmental Factors. Psychological Factors. Big Five Personality traits.<br><br>**Unit II:** **15**<br>Feelings, Classification of Feelings. Dimensions of Emotions. Emotions and External Constraints. Emotional Intelligence. Spiritual Intelligence. Authority, Responsibility and Accountability: Meaning of Authority, Responsibility and Accountability. Balance between Authority, Responsibility and Accountability.<br><br>**Unit III:** **15**<br>Human Resource Policies& Procedures. Introduction, Importance of Policies, Policy formation, Human resources planning. Decision-making &Ethics.<br><br>**Unit IV:** **15**<br>Concept of moral Relativism and Moral Imperialism. Cognitive Moral Development. Encouragement to Ethical Behaviour. Approaches to Fostering Ethical Behaviour. | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | |

| **Course no:**<br>**MEL 102** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of Course** | Theory | | | |
| **Course Title** | **ENGINEERING MECHANICS** | | | |
| **Course Coordinator** | ABHISHEK GANDHI | | | |
| **Course objectives:** | This course is to introduce the basic principles of engineering mechanics with emphasis on their analysis and application to practical engineering problems. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: YES** | | **Spring YES** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | Nil | Nil | | | |
| **Prerequisite Credits** | Nil | Nil | | | |
| **Equivalent course codes as per proposed course and old course** | MEL 102 | Nil | | | |
| **Overlap course codes as per proposed course numbers** | Nil | Nil | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Engineering Mechanics |
| | Author | Timoshenko, Young, Rao &Pati |
| | Publisher | McGraw Hill Education India |
| | Edition | 5 (2013) |
| 2. | Title | |
| | Author | |
| | Publisher | |

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|---|---|---|
| | Edition | |
| 3. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | Engineering Mechanics |
| | Author | J.L. Meriam & L.G. Kraige |
| | Publisher | Wiley |
| | Edition | 7 (2011) |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |

**Content**

**UNIT I:** **03**

System of Coplanar forces: Introduction to coplanar & non-coplanar force system. Forces and their components. Moment of the force about a point, couple. Resultant of coplanar force system - concurrent forces, parallel forces, non-concurrent non-parallel system of forces.

**UNIT II:** **03**

Equilibrium of coplanar force system: Meaning of equilibrium, free body diagrams, equilibrium of concurrent, parallel and non-concurrent non-parallel (general) system of forces. Types of supports, determination of reactions at supports for various types of determinate beams.

**UNIT III:** **03**

Forces in Space: Rectangular components of forces in space, Resultant of concurrent forces, moment of a force about a point, moment of a force about a given axis, resultant of general force system, Equilibrium of a particle in space.

**UNIT IV:** **03**

Analysis of pin jointed frame/ truss: Perfect truss, Imperfect truss, Analysis of truss by method of joints and method of section.

**UNIT V:** **03**

Friction: Laws of friction, angle of friction, angle of repose, cone of friction, Equilibrium of bodies on rough horizontal and inclined plane, application to problems involving wedges, ladder. Belt friction, flat belts on the flat pulleys.

**UNIT VI:** **03**

Centroid of Plane Areas: Concept of Centroid of plane areas. Centroid of areas by integration. Centroid of composite areas.

**UNIT VII:** **03**

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| | Moment of Inertia: Moment of inertia of plane areas, parallel axis theorem. Introduction to polar moment of inertia, product of inertia and mass moment of inertia.<br><br>**UNIT VIII: 03**<br><br>Kinematics of Particle: Velocity and acceleration in terms of rectangular coordinate system, rectilinear motion, motion along plane curved path, tangential and normal component of acceleration, acceleration - time, velocity- time, graphs and their use, relative velocity, projectile motion, simple harmonic motion.<br><br>**UNIT IX: 03**<br><br>Kinematics of rigid bodies: Translation, pure rotation and plane motion of rigid bodies, instantaneous, centre of rotation for velocity for bodies in plane motion, link mechanisms (upto two links)<br><br>**UNIT X: 03**<br><br>Kinetics of Particles: Newton's laws of motion, D'Alembert's principle, equation of dynamic equilibrium, linear motion, curvilinear motion.<br><br>**UNIT XI: 03**<br><br>Energy and Momentum Principles: Work done by a force, potential and kinetic energy, power, work energy equation, principle of conservation of energy, momentum, impulse and momentum principle, principle of conservation of momentum, impact of solid bodies, elastic impact, semi-elastic impact and plastic impact.<br><br>**UNIT XII: 03**<br><br>Kinetics of rigid bodies: D'Alembert's principle for bodies under translational motion, rotational motion about a fixed axis and plane motion. Application to motion of bars, cylinders, spheres. |
| **Course Assessment** | Continuous Evaluation 25%<br><br>Mid Semester 25%<br><br>End Semester 50% |

| Course no: CYP-100 | Open Course (YES/NO) YES | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | No |
| **Type of course** | Practical | | | |
| **Course Title** | **Chemistry Laboratory** | | | |
| **Course Coordinator** | Dr. A. P. Singh & Dr. Suman Srivastava | | | |
| **Course objectives:** | This course will provide the practical knowledge to the students on:<br>i) Various types of Titrations<br>ii) Synthesis and characterization of various organic and inorganic compounds.<br>iii) Identification of unknown compounds<br>iv) Hand on experience on various analytical equipments. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Laboratory hours** |
| **Contact Hours** | 0 | 0 | 3 | 2 | 36 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Essentials of Experimental Engineering Chemistry, |
| | Author | Shashi Chawla |
| | Publisher | Dhanpat Rai and Co Pvt Ltd |
| | Edition | $4^{th}$ Edition |
| **2.** | Title | Vogel's Quantitative Inorganic Analysis |
| | Author | G. Svehla |
| | Publisher | Prentice Hall |
| | Edition | $7^{th}$ Edition |

**Content**

**1.** To find the strength in grams per liter of the given solution of sodium hydroxide with the help of stander oxalic acid solution.

**2.** Estimation of water hardness by EDTA method.
   a. To determine the strength of calcium ion in given $CaCO_3$ solution by complexometric titrations.
   b. To determine the strength of magnesium ion in given $MgSO_4$ solution by complexometric titrations.
   c. To determine the total hardness of given water sample by complexometric titrations.

**3.** To determination the strength of ferrous ammonium sulphate with the help of $K_2Cr_2O_7$ solution.

**4.** To Preparation of a nickel complex $[Ni(NH_3)_6]Cl_2$ and estimation of nickel by complexometric titration.

**5.** Preparation of benzimidazole.

**6.** Identification of functional group present in an organic compound- unknown sample

**7.** Measurement of physical properties: Surface tension and viscosity.

**8.** Chemical kinetics- Acid hydrolysis of ethyl acetate.

**9.** Acid-base titration using pH meter.

**10.** Acid-base titration by conductometry.

| **Course Assessment** | Continuous Evaluation 50%<br>End Semester 50% |
|---|---|

| **Course no: MEP 104** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of Course** | Laboratory | | | |
| **Course Title** | **PRODUCT DESIGN & REALIZATION LABORATORY - II** | | | |
| **Course Coordinator** | ABHISHEK GANDHI | | | |
| **Course objectives:** | The student will be able to identify the manufacturing processes required to manufacture an engineering product. The student will have a brief exposure of basic manufacturing machineries and processes, which are widely utilized in industries to manufacture products. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: NO** | | **Spring: YES** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 0 | 0 | 24 | 1 | 24 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | MEP 104 | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Introduction to Basic Manufacturing Processes and Workshop Technology |
| | Author | Rajendra Singh |
| | Publisher | New Age International Publishers, India |
| | Edition | 2006 |
| 2. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | A Textbook of Workshop Technology : Manufacturing Processes |
| | Author | R. S. Khurmi& J K Gupta |
| | Publisher | S. Chand Publications |
| | Edition | 16/e |
| 2. | Title | |
| | Author | |

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|---|---|---|
| | Publisher | |
| | Edition | |
| **Content** | **UNIT I:** **04**<br>Fitting trade: Preparation of T-Shape Work piece as per the given specifications. Preparation of U-Shape Work piece that contains: Filing, Sawing, Drilling, Grinding. Practice marking operations<br><br>**UNIT II:** **04**<br>Machine Shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools). Demonstration of different operations on Lathe machine. Practice of Facing, Plane Turning, step turning, taper turning, knurling and parting. Study of Quick return mechanism of Shaper.<br><br>**UNIT III:** **04**<br>Carpentry: Study of Carpentry Tools, Equipment and different joints. Practice of Cross Half lap joint, Half lap Dovetail joint and Mortise Tenon Joint<br><br>**UNIT IV:** **04**<br>Foundry trade: Introduction to foundry, Patterns, pattern allowances, ingredients of moulding sand and melting furnaces. Foundry tools and their purposes. Demo of mould preparation. Practice – Preparation of mould by using split pattern.<br>**UNIT V:** **04**<br>Welding: Introduction: Study of Tools and welding Equipment (Gas and Arc welding), Selection of welding electrode and current, Bead practice, Practice of Butt Joint, Lap Joint.<br><br>**UNIT VI:** **04**<br>Forging: Introduction, upsetting, drawing down, punching, bending, swaging and fullering. | |
| **Course Assessment** | Continuous Evaluation 50%<br>End Semester 50% | |

| Course no: EEL 201 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Core | | | |
| **Course Title** | **Network Analysis & Synthesis** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To introduce the fundamentals of network analysis using matrices, two-port, and network synthesis. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **1** | **0** | **4** | **36(L) + 12(T)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

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|---|---|---|
| 1. | Title | Network Analysis |
| | Author | M.E. Van Valkenburg |
| | Publisher | Prentice Hall |
| | Edition | 3rd Ed. |
| 2. | Title | Network Analysis and Synthesis |
| | Author | Franklin F. Kuo |
| | Publisher | Wiley |
| | Edition | 2nd Ed. |
| 3. | Title | Engineering Circuit Analysis |
| | Author | W. H. Hayt and J E Kemmerly |
| | Publisher | TMH |
| | Edition | 8th Ed. |

**Content**

**Unit I: Introduction6**
KCL, KVL, Network theorems and its application in the analysis of networks.

**Unit II: Network Functions and Response Analysis 8**
Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function, Impulse response and complete response, Time domain behavior form pole-zero plot.

**Unit III: Poly-Phase Circuits7**
Introduction to polyphase system, Generation of three-phase voltages, Interconnection of 3 phase sources and loads, Star-to-Delta and Delta-to-Star transformation, Voltage, current and power in a star and delta

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| | connected system, Three phase balanced and unbalanced circuits.<br><br>**Unit IV: Two-Port Networks7**<br>Two Port networks: Two port parameters, relationships among different network parameters, interconnections of networks.<br><br>**Unit V: Network Synthesis8**<br>Network Synthesis: Realizability concept, Hurwitz property, positive realness, properties of positive real functions, properties of one port immittance functions and their synthesis, Foster and Cauer forms, RLC synthesis, Introduction to two-port network synthesis. |
| **Curse Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEB 202 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Core | | | |
| **Course Title** | **Electrical and Electronic Measurements** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To impart knowledge of principles of measurement of electrical quantities, construction and operating principles of electrical instruments, their static and dynamic characteristics, and errors in measurement. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | lectronic Instrumentation and Measurement Techniques |
| | Author | W.D. Cooper & A.D. Helfrick |
| | Publisher | Prentice-Hall India |
| | Edition | |
| 2. | Title | Electrical Measurement & Measuring Instruments |
| | Author | E.W. Golding |
| | Publisher | Wheeler Publishing |
| | Edition | |
| 3. | Title | A Course in Electrical & Electronic Measurements and Instrumentation |
| | Author | A.K.Sawhney |
| | Publisher | Dhanpat Rai |
| | Edition | 19th |
| | | |

**Content**

**Unit I: Errors and Accuracy** **4**

Static error, static calibration, error calibration curve, limiting errors, relative limiting errors, types of errors- gross errors, systematic errors, random (residual) errors, accuracy and precision, static sensitivity, linearity, hysteresis, threshold, dead time, resolution of instrument, loading effects, introduction to measurement standards.

**Unit II: Electrical and Magnetic Measurements** **7**

Introduction, D'Arsonval galvanometer, moving iron & moving coil instruments, electrodynamometer, electrostatic instruments, induction type energy-meter, wattmeter.

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| | **Unit III: Resistance Measurements** **7**<br>Methods of measurement of low, medium and high resistance, measurement of earth resistance, localization of cable faults by Murray and Varley loop test.<br><br>**Unit IV: Inductance and Capacitance Measurements** **5**<br>Measurement of inductance and capacitance by A.C. Bridge methods, Q-factor and dissipation factor, sources of errors in bridge circuits, methods of reducing bridge errors, Wagner Earthing Device.<br><br>**Unit V: Measurement of Power Factor and Frequency** **4**<br>Single phase, three phase Electrodynamometer type power factor meter, moving iron power factor meters, types of frequency meter, mechanical resonance type, electrical resonance type, ratio meter type and Weston frequency meter.<br><br>**Unit VI: Potentiometers** **4**<br>Basic D.C. potentiometer circuit, modern form of D.C. potentiometer, measurement of voltage, current, resistance and calibration of voltmeter & ammeter using D.C. potentiometer, volt ratio box, A.C. potentiometers and their applications.<br><br>**Unit VII: Instrument Transformers** **5**<br>Introduction, use of Instrument transformers, ratios, basic constructional features of C.T. and P.T., ratio and phase angle errors, reduction of errors. |
| **Curse Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| Course no: EEL 203 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | N | Y | N |
| **Type of course** | Core | | | |
| **Course Title** | **Electromagnetic Field Theory** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn the fundamental concepts applied in Electrostatics, Magnetostatics, Time-varying fields and Electromagnetic Waves | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **1** | **0** | **4** | **36(L) + 12(T)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Principles of Electromagnetics |
| | Author | Mathew N. O. Sadiku |
| | Publisher | Oxford University Press Inc. |
| | Edition | |
| 2. | Title | Electromagnetism – Theory and Applications |
| | Author | AshutoshPramanik |
| | Publisher | PHI. |
| | Edition | |
| 3. | Title | Engineering Electromagnetics |
| | Author | W H Hayt, J A Buck |
| | Publisher | McGraw Hill Education |
| | Edition | |
| **Reference Book:** | | |
| 1. | Title | Theory and Problems of Electromagnetics |
| | Author | Joseph. A.Edminister |
| | Publisher | Tata McGraw Hill |
| | Edition | Second edition |
| 2. | Title | Electromagnetics with Applications |
| | Author | Kraus and Fleish |
| | Publisher | |
| | Edition | McGraw Hill International Editions, Fifth Edition, 1999 |

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| **Content** | **Unit I: Introduction** **5**<br>Sources and Effects of Electro-Magnetic Fields – Vector Fields – Different Co-ordinate Systems – Vector Calculus – Gradient, Divergence and Curl – Divergence Theory – Stoke's Theorem.<br><br>**Unit II: Electrostatics** **10**<br>Coulomb's Law – Electric field intensity – Field due to point and continuous charges – Gauss's lawand application – Electric potential – Electric field and equipotential plots – Electric field in freespace, conductors, dielectric -Dielectric polarization - Dielectric strength - Electric field in multipledielectrics – Boundary conditions, Poisson's and Laplace's equations – Capacitance- Energy<br><br>**Unit III: Magnetostatics** **11**<br>Lorentz Law of force, magnetic field intensity – Biot–savart Law - Ampere's Law – Magnetic field dueto straight conductors, circular loop, infinite sheet of current – Magnetic flux density (B) – B in freespace, conductor, magnetic materials – Magnetization – Magnetic field in multiple media –Boundaryconditions – Scalar and vector potential – Magnetic force – Torque – Inductance – Energy density –Magnetic circuits.<br><br>**Unit IV: Electro-Magnetic Waves** **10**<br>Generation – Electro Magnetic Wave equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors-skin depth, Skin Effect, Proximity Effect,Poynting vector – Plane wave reflection and refraction – Transmission lines–Line equations – Inputimpedances – Standing wave ratio and power, Smith's Chart. |
| **Curse Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: ECB 206 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Other Engg. Core | | | |
| **Course Title** | **Analog Electronics** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To make the Students<br>i. familiar with the structure of basic electronic devices.<br>ii. exposed to the operation and applications of electronic devices. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring:** Yes | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Electronic Devices and Circuits |
| | Author | David A. Bell |
| | Publisher | Prentice Hall of India |
| | Edition | |
| 2. | Title | Microelectronic Circuits |
| | Author | Sedra and smith |
| | Publisher | Oxford University Press |
| | Edition | 2004 |
| 3. | Title | Electronic Devices and Circuit theory |
| | Author | Robert L.Boylestad |
| | Publisher | Pearson Education |
| | Edition | 11 edition (2015) |
| 4. | Title | Integrated Electronics |
| | Author | Millman&Halkias |
| | Publisher | McGraw Hill Education |
| | Edition | 3 edition (2010) |

**Reference Book:**

| | | |
|---|---|---|
| 1. | Title | Electronic Devices |
| | Author | Floyd |
| | Publisher | Pearson Asia |
| | Edition | 9th Edition, 2012. |

| **Content** | **UNIT I Diodes** **4**<br>Review of semiconductors, p-n junction, forward and reverse biased junction, equivalent circuits; Applications - rectifier, clipper, clamper, voltage doubler, transfer characteristics; Zener diode; Power supply, filter, zener regulator; Special purpose diodes. |
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| | **UNIT II Bipolar Junction transistors** **9**<br>npn and pnp transistors, input and output characteristics - cut-off, saturation and active regions; CE, CB and CC configurations, small signal model, BJT as amplifier; Biasing circuits; Stability analysis, DC and AC equivalent circuits.<br>Small-signal Analysis:h-parameter model of BJT, analysis of BJT amplifier circuits, cascaded amplifiers, frequency response of RC coupled amplifier.<br><br>**UNIT III Power Amplifiers** **3**<br>DC and AC load lines; Class A operation; Class B operation, push-pull circuit; Biasing circuits, Class C amplifier; Current source<br><br>**UNIT IV Field Effect Transistors** **4**<br>Operating characteristic, transductance, JFET as amplifier, biasing circuits; Applications.<br><br>**UNIT V Operational Amplifier** **9**<br>Differential amplifier, level shifter, output stage and parameters of OPAMP; Applications of OPAMP: inverting and non inverting amplifier, active filters- low pass, high pass, band pass, active diode, active full wave rectifier, clipper, clamper, waveform generator circuits – square, triangular and sine wave generator.<br><br>**UNIT VI Oscillators** **4**<br>Barkhausen criterion, damped oscillation in LC circuits; Harmonic oscillators- RC-phase shift oscillator, transistor phase shift oscillator, Wein's bridge oscillator; Tuned oscillator- Colpitts oscillator, Hartley oscillator; Crystal oscillator<br><br>**UNIT VII Voltage Regulators** **3**<br>Zener voltage regulator, emitter follower regulator, series voltage regulator, IC regulator<br><br>**Laboratory Experiments:**<br>1. Ripple And Regulation Characteristics Of Full Wave And Half Wave With Filters (C,L,Lc,Clc)<br>2. Clippers And Clampers<br>3. Half Wave And Full Wave Voltage Doubler, Tripler.<br>4. BJT Characteristics NPN & PNP (CB, CC And CE).<br>5. Biasing Circuits Of BJT<br>6. Amplifier Class A,B,AB By Using BJT<br>7. FET Characteristics (N & P Channel)<br>8. MOSFET Characteristics (N & P Channel)<br>9. Op Amp Inverting And Non-Inverting Amplifiers.<br>10. Active Filters ( Low Pass , High Pass And Band Pass ) Using Op –Amp<br>11. Wein-Bridge Oscillator Using Op- Amp<br>12. RC Phase Shift Oscillators By Using BJT<br>13. Zener Diode & IC Voltage Regulator<br>14. Series & Emitter Follower Voltage Regulator |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| **Course no:**<br>**ECB 204** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of Course** | Theory | | **Core Engineering Course** | |
| **Course Title** | **SIGNALS AND SYSTEMS** | | | |
| **Course Coordinator** | DR. RAJIV KUMAR TRIPATHI | | | |
| **Course objectives:** | Coverage of continuous and discrete-time signals and systems, their properties and representations and methods those are necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc. Knowledge of frequency-domain representation and analysis concepts using Fourier Analysis tools, Z-transform. Mathematical and computational skills needed in application areas like communication, signal processing and control, which will be taught in other courses | | | |
| **POs** | | | | |
| **Semester** | **Autumn: Yes** | | **Spring: No** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 0 | 2 | 4 | |
| **Prerequisite course code as per proposed course numbers** | None | | | | |
| **Prerequisite Credits** | None | | | | |
| **Equivalent course codes as per proposed course and old course** | None | | | | |
| **Overlap course codes as per proposed course numbers** | None | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Signals and Systems |
| | Author | Alan V. Oppenheim, Alan S. Willsky with S. Hamid |

| | | |
|---|---|---|
| | | Nawab |
| | Publisher | PHI Publications |
| | Edition | |
| 2. | Title | Principles of Linear Systems and Signals |
| | Author | B.P. Lathi |
| | Publisher | Oxford University Press Publications |
| | Edition | |
| 3. | Title | Signals and Systems |
| | Author | Simon Haykin |
| | Publisher | John Wiley and Sons Publications |
| | Edition | |

**Content**

**Unit I:** **06**

What is Signal and System Theory? The black-box approach. Formal definition of 'signal' and 'system'. The domain and range variables, continuous and discrete signals and cont. and discrete systems. Signal operations: folding, Shifting, scaling for Continuous and Discrete Time Signal. Characterization of systems: memory, linearity, causality, time-invariance, stability and Invertibilty. Condition on Impulse response of a system for an LTI system for memory, linearity, causality, time-invariance, stability, Invertibilty.

**Unit II:** **08**

Periodic signals: definition, periodicity of the sum of two signals, Orthogonal functions, Sinusoidal Fourier Series, Derivation of Fourier coefficient of sinusoidal series, continuous-time complex exponential Fourier Series. Relationship between Fourier coefficient of Sinusoidal and Exponential Fourier Series, Signal approximation using truncated Fourier series. Brief discussion of convergence issues and conditions for existence of the CTFS. Aperiodic signals and their representation: the transition from the CTFS to the Continuous Time Fourier Transform (CTFT). Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the FT. Extension of the FT for finite power signals: frequency domain Dirac impulses. Properties of the FS and FT: particular emphasis on convolution.

**Unit III:** **08**

A discussion of the discrete-time complex exponential. Discrete time systems and complex exponentials. Periodic discrete signals: sampling periodic continuous time signals. Periodic signal as a sum of complex exponentials. The discrete-time Fourier series: analysis and synthesis equations. The DFT: N-point DFT of an M-point signal. Aperiodic signals and their representation: the transition from the DTFS to the discrete-time Fourier Transform. Finite power and finite energy signals. Brief discussion of convergence issues and conditions for existence of the DTFT. Extension of the DTFT for finite power signals: frequency domain Dirac impulses. Properties of the DTFS and DTFT: particular emphasis on convolution.

**Unit IV:** **08**

The principle of cont. signal sampling. The primary objective: perfect reconstruction. Ideal sampling and the sampling theorem: over- and under-sampling. Reconstruction theory: finite order interpolators and reconstruction distortion; ideal reconstruction. Non-ideal sampling and

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| | reconstruction. Sampling of discrete-time signals.<br>**Unit V:** **06**<br>Laplace Transform as a generalization of the FT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the LT. Inference of the FT from the LT. System characterization from the pole-zero plots. One-sided LT. The z-Transform as a generalization of the DTFT. The region of convergence and its properties. Pole-zero plots. Inverse transformation: role of the ROC in ensuring uniqueness. Properties of the ZT. Inference of the DTFT from the LT. System characterization from the pole-zero plot. Cont. to discrete system transformations. One-sided ZT.<br>**Tentative List of Experiments:**<br>1. Matlab Basics, Independent and dependent variable and function generation<br>2. Signal Generation: Such as unit impulse, unit step, Sinusoidal, exponential and others.<br>3. To create user function for performing signal operations: folding, Shifting, scaling, addition for continuous and discrete time signal.<br>4. Convolution and its properties for continuous and discrete time signal.<br>5.Implementation of Continuous Time Fourier Series (CTFS) of continuous periodic time signals.<br>6. Properties of CTFS and mplementation of Discrete Time Fourier Series (DTFS) of Discrete periodic time signals.<br>7.Properties of DTFS.<br>8. mplementation of Discrete Time Fourier Transform (DTFT) of discrete time aperiodic signals.<br>9. Properties of DTFT.<br>10. Implementation of Discrete Fourier Transform (DFT) of discrete time signals. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: MAL201 | Open course (YES/NO) : | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | NO | N | N | N |
| Type of course | Regular | | | |
| Course Title | Ordinary Differential Equations and Transforms | | | |
| Course Coordinator | DrAmitMahajan | | | |
| Course objectives: | This course provides an introduction to topics involving ordinary differential equations. Emphasis is placed on the development of abstract concepts and applications for first-order and linear higher-order differential equations, systems of differential equations, series solutions, special functions, Laplace and Fourier transforms. | | | |
| POs | | | | |

| Semester: 3rd | Autumn: Yes | | Spring: | | |
|---|---|---|---|---|---|
| | Lecture | Tutorial | Practical | Credits | Total Teaching Load |
| Contact Hours | 3 | 1 | 0 | 4 | 48 |
| Prerequisite course code as per proposed course numbers | Nil | Nil | | | |
| Prerequisite credits | Nil | Nil | | | |
| Equivalent course codes as per proposed course and old course | Nil | Nil | | | |
| Overlap course codes as per proposed course numbers | Nil | Nil | | | |

| Text Books: | | |
|---|---|---|
| 1. | Title | An Introduction to Ordinary Differential Equations, |
| | Author | E.A. Codington, |
| | Publisher | Dover Publications, |
| | Edition | 1989. |
| 2. | Title | Advanced Engineering Mathematics |
| | Author | E. Kreyszig, |
| | Publisher | John Wiley and Sons |
| | Edition | 8th Edition, 2008. |
| **Reference Book:** | | |
| 1. | Title | Advanced Engineering Mathematics, |
| | Author | R. K. Jain and S. R. K. Iyengar |
| | Publisher | Narosa Pub. House |
| | Edition | 2008. |

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| **Content** | **Unit I: Ordinary Differential Equations:** 14<br>Formation of differential equations; Separable equations; Equations reducible to separable form; Exact solutions, Exact equations, Integrating factors, Linear first order equations; Bernoulli's equation; Orthogonal trajectories. Homogeneous linear equations of arbitrary order with constant coefficients; Non-homogeneous linear equations with constant coefficients; Euler and Cauchy's equations; Method of variation of parameters; System of linear differential equations.<br><br>**Unit II: Special Functions:** 14<br>Classification of singularities of an ordinary differential equation, series solution, Method of Frobenius, Indicial equation; Examples of Bessel and Legendre functions; Bessel of first kind-recurrence formulae-generating functions-orthogonality of Bessel functions; Legendre polynomial-Rodrigue's formula- generating function-recurrence formula- orthogonality of Legendre polynomials.<br><br>**Unit III: Laplace Transform:** 6<br>Laplace transform– Inverse Laplace transform–properties of Laplace transforms, Convolution theorem–Solution ODE by Laplace transform. Laplace transform of periodic function, Dirac-Delta function, Unit Step function.<br><br>**Unit IV: Fourier Series and Transform:** 14<br>Fourier Series-Expansion of a function in Fourier series for a given range – Half range sine and cosine expansions. Fourier transformation and inverse transforms – sine, cosine transformations and inverse transforms–simple illustrations. |
| **Curse Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEB 251 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Core | | | |
| **Course Title** | **Electrical Machines-I** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To develop basic concepts of Transformers and DC machines. Understand their constructional details, working principles, operating characteristics, operational issues and practical applications. Understand the fundamental concepts of electro-mechanical energy conversion | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Electrical Machines |
| | Author | Nagrath and Kothari |
| | Publisher | Tata McGraw Hill |
| | Edition | |
| 2. | Title | Electrical Machinery |
| | Author | P. S. Bimbhra |
| | Publisher | Khanna Publisher |
| | Edition | Seventh |

**Reference Book:**

| | | |
|---|---|---|
| 1. | Title | Theory of AC Machinery |
| | Author | A.S.Langsdorf |
| | Publisher | Tata McGraw Hill |
| | Edition | |
| 2. | Title | Electric Machinery |
| | Author | A.E.Fitzerald, C.Kingsley and S.D.Umans |
| | Publisher | Tata McGraw Hill |
| | Edition | |

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| **Content** | **Unit I: Transformers 14**<br>Construction, theory and operation, E.M.F. equation, phasor diagram, ideal transformer, equivalent circuit, open and short circuit tests, back to back test, voltage regulation and efficiency, per-unit transformer values, application, auto-transformers, three winding transformer, parallel operation of single phase and three phase transformers, three phase |

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| | transformer connections, phasor groups, three phase to two phase and six phase conversion.<br><br>**Unit II: Basic Concepts of Rotating Electrical Machines 8**<br>Constructional details of various rotating machines, introduction to lap and wave windings, EMF generation, effect of chording and distribution of winding on EMF, Harmonics in generated emf, MMF produced by distributed winding.<br><br>**Unit III: DC Machines 14**<br>Construction, types of dc machine, EMF equation, armature reaction, commutation, interpoles and compensating windings, characteristics of dc generators, voltage build up, DC motor: principle, torque of dc machine, types of dc motors, characteristics of dc motor, speed control of dc motor, three point starter, four point starter, Ward-Leonard system, Swinburne's test, Hopkinson's test, braking of dc motor, losses and efficiency, applications of DC motors.<br><br>**Electrical Machines – I Laboratory:**<br>Determination of open circuit characteristic of D.C. machine, determination of load characteristics of D.C. generators, speed control of D.C. motors using armature control and field control methods, brake test on D.C. shunt motor & Swinburne's test, fields test on two identical D.C. series machines, retardation test on D.C. machines to determine moment of Inertia, Hopkinson test on two identical D.C. machines, O.C. and S.C. tests on single phase transformer, load test on single phase transformer, Sumpners test on two single phase transformers, Scott connection of single phase transformers, separation of no load losses of a single phase transformer. |
| **Curse Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| Course no: EEB 252 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Core | | | |
| **Course Title** | **Control Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This is a first course on feedback control of dynamic systems. It provides basic concepts and principles of modeling, analysis and controller design for continuous linear time-invariant systems with techniques including roots locus and frequency response methods. Laboratory experiments are designed so that the theory learnt in the class can be applied to real physical systems. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Control Systems Engineering |
| | Author | I.J. Nagarath& M. Gopal |
| | Publisher | New Age Pub. Company |
| | Edition | |
| 2. | Title | Automatic Control Systems |
| | Author | B.C. Kuo |
| | Publisher | PHI |
| | Edition | |
| 3. | Title | Modern Control Engineering |
| | Author | Kotsuhiko Ogata |
| | Publisher | Prentice Hall of India |
| | Edition | |

**Content**

**Unit I: Introduction** **3**

Concepts of control systems, open loop and closed loop control systems and their differences, different examples of control systems.

**Unit II: Mathematical Modeling and Transfer Function of Physical Systems5**

Mathematical modeling of electrical and mechanical systems, transfer function of DC servo motor, AC servo motor, block diagram representation of systems considering electrical systems as examples, block diagram reduction technique and signal flow graph, mason's gain formula.

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| | **Unit III: Time Response Analysis** **6**<br>Standard test signals, time response of first order systems, characteristic equation of feedback control systems, transient response of second order systems, time domain specifications, steady state response, steady state errors and error constants, effects of proportional derivative, proportional integral systems.<br><br>**Unit IV: Stability Analysis in S-Domain** **5**<br>The concept of stability- Routh's stability criterion, absolute, relative, conditional and bounded input, bounded output stability, limitations of Routh's stability.<br><br>**Unit V: Root Locus Technique** **5**<br>The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci.<br><br>**Unit VI: Frequency Response Analysis** **6**<br>Introduction, frequency domain specifications, bode diagrams-determination of frequency domain specifications and transfer function from the bode diagram, phase margin and gain margin, stability analysis from bode plots, polar plot, nyquist plots, stability analysis.<br><br>**Unit VII: Classical Control Design Techniques** **6**<br>Compensation techniques – Lag, Lead, Lead-Lag controllers design in frequency domain, PID controllers. |
| **Curse Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| Course no: EEL253 | Open course (Y/N) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Core | | | |
| **Course Title** | **Power Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To familiarize students with the infrastructure of power systems and to introduce the design aspects of power system generation, distribution and transmission and utilization. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **4** | **0** | **0** | **4** | 46 |
| **Prerequisite course code as per proposed course numbers** | NA | | | | |
| **Prerequisite credits** | NA | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Elements of Power System Analysis |
| | Author | J. J. Grainger and W.D. Stevenson |
| | Publisher | Tata McGraw-Hill Publishing Company Limited, |
| | Edition | 2008 |
| 2. | Title | Power System Engineering |
| | Author | D.P.Kothari, I. J. Nagarath |
| | Publisher | Tata McGraw Hill |
| | Edition | |
| 3. | Title | Electrical Power Systems |
| | Author | C.L.Wadhwa |
| | Publisher | New age international |
| | Edition | |

**Reference Book:**

| | | |
|---|---|---|
| 1. | Title | Electrical Power System- Concepts, Theory and Practices |
| | Author | Roy S. |
| | Publisher | Prentice Hall of India Private Limited |
| | Edition | 2007 |
| 2. | Title | Electric Power Systems |
| | Author | B.M. Weedy and B.J.Cory |
| | Publisher | Wiley India. |
| | Edition | 4th Ed. |

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| **Content** | **Unit I: Introduction 9**<br>General Structure of Electrical Power System- Introduction to Power System, Generation, Transmission, Distribution and Utilization- Overview Single Line Diagram (SLD) Representation. Different Types of Transmission Substations, Idea About Substation and Equipments in Substation, Radial and Grid Systems. Overhead vs. underground systems. Comparison of AC and DC systems and choice of working voltages for transmission and distribution.<br><br>**Unit II: Transmission Lines 10**<br>Line resistance, inductance and capacitance calculations, effect of earth on capacitance of overhead transmission lines, representation of lines: short transmission lines, medium length lines, nominal T and PI-representations, long transmission lines. The equivalent circuit representation of a long line, A, B, C, D constants, Ferranti Effect, Power flow through a transmission line, receiving end power circle diagram.<br><br>**Unit III: Travelling Waves10**<br>Production of travelling waves, open circuited line, short circuited line, line terminated through a resistance, line connected to a cable, reflection and refraction at T-junction line terminated through a capacitance, capacitor connection at a T-junction, Attenuation of travelling waves. corona loss, Factors affecting corona loss and methods of reducing corona loss.<br><br>**Unit IV: Overhead Line Insulators and Insulated Cables 10**<br>*Overhead line Insulators:* Introduction, types of insulators, Potential distribution over a string of suspension insulators, Methods of equalizing the potential.<br>*Insulated Cables:* Introduction, insulation, insulating materials, Extra high voltage cables, grading of cables, insulation resistance of a cable, Capacitance of a single core and three core cables, Overhead lines versus underground cables, types of cables.<br><br>**Unit V: Economics of Generation 9**<br>Introduction, definitions of connected load, maximum demand, demand factor, load factor, diversity factor, Load duration curve, number and size of generator units. Base load and peak load plants. Cost of electrical energy-fixed cost, running cost, Tariff on charge to customer. |
| **Curse Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: CSB 254 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | NO | NO | NO | NO |
| **Type of course** | **Other Engineering Courses** | | | |
| **Course Title** | **DIGITAL ELECTRONICS & LOGIC DESIGN** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This course is aimed to provide an introduction to digital logic design and its ability to understand number system representations, binary codes, binary arithmetic and Boolean algebra, its axioms and theorems, and its relevance to digital logic design. It also introduces combinational circuits, synchronous sequential logic and Asynchronous sequential logic. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| **IV** | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
| **Contact Hours** | 3 | 0 | 2 | 4 | 36 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

| **Text Books:** | | |
|---|---|---|
| 1 | Title | Digital Design |
| | Author | Mano, M. Morris |
| | Publisher | Pearson Education |
| | Edition | Third Edition, 2002 |
| **Reference Book:** | | |
| 1 | Title | Digital Fundamentals |
| | Author | Floyd, Thomas L. |
| | Publisher | Pearson Education, Singapore |
| | Edition | Seventh Edition, 2002 |
| 2 | Title | Digital Electronics |
| | Author | Gothmann, William H. |
| | Publisher | PHI, New Delhi |
| | Edition | Second Edition 2000 |
| 3 | Title | Jain, R.P. |
| | Author | Modern Digital Electronics |
| | Publisher | TMH, New Delhi |
| | Edition | Third Edition 2003 |

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|---|---|---|
| 4 | Title | Digital Logic Design |
| | Author | B Holdsworth |
| | Publisher | TMH, New Delhi |
| | Edition | Second Edition 1991 |
| 5 | Title | Logic Design Theory |
| | Author | Nripendran N. Biswas |
| | Publisher | PHI, New Delhi |
| | Edition | 1993 |
| 6 | Title | Leach, D. P., Albert P. Malvino |
| | Author | Digital Principles and Applications |
| | Publisher | TMH, New Delhi |
| | Edition | Fifth Edition 1995 |

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| **Content** | **Unit** I (5 Hours)<br>Binary systems: Digital Systems, Binary Numbers, Number Base Conversions, Octal And Hexadecimal Numbers, Complements, Signed Binary Numbers, Binary Codes, Binary Storage Registers And Binary Logic.<br><br>**Unit** II (7 Hours)<br>Basic Theorems And Properties Of Boolean Algebra , Boolean Functions, Canonical And Standard Forms, Other Logical Operations , Digital Logic Gates, Integrated Circuits.<br><br>**Unit** III (8 Hours)<br>Gate level minimization: The Karnaugh-Map Method, Four-Variable Map, Five-Variable Map, prime cubes, Minimum sum of Products and Product Of Sums Simplification, Don't –Care Conditions, NAND And NOR Implementation, prime implicant chart, cyclic prime implicant chart. LOGICFAMILIES<br><br>**Unit IV** (8 Hours)<br>Combinational Logic: Combinational Circuits, Analysis Procedure, Design Procedure, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, parallel adders and look-ahead adders, Magnitude Comparator, Decoders, Encoders, multiplexers and demultiplexers, parity generators and checkers.<br><br>**Unit** V (8 Hours)<br>Programmable Logic Devices, Introduction to sequential circuits, memory elements, latches. Flip-flops, analysis of sequential circuits, state tables, state diagrams, design of sequential circuits, excitation tables, registers, shift registers, counters. |
| **Course Assessment** | Continuous Evaluation 25% |
| | Mid Semester 25% |
| | End Semester 50% |

| **Course no:**<br>**MAL 251** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **Yes** | **No** |
| **Type of Course** | Theory | | | |
| **Course Title** | **PARTIAL DIFFERENTIAL EQUATIONS AND NUMERICAL ANALYSIS** | | | |
| **Course Coordinator** | DR. PRASHANT KUMAR | | | |
| **Course objectives:** | This course provides an introduction to topics involving partial differential equations and numerical methods. Firstly, emphasis is placed on the development of abstract concepts and applications of linear and nonlinear first order partial differential equations, solution of wave, heat and Laplace's equations. Secondly, this course focuses on computational methods since mathematical models describing physical phenomena are rarely analytically solvable. | | | |
| **POs** | | | | |
| **Semester** | **Autumn: No** | | **Spring: Yes** | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | 3 | 1 | 0 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | NIL | | | | |
| **Overlap course codes as per proposed course numbers** | NIL | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Numerical Analysis: Mathematics of Scientific computing |
| | Author | D. Kincaid and W Cheney, |

| | | |
|---|---|---|
| | Publisher | AMS |
| | Edition | 3rd edition 2002 |
| 2. | Title | Advanced Engineering Mathematics |
| | Author | E. Kreyszig, |
| | Publisher | John Wiley and Sons |
| | Edition | 8th Edition, 2008. |
| 3. | Title | |
| | Author | |
| | Publisher | |
| | Edition | |
| **Reference Books:** | | |
| 1. | Title | An Introduction to Numerical Analysis |
| | Author | K. E. Atkinson |
| | Publisher | John Wiley and Sons |
| | Edition | 2nd Edition 1989 |
| **Content** | **Unit I:** **24**<br>Partial Differential Equations: Formation and solutions of partial differential equations, Lagrange's linear equation of the first order, Non-linear equations, Charpit's method, Homogeneous linear equations with constant co-efficient, Non-homogeneous linear equations. Solutions of Wave equation, Heat equation and Laplace's equation by the method of separation of variables.<br><br>**Unit II:** **24**<br>Numerical Analysis: Principles of floating point computations and rounding errors. Solutions of nonlinear equations: Bisection method, Newton's method and its variants, fixed point iterations, convergence analysis; Newton's method for non-linear systems. Interpolation: Polynomial interpolation, Hermite interpolation, spline interpolation, error estimates. Numerical differentiation: Based on interpolation, the method of undetermined coefficients, Richardson extrapolation, Error estimates. Numerical integration: Based on interpolation, quadrature methods, Gaussian quadrature, Error estimates. Initial value problems: Taylor series method, Euler and modified Euler methods, Runge-Kutta methods, multistep methods, stability and convergence analysis. | |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% | |

| Course no: EEL 261 | Open course (Y/N) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Transducers & Signal Conditioning** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To impart knowledge of the principles, working and characteristics of transducers and the associated signal conditioning circuits for industrial applications. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Transducers and Instrumentation |
| | Author | D. V. S. Murty |
| | Publisher | Prentice-Hall of India Private Limited |
| | Edition | 2nd |
| 2. | Title | Instrumentation Devices & Systems |
| | Author | C.S. Rangan, G.R. Sarma and V. S.V. Mani |
| | Publisher | Tata Mc-Graw Hill |
| | Edition | 2nd |
| 3. | Title | A course in Electrical & Electronic Measurements & Instrumentation |
| | Author | A. K. Sawhney |
| | Publisher | Dhanpat Rai & Sons |
| | Edition | |

**Content**

**Unit I: Transducers** **10**

Introduction, classification, mechanical devices as primary detectors, basic requirements of a transducer, electrical transducers, type of transducers for measuring displacement, strain, vibration, pressure, flow, temperature, force, torque, liquid level, humidity, P. H. value, velocity (angular & linear), acceleration, basic principles of resistive transducers, inductive transducers, capacitive transducers, thermoelectric transducers, piezoelectric transducers, hall effect transducers, electromechanical transducers, photoelectric transducers, digital transducers.

**Unit II: Signal Processing Circuits** **8**

Introduction, ideal op-amp, operational amplifier specifications, zero

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| | crossing detector, zero crossing detector with hysteresis, inverting and non-inverting amplifiers, voltage-follower, adder, subtractor, multiplier, divider, integrator, differentiator, voltage to current converter, current to voltage converter, phase shifter circuit, absolute-value circuit, peak detector, ac to dc converter, logarithmic converter, differential-amplifier, instrumentation amplifier, analog modulators & demodulators.<br><br>**Unit III: Data Display and Recording Systems 5**<br>Introduction to analog and digital display methods, analog recorders, C.R.O., magnetic tape recorders, digital input-output devices, digital frequency meter, digital voltmeter.<br><br>**Unit IV: Data Transmission and Telemetry 6**<br>Introduction, characteristics of frequency division multiplexing, time-division multiplexing, transmission channels and media.<br><br>**Unit V: Data Acquisition and Conversion 7**<br>Introduction, signal conditioning of the inputs, single channel D A S, Multi-channel D A S, data conversion, multiplexer, S/H circuit, A/D converter. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL 262 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Biomedical Instrumentation** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To familiarize students with various types of biomedical instrumentation systems. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | EEL202 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Biomedical Instrumentation and Measurements |
| | Author | Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer |
| | Publisher | Prentice-Hall of India Private Limited |
| | Edition | 2nd |
| 2. | Title | Hand- book of Biomedical Instrumentation |
| | Author | R.S. Khandpur |
| | Publisher | Tata Mc-Graw Hill |
| | Edition | 2nd |
| 3. | Title | Biomedical Instruments: Theory and Design |
| | Author | Walter Welkowitz, Sid Deutsch and MetinAkay |
| | Publisher | Academic Press |
| | Edition | 2nd |

**Content**

**Unit I: Introduction** **4**

Development of biomedical instrumentation, components, physiological systems of the body and problems in measuring a living system.

**Unit II: Transducers and Electrodes** **5**

The transducers & transduction principles, active transducers, passive transducers, transducer for biomedical applications, pulse sensors, respiration sensors, bioelectric potentials, biopotential electrodes.

**Unit III: Biomedical Recorders and Display Systems** **4**

Block diagrams of electro cardiograph, phonocardiograph, electroencephalograph and electro-myograph.

**Unit IV: Patient Care and Monitoring** **4**

Elements of intensive care monitoring, patient monitoring displays,

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| | diagnosis, calibration &repairability of patient monitoring equipment, pacemakers, defibrillators.<br><br>**Unit V: Shock Hazards and Prevention 7**<br>Physiological effects of electric current, electric shock hazards from electrical equipment, methods of accident prevention.<br><br>**Unit VI: Bio-Telemetry 5**<br>Introduction, components of biotelemetry and applications of telemetry in patient care.<br><br>**Unit VII: Diagnostic Techniques 7**<br>X-ray machine and X-ray computed tomography, basic magnetic resonance imaging components, basic ultrasonic imaging system, computer applications in biomedical instrumentation. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL263 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Electrical Engineering Materials** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To familiarize students with the properties of various types of electrical engineering materials | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | EEL203 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Materials for Electrical Engineering |
| | Author | B.M.Tareev |
| | Publisher | Higher School Pubishing House |
| | Edition | 1st |
| 2. | Title | Electronic Properties |
| | Author | R. Rose, L.A. Shepard and J. Wulff |
| | Publisher | Wiley Eastern Pvt. Ltd |
| | Edition | 1st |

**Content**

**Unit I: Magnetic Materials** **9**

Dia, Para, Ferro, anti ferro and Ferri magnetic materials, soft and hard magnetic materials, tapes and films, magnetic anisotropy magnetostriction, effect of impurities, losses in magnetic materials.

**Unit II: Semiconductors** **9**

Silicon wafer preparation, different fabrication techniques involved in electronic chip in VLSI technology, conductivity of materials electrical and thermal conductivity of materials, bimetals high temperature materials, thermocouples, free electron theory of metals, factors affecting electric conductivity of metals, thermal conductivity of metals, heat developed in current carrying conductors, thermoelectric effect, super conductivity.

**Unit III: Dielectric Materials** **9**

Field vectors, polarization, Ferro electricity and Piezo electrics, behavior of polarization under impulse and frequency switching, dielectric loss, spontaneous polarization.

**Unit IV: Insulating Materials** **9**

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| | Electrical, mechanical and thermal properties of liquid, solid, fibrous insulating materials, glass, ceramic, mineral and plastic materials,relationships between structure and electrical, mechanical, thermal, chemical properties. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL264 | Open course (Y/N) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| Type of course | | | | YES |
| Course Title | Electrical Distribution systems | | | |
| Course Coordinator | | | | |
| Course objectives: | To impart knowledge about power distribution system and study of automation- SCADA. | | | |
| POs | | | | |

| Semester | Autumn: | | Spring: Yes | | |
|---|---|---|---|---|---|
| | Lecture | Tutorial | Practical | Credits | Teaching Hours |
| Contact Hours | 3 | 0 | 0 | 3 | 36 |
| Prerequisite course code as per proposed course numbers | | | | | |
| Prerequisite credits | | | | | |
| Equivalent course codes as per proposed course and old course | | | | | |
| Overlap course codes as per proposed course numbers | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Electric Power Distribution |
| | Author | A.S. Pabla |
| | Publisher | Tata McGraw Hill Publishing Co. Ltd |
| | Edition | 4th |
| 2. | Title | Learning Material for Electrical Power Distribution |
| | Author | M.K. Khedkar, G.M. Dhole |
| | Publisher | Laxmi Publications Ltd |
| | Edition | |

**Content**

**Unit I: Load and Energy Forecasting 9**

Distribution of power, Management, Power Loads, Load Forecasting, Power System Loading, Technological Forecasting. Need Based Energy Management (NBEM) – Objectives:, Advantages, Distribution Management System (D.M.S.)

**Unit II: Distribution Automation 9**

Definition, Restoration / Reconfiguration of Distribution Network, Different Methods and Constraints. Interconnection of Distribution, Control & Communication Systems.

**Unit III: SCADA 8**

Introduction, Block Diagram, SCADA Applied To Distribution Automation. Common Functions of SCADA, Advantages of Distribution Automation through SCADA.

**Unit IV: Switch Placement, maintenance and managements 10**

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial, Distribution Systems,

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| | Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Maintenance of Automated Distribution Systems, Difficulties in implementing Distribution. Automation in Actual Practice, Urban/Rural Distribution, Energy Management. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL 265 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Power station Practice** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn the operations of various power plants. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Elements of Electrical Power Station Design |
| | Author | M.V. Deshpande |
| | Publisher | Prentice-Hall of India Private Limited |
| | Edition | |
| 2. | Title | Generation of Electrical Energy |
| | Author | B.R. Gupta |
| | Publisher | Eurasia Publishing house |
| | Edition | 4th |
| 3. | Title | Power Plant Technology |
| | Author | M.M. El-Wakil |
| | Publisher | McGraw- Hill |
| | Edition | |
| 4. | Title | A Course in Power Plant Engineering |
| | Author | Arora and Domkundwar |
| | Publisher | Dhanpat Rai and Sons |
| | Edition | 3rd |

**Content**

**Unit I: Conventional Sources of Electrical Energy 6**

Steam, Hydro, Nuclear, Diesel and Gas; Their Scope and Potentialities for Energy Conversion

**Unit II : Generation 4**

Different Factors Connected With a Generating Station; Load Curve, Load Duration Curve, Energy Load Curve; Base Load and Peak Load Plants.

**Unit III: Thermal Stations 6**

Selection of Site, Size and Number of Units, General Layout, Major Parts, Auxiliaries, Generation Costs Of Steam Stations.

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| | **Unit IV: Hydro Stations** **6**<br>Selection of Site, Mass Curve, Flow Duration Curve, Hydrograph, Classification of Hydro Plants, Types of Hydro Turbines, Pumped Storage Plants.<br><br>**Unit V: Nuclear Stations** **6**<br>Main Parts, Location, Principle of Nuclear Energy, Types of Nuclear Reactors, Reactor Control, Nuclear Waste Disposal.<br><br>**Unit VI: Power Station Control and Interconnection** **8**<br>Excitation Systems, Excitation Control, Automatic Voltage Regulator Action; Advantage of interconnection , Alternate Energy Sources Overview |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL 266 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Finite Element Methods and Applications** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To introduce finite element methods and their applications in engineering. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | An Introduction to the Finite Element Method |
| | Author | J.N. Reddy |
| | Publisher | McGraw Hill |
| | Edition | 3rd |
| 2. | Title | Electrical Machine analysis using Finite Elements |
| | Author | Nicola Biyanchi |
| | Publisher | Taylor and Francis Group, CRC Publishers |
| | Edition | |
| 3. | Title | Finite Element Analysis of Electrical Machines |
| | Author | S.J. Salon |
| | Publisher | Kluwer Academic Publishers |
| | Edition | |
| 4. | Title | Applied Finite Element Analysis |
| | Author | L.J. Segerlind |
| | Publisher | John Wiley |
| | Edition | 2nd |
| **Reference Book:** | | |
| 1. | Title | Finite Element Method in Engineering |
| | Author | S.S. Rao |
| | Publisher | Pergamon Press |
| | Edition | 2nd |
| 2. | Title | Finite Elements in Engineering |
| | Author | Chandrupatla&Belagundu |
| | Publisher | Prentice Hall of India Private Ltd. |
| | Edition | |
| 3. | Title | Finite Elements and Applications to |

| | | |
|---|---|---|
| | | Electromagnetics |
| | Author | Chary |
| | Publisher | John Wiley and Sons |
| | Edition | |

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|---|---|
| **Content** | **Unit I: Introduction** **9**<br>Basic Concepts of FEM – Variational Formulation B. V. P – Ritz method – Finite Element Modeling – Element Equations – Linear and Quadratic shape functions.<br><br>**Unit II: Finite Element Analysis of 2D problems** **9**<br>Basic Boundary Value Problems in 2 Dimensions - Triangular, quadrilateral, higher order elements -Poisson's and Laplace Equations - Weak Formulation - Elements Matrices and Vectors.<br><br>**Unit III: ISO Parametric Formulation** **9**<br>Natural Co-ordinate System - Lagrangian Interpolation Polynomials - Iso-parametric Elements -Formulation - Numerical Integration - 1D -2D Triangular elements - rectangular elements.<br><br>**Unit IV: Applications** **9**<br>Introduction, magnetic circuits, reviews of electromagnetic theory, application of finite element method to magnetic circuit design. CAD tools - SPEED™, MAXWELL™ and applications to magnetic circuit design. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| Course no: EEL 267 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | | | | YES |
| **Course Title** | **Instrumentation & Measurement** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | After learning this course students should have:<br>1. Sound knowledge on Displacement and Strain measuring techniques.<br>2. Sound knowledge on thermocouples, pyrometer and other temperature measuring techniques.<br>3. Familiar with the operation and usage of various waveform analysing instruments | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring: Yes** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | EEB 100 & EEL 202 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Transducers and Instrumentation |
| | Author | D. V. S Murty |
| | Publisher | Prentice–Hall of India Private Limited |
| | Edition | |
| 2. | Title | Principles of Industrial Instrumentation |
| | Author | D Patranabis |
| | Publisher | Tata McGraw Hill |
| | Edition | 2nd |
| 3. | Title | A course in Electrical & Electronic Measurements & Instrumentation |
| | Author | K. Sawhney |
| | Publisher | Dhanpat Rai & Sons |
| | Edition | |

**Content**

**UnitI: Introduction to instrumentation 4**

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, Statistical analysis of measurement data. Standards and Calibration.

**Unit II: Measurement of Displacement and Strain 8**

Resistive, inductive and capacitive transducers for displacement; Wire, metal film and semiconductor strain gauges; LVDT; Synchros, eddy current transducers, proximity detectors, Wheatstone-bridge circuit with one, two and four active elements, temperature compensation.

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| | Measurement of Speed and Torque:Electro-magnetic and photoelectric tachometers; Torque shaft, strain-gauge, electromagnetic and radio type torque meters.<br>Measurement of Force and Pressure: Column, ring and cantilever-beam type load cells; Elastic elements for pressure sensing; Using displacement sensors and strain gauges with elastic elements.<br><br>**Unit III: Measurement of Temperature 7**<br>Resistance temperature detector (RTD), principle and types, construction requirements for industry, measuring circuits. NTC and PTC Thermistors, principle and types, manufacturing techniques, measuring circuits, linearization methods and applications. Seebeck effect, thermocouple and thermopile. Pyrometers, integrated circuit sensors, diode type sensors, ultrasonic thermometers, Johnson noise thermometer, fluidic sensors, spectroscopic temperature measurements, thermograph, temperature switches and thermostats.<br>Radiation measurement: Radiation thermometers, introduction, definition of terms, general form of radiation measurement system, radiation thermometer types, photo electric radiation thermometers, signal conditioning for radiation thermometers, remote reading thermometers. Temperature sensor selection and applications.<br><br>**Unit IV: Flow measurement 7**<br>Introduction, definitions and units, classification of flow meters, pitot tubes, orifice meters, venture tubes, flow tubes, flow nozzles, positive displacement liquid meters and provers, positive displacement gas flow meters, variable area flow meters.<br>Anemometers: Hot wire/hot film anemometer, laser doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters.<br>Measurement of mass flow rate: Radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine coriolis, gyroscopic and heat transfer type mass flow meters.<br><br>**Unit V: Analog Electronic Instrumentation 5**<br>Tuned and sampling voltmeters; AC and DC current probes; Wave analyser, harmonic distortion meter, harmonic analyser, spectrum analyser.<br><br>**Unit VI: Digital Electronic Instrumentation 5**<br>Digital counter-timer and frequency meter, time standards, digital voltmeter and multimeter, accuracy and resolution considerations, comparison with analog electronic instruments. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

| **Course no: EEB 301** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **Yes** | **No** |
| **Type of Course** | Theory and Practical | | | |
| **Course Title** | **Electrical Machines - II** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To develop the basic understanding of ac rotating electrical machines. Familiarize with constructional details, working principles, operating characteristics, operational issues and practical applications of single-phase &three-phase Induction Machines and Synchronous Machines. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | **EEB 251** | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| | | |
|---|---|---|
| 1. | Title | Electric Machinery |
| | Author | A.E.Fitzerald, C.Kingsley and S.D.Umans |
| | Publisher | Tata McGraw Hill |
| | Edition | |
| 2. | Title | Theory of AC Machinery |
| | Author | A.S.Langsdorf |
| | Publisher | Tata McGraw Hill |
| | Edition | |

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|---|---|
| **Content** | **Unit I: Polyphase Induction Machines**<br><br>Theory of three phase induction motors, principle of operation, slip, equivalent circuits, expression for torque, full load torque, maximum torque, starting torque and output power, torque-slip and torque-speed characteristics, circle diagram, no load and blocked rotor test, deep bar cage and double cage induction motor, starting of induction motors, speed control of induction motor, cogging &crawling, induction generators.<br><br>**Unit II: Single Phase Induction Motors**<br><br>Principle of operation on the basis of double revolving field theory, equivalent circuit<br><br>**Unit III: Synchronous Machines**<br><br>Types of exciters for synchronous machines, flux and MMF phasor diagrams for cylindrical rotor synchronous machines, armature reaction, open and short circuit characteristics, leakage reactance, synchronous reactance, phasor diagram under loaded conditions, operating characteristics of alternators and their ratings, predetermination of regulation by EMF and potier triangle methods for non-salient pole alternators, steady state power flow equations, power angle characteristics, constant excitation and constant power output, circle diagram for synchronous machines, two reaction theory for salient pole alternators and pre-determination for regulation, slip test, V curves, hunting and its suppression, starting of synchronous motor, synchronous condenser.<br><br>**Unit IV: Parallel Operation of Alternators**<br><br>Synchronization of alternators by dark lamp method, parallel operation of alternators, alternator on infinite bus bar, effect of change of excitation and prime mover inputs.<br><br>**Electrical Machines – II Laboratory**<br><br>Determination of equivalent circuit parameters of three phase induction motor, Brake test on 3-phase induction motor, circle diagram of 3-phase induction motor, speed control of 3-phase induction motor, single phase operation of 3-phase induction motor, regulation of 3-phase alternator by Z.P.F. method, parallel operation of alternators, determination of V and inverted V curves of 3-phase synchronous machine, characteristics of 3-phase Schrage motor, no load and load characteristics of an amplidyne, determination of equivalent circuit parameters of single phase induction motor. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory for overall grading |

| Course no: EEL 302 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Theory | | | |
| **Course Title** | **Power System Analysis** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To provide in-depth knowledge of power system analysis under normal conditions and on fault, and the concepts of power system and voltage stability. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring:** No | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **1** | **0** | **4** | **36(L) + 12(T)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Power System Analysis |
| | Author | H.Saadat |
| | Publisher | Tata McGraw-Hill Publishing Company Limited |
| | Edition | 2008 |
| 2. | Title | Computer Techniques in Power System Analysis |
| | Author | M. A.Pai |
| | Publisher | Tata McGraw-Hill Publishing Company Limited |
| | Edition | 2nd Ed.,2008 |
| 3. | Title | Reactive Power Control in Electric Systems |
| | Author | T. J. E.Miller |
| | Publisher | John Wiley and Sons |
| | Edition | 2010 |
| 4. | Title | Power System Analysis |
| | Author | J. J. Grainger and W. D.Stevenson |
| | Publisher | McGraw-Hill International Book Company |
| | Edition | 2008 |
| 5. | Title | Power System Analysis and Design |
| | Author | J. D. Glover and M. S.Sarma |
| | Publisher | Cengage Learning |
| | Edition | 4th Ed. |

| **Content** | **Unit I: Formation of Network Matrices**<br>Formation of admittance matrix with and without mutual impedances, Z-bus |
|---|---|

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| | building algorithm with and without mutual impedances.<br><br>**Unit II: load flow analysis**<br><br>Formation of static load flow equations, solution of load flow problem by Gauss-Seidel, Newton-Raphson (polar and rectangular) and fast decoupled techniques.<br><br>**Unit III: Short circuit Analysis**<br><br>Significance of positive, negative and zero sequence components, Average 3-phase power in terms of symmetrical components, sequence impedances and sequence networks, fault calculations, sequence network equations, single line to ground fault, line to line fault, double line to ground fault, three phase fault, faults on power systems, faults with fault impedance, reactors and their location, short circuit capacity of a bus.<br><br>**Unit IV: Power System stability**<br><br>Swing equation, power angle equation, synchronizing power coefficient, basic concepts of steady state, dynamic and transient stability, equal area criterion, solution of the swing equation, multi-machine transient stability studies with classical machine representation.<br><br>**Unit V: Voltage stability**<br><br>Introduction, comparison of angle and voltage stability, reactive power flow and voltage collapse, mathematical formulation of voltage stability problem, voltage stability analysis, prevention of voltage collapse, trends and challenges |
| **Curse Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEB 303 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | | DE (Y/N) |
|---|---|---|---|---|---|
| | **No** | **No** | **Yes** | | **No** |
| **Type of Course** | Theory and Practical | | | | |
| **Course Title** | **Introduction to Microprocessors and Interfacing** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To introduce the 8085 and 8086 microprocessors and their interfacing | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** Yes | | **Spring:** No | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |
| **Text Books:** | | | | | |
| 1. | Title | Microprocessors and Interfacing | | | |
| | Author | Douglas V. Hall, SSSP Rao | | | |
| | Publisher | Mc Graw Hill | | | |
| | Edition | 3rd Edition, 2012 | | | |

**Content**

**Unit I : 8085 and 8086 Microprocessor Architectures**

The 8085 Microprocessor Family Overview, Registers in 8085, 8085 Machine Instructions, Main features of 8086, Important 8086 pin diagram/Description, The 8086 Microprocessor family-An overview, 8086 Internal Architecture, The BIU, Introduction to programming 8086, a basic 8086 microcomputer system

**Unit II : 8086 Family Assembly Language programming**

Constructing machine codes for 8086 instructions, Introduction to assembler EMU8086, 8086 instruction descriptions and assembler directives, assembly level programs using assembler EMU8086

**Unit III : Input and output modes and interfacing**

Peripheral Devices, Input/output Devices, I/O modes in computer systems, Programmed I/O mode, Interrupt Mode of I/O, 8086 Interrupts and Interrupt Responses, Hardware Interrupt Applications, 8254 Software programmable timer/counter, 8259A Priority Interrupt Controller, Software Interrupt Applications, Direct Memory Access (DMA) Mode I/O, I/O

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|---|---|
| | Channels<br><br>**Laboratory:** Experiments follow the contents of the course covered during the lectures. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br><br>Lab: Continuous Evaluation 50% End Semester 50%<br><br>60% weightage to theory and 40 % weightage to laboratory foroverall grading |

| Course no: ECB 304 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | | DE (Y/N) |
|---|---|---|---|---|---|
| | **NO** | **N** | **N** | | **N** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **IC Applications** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | This course is aimed to cover OP AMP basic characteristics, AC and DC parameters. It also covers OP AMP linear as well as non linear applications. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn: Yes** | | **Spring:** | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Load** |
| **Contact Hours** | 3 | 0 | 2 | 4 | 48 |
| **Prerequisite course code as per proposed course numbers** | Analog Electronics | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | OP-AMP and linear integrated circuits |
| | Author | Ramakant A. Gayakwad. |
| | Publisher | Pearson Pub. |
| | Edition | 2nd |
| 2. | Title | Design with operation amplifiers and Analog Integrated circuits |
| | Author | Sergei Franco |
| | Publisher | John Wiley and Sons |
| | Edition | 2011 |
| **Reference Books:** | | |
| 1. | Title | Integrated Electronics: Analog and Digital circuits & system |
| | Author | Millman & Halkias |
| | Publisher | TMH |
| | Edition | 2008 |

| | |
|---|---|
| **Content** | **Unit I: INTRODUCTION TO OPERATIONAL AMPLIFIERS**:<br><br>The basic operational amplifier & its schematic Bsymbol, Block diagram representation of OP-AMP, Power supply requirements of an OP-AMP, Evolution of OP-AMP., Specification of a typical OP-AMP (741).<br><br>**Unit II: THE PRACTICAL OP-AMP**:<br><br>Input offset voltage, input bias current, input offset current. total output offset voltage, thermal drift, error voltage, variation of OP-AMP parameter with temperature & supply voltage. Supply voltage rejection ration (SVRR), CMRR-Measurement of OP-AMP parameters.Frequency response compensator networks. Frequency response of internally compensated OP-AMP & non-compensated OP-AMP. High frequency OP-AMP equivalent circuit, open loop voltage gain as a function of frequency. Slew rate, causes of slew rates and its effects in application.<br><br>**Unit III: OPERATIONAL AMPLIFIER CONFIGURATIONS & LINEAR APPLICATION:**<br><br>Open loop OP-AMP configurations- The differential amplifier, inverting amplifier, noninverting amplifier, negative feed back configurations - inverting and non inverting amplifiers, voltage followers & high input impedance configuration, differential amplifiers, closed loop frequency response & circuit stability, single supply operation of OP-AMP, summing, scaling and averaging amplifier, voltage to current & current to voltage converters, integrators & differentiators, logarithmic & anti logarithmic amplifiers.<br><br>**Unit IV: ACTIVE FILTERS & OSCILLATORS:**<br><br>Advantages of active filters, classification of filters, response characteristics of butter worth, chebyshev, causal filters, first order and second order butter worth filters- low pass and high pass types. Band pass & band reject filters. Oscillator principles, types of oscillators - phase shift, wein bridge & quadrature. square wave, triangular wave and saw tooth wave generators, voltage controlled oscillator.<br><br>**Unit V: COMPARATORS & CONVERTERS:**<br><br>Basic comparator & its characteristics, zero crossing detector, voltage limiters, clippers & clampers, small signal half wave & full wave rectifiers, absolute value detectors, sample and hold circuit. |
| **Course Assessment** | Continuous Evaluation 25%<br>Mid Semester 25%<br>End Semester 50% |

**Elective - II**

| **Course no: EEL 311** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Elective | | | |
| **Course Title** | **Digital Image Processing** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn the basics of Image Analysis | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**,

| | | |
|---|---|---|
| 1. | Title | Digital Image Processing |
| | Author | R. Gonzalez and R. E. Wood |
| | Publisher | Pearson Education |
| | Edition | 3rd Edition, 2016 |
| 2. | Title | Introductory Computer Vision and Image Processing |
| | Author | Adrian Low |
| | Publisher | McGraw Hill |
| | Edition | |
| 3. | Title | Fundamentals of Digital Image Processing |
| | Author | A. K. Jain |
| | Publisher | Pearson Education |
| | Edition | 2015 |
| 4. | Title | Pattern Recognition |
| | Author | William Gibson |
| | Publisher | Berkley |
| | Edition | 2005 |

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|---|---|
| **Content** | **Unit I: Introduction**<br><br>Digital image representation, fundamental steps in image processing, elements of digital image processing systems, elements of visual perception, image model, sampling and quantization, relationship between pixels, imaging geometry.<br><br>**Unit II: Image Enhancement** |

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| | Enhancement by point processing, sample intensity transformation, histogram processing, image subtraction, image averaging, spatial filtering, smoothing filters, sharpening filters, frequency domain: low-pass, high-pass, homomorphic filtering.<br><br>**Unit III: Image Transformations**<br><br>*Geometric transformations*: Translation, rotation, scaling and shearing. *Frequency transformation*: Discrete Fourier transform (DFT), fast Fourier transform (FFT), short-time Fourier transform (STFT), *Multi-resolution Expansions*: Wavelet Transforms in 1-D and 2-D., Wavelet Packets Transform.<br><br>**Unit IV: Image Compression**<br><br>Coding redundancy, Inter-pixel redundancy, fidelity criteria, image compression models, error-free compression, variable length coding, bit-plane coding, loss-less predicative coding, lossy compression, image compression standards, Real-Time image transmission, JPEG and MPEG.<br><br>**Unit V: Image Segmentation**<br><br>Detection of discontinuities, edge linking and boundary detection, thresholding, region oriented segmentation, use of motion in segmentation, spatial techniques, frequency domain techniques. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 312 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Distribution System Planning &Automation** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To provide in-depth knowledge of distribution system components, planning and protection. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL253<br>EEL265 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| 1. | Title | Electric Power Distribution Engg |
|---|---|---|
| | Author | Turan Gonen |
| | Publisher | Mc Graw Hill |
| | Edition | |

**Content**

**Unit I: Distribution System Planning**

Planning and forecasting techniques, load characteristics- definitions, load forecasting, load management, tariffs.

**Unit II: Distribution Transformers**

Types, three phase and single phase transformers, connections, dry type and self protected type transformers, regulation and efficiency.

**Unit III: Distribution Sub-Stations**

Introduction to distribution substations, bus schemes, substation location and rating, primary systems, voltage drop and power loss calculations, location of capacitors in distribution systems.

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| | **Unit IV: Distribution System Protection**<br><br>Distribution system automation, Grounding-necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 313 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Micro Electro Mechanical systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand the working and operation principle of various MEMS Devices | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | D. H. Modeling MEMS and NEMS |
| | Author | Pelesko, J. A. and Bernstein |
| | Publisher | Chapman and Hall/CRC, 2003 |
| | Edition | |
| 2. | Title | On Variational Approaches to Plate Models |
| | Author | Teresi, L. and Tiero, A., 1997 |
| | Publisher | Meccanica, 32, 143-156 |
| | Edition | |
| 3. | Title | Review of modeling electrostatically actuate microelectromechanical systems |
| | Author | Batra, R. C., Porfiri, M., Spinello, D. |
| | Publisher | Smart Materials and Structures, 16(6), R23-R31. |
| | Edition | |

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| **Content** | **Unit I:**<br><br>Non-dimensionalization and single degree of freedom systems, Elastic MEMS and kinematics of continua. Equilibrium equations, constitutive equations in linear elasticity, and Naviers's equations**.**<br><br>**Unit II:**<br><br>Strings and Membranes, Beam Theory. Variation Calculus: Lagrange's equations and an alternative way to look at strings, membranes and plates. |

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| | **Unit III:**<br><br>Plate Theory, Plate Problems. Fundamentals of electrodynamics and small is different. Analysis of single degree of freedom models for electrostatically actuated MEMS.<br><br>**Unit IV:** Modelling electrostatically actuated micro membranes, Modelling and numerical analysis of electrostatically actuated micro beams and micro plates. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 314 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Advanced Control Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To familiarize students with classical and modern control systems including non-linear systems. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 252 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Control System Engineering |
| | Author | Nagrath I. J. and Gopal M. |
| | Publisher | New Age International Private Ltd. Publishers. |
| | Edition | 5th Ed. |
| 2. | Title | Automatic Control System |
| | Author | Kuo B.C. |
| | Publisher | Wiley India |
| | Edition | 8th Ed. |
| 3. | Title | Modern Control Engineering |
| | Author | Ogata K. |
| | Publisher | Pearson Education |
| | Edition | 4th Ed. |

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| **Content** | **Unit I: State Variable Approach:**<br><br>Derivation of state model of linear time invariant (LTI) continuous systems, transfer function from ordinary differential equations, canonical variable diagonalization, system analysis by transfer function and state space methods for continuous,<br>Systems convolution integral; State transition matrices and solution of state equations for continuous and discrete time system.<br><br>**Unit II: Discrete Data Systems:** |

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| | Introduction to discrete time systems, sample and hold circuits, pulse transfer function, representation by difference equations and its solution using z-transform and inverse z transforms, analysis of LTI systems, unit circle concepts; Stability<br><br>**Unit III: Controllability and Observability:**<br><br>Concept of controllability and observability, definitions, state and output controllability and observability tests for continuous and discrete systems, controllability and observability of time varying systems.<br><br>**Unit IV: Modern Control:**<br><br>Introduction, effect of state feedback on controllability and observability, design via state feedback full order observer, reduced order observers design of state observers and controllers.<br><br>**Unit V: Non Linear Systems:**<br><br>Types of non linearity, limit cycles, jump resonance, linearization techniques; Perturbation methods: phase plane and describing function analysis; Stability concepts, Lyapunov functions for linear and non linear systems. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 315 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Energy Audit &Management** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To impart knowledge to the students about current energy scenario, energy management, auditing and assessment. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL-253, EEB - 251 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Industrial Energy Management: Principles Applications |
| | Author | Giovanni and Petrecca |
| | Publisher | The Kluwer International Series-207, 1999 |
| | Edition | |
| 2. | Title | Handbook of Energy Audits |
| | Author | Albert Thumann |
| | Publisher | Fairmont press |
| | Edition | 5th edition 1998 |
| 3. | Title | Energy Efficient Electric Motors and Applications |
| | Author | H.E. Jordan |
| | Publisher | Plenum Pub. Corp |
| | Edition | second edition 1994 |
| 4. | Title | Energy Management Handbook |
| | Author | W.C. Turner |
| | Publisher | John Wiley and Sons |
| | Edition | |
| 5. | Title | Energy Management |
| | Author | W. R. Murphy, G. Mckay |
| | Publisher | Butterworths |
| | Edition | |

**Content**

**Unit I: Energy Audit and Management**

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach understanding energy costs, Bench marking, Energy

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| | performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit Instruments energy management, Roles and responsibilities of energy Manager and Accountability, Financial analysis techniques, Financing options, Energy performance contracts and role of ESCOs. Defining monitoring &targeting, Elements of monitoring&targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences.<br><br>**Unit II: Energy Efficiency in Electrical Systems**<br><br>Electricity billing, Electrical load management and maximum demand Control, Maximum demand controllers; Power factor improvement, Automatic power factor controllers, efficient operation of transformers, Energy efficient transformers; Induction motors efficiency, motor retrofitting, energy efficient motors, Soft starters, Variable speed drives; Performance evaluation of fans and pumps, Flow control strategies and energy conservation opportunities in fans and pumps, Energy efficiency measures in lighting system, Electronic ballast, Occupancy sensors, Energy efficient lighting controls Factors affecting selection of DG system, Energy performance assessment of diesel conservation avenues.<br><br>**Unit III: Energy Conversion in Thermal systems**<br><br>Types of boilers, Combustion in boilers, Performances evaluation, Feed water treatment, Blow down, Energy conservation opportunities in boiler, Properties of steam, Assessment of steam distribution losses,Steam leakages, Steam trapping, Condensate and flash steam recovery system, Identifying opportunities for energy savings. Classification, General fuel economy measures in furnaces, Excess air, Heat Distribution, Temperature control, Draft control, Waste heat recovery. Insulation-types and application, Economic thickness of insulation, Heat savings and application criteria.<br><br>**Unit IV: Energy Performance &Assessment**<br><br>On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, Fans and pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio( ILER ) method Financial Analysis: simple payback period, NPV, IRR, Case studies of few selected industries, analysis of results and inference. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 316 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Renewable Energy Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn the principles of generating Heat Energy and Electrical energy from Non-conventional / Renewable Energy Sources. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** Yes | **Spring:** No | | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Wind power generation |
| | Author | Nick Jackinse |
| | Publisher | IET |
| | Edition | |
| 2. | Title | Analysis of electrical machinery |
| | Author | P. C. Krause |
| | Publisher | Wiley-IEEE Press |
| | Edition | |

**Content**

**Unit I: Solar Energy &Wind energy**

Introduction, Brief history about wind turbine, installed wind turbine worldwide, their usage and electricity generation capability.

**Unit II: Wind turbines**

Construction, working, principle, different types turbine blades, their structure, horizontal and vertical wind turbine system, power in the wind, various factors affecting the power in the wind, impact of tower height, Betz experiment, coefficient of performance, tip speed ratio, Weibull distribution function, Rayleigh probability distribution function, cumulative distribution function, average wind speed, capacity factor, wake effect.

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|---|---|
| | **Unit III: Generator system**<br><br>Squirrel cage induction generator, principle and working, equivalent circuit and derivation of circuit parameters, wound rotor induction generator, equivalent circuit and parameter derivation, Doubly fed induction machine – power injected from network in to rotor and from rotor to network, equivalent circuit, induction machine – dynamic modelling. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 317 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Restructuring in Power Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand the electricity power business and technical issues in a restructured power system in both Indian and world scenario. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Operation of Restructured Power Systems |
| | Author | K. Bhattacharya, MHT Bollen and J.C Doolder |
| | Publisher | Kluwer Academic Publishers, USA, 2001 |
| | Edition | |
| 2. | Title | Power System restructuring and deregulation |
| | Author | Lei Lee Lai |
| | Publisher | John Wiley and Sons |
| | Edition | UK. 2001 |

**Content**

**Unit I: Deregulation of the Electricity Supply Industry**

Deregulation, Reconfiguring Power systems, unbundling of electric utilities, Background to deregulation and the current situation around the world, benefits from a competitive electricity market, after-effects of deregulation.

**Unit II: Power System Operation in Competitive Environment**

Role of the independent system operator, Operational planning activities of ISO: ISO in Pool markets, ISO in Bilateral markets, Operational planning activities of a GENCO: Genco in Pool and Bilateral markets, market participation issues, competitive bidding

**Unit III: Transmission/Distribution Open Access and Pricing Issues**

| | |
|---|---|
| | Power wheeling, Transmission open access, pricing of power transactions, security management in deregulated environment, and congestion management in deregulation<br><br>**Unit IV: Ancillary Services Management**<br><br>General description of some ancillary services, ancillary services management in various countries, and reactive power management in some deregulated electricity markets<br><br>**Unit V: Reliability and Deregulation**<br><br>Reliability analysis: interruption criterion, stochastic components, component models, calculation methods, Network model: stochastic networks, series and parallel connections, minimum cut sets, reliability costs, Generation, transmission and distribution reliability, Reliability and deregulation: conflict, reliability analysis, effects on the actual reliability, regulation of the market. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 318 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Digital Control** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To study the stability analysis of digital control system. To introduce student to fundamental concepts of digital control components and systems. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** YES | | **Spring:** NO | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 252 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Digital Control Systems |
| | Author | B. C. Kuo |
| | Publisher | Oxford University Press |
| | Edition | 2/e, Indian Edition, 2007 |
| 2. | Title | Discrete Time Control Systems |
| | Author | K. Ogata |
| | Publisher | Prentice Hall |
| | Edition | 2/e, 1995 |
| 3. | Title | Digital Control and State Variable Methods |
| | Author | M. Gopal |
| | Publisher | Tata Mcgraw Hill |
| | Edition | 2/e, 2003 |
| 4. | Title | J. D. Powell and M. L. Workman, Digital Control of Dynamic Systems |
| | Author | G. F. Franklin |
| | Publisher | Addison Wesley, 1998, Pearson Education, Asia |
| | Edition | 3/e, 2000 |

**Content**

**Unit I: Introduction to digital control**

Introduction- Discrete time system representation, mathematical modelling of sampling process, data reconstruction.

**Unit II: Modelling Discrete-time Systems by Pulse Transfer Function**

Revisiting Z-transform, mapping of s-plane to z-plane, pulse transfer function,

| | |
|---|---|
| | Pulse transfer function of closed loop, Sampled signal flow graph.<br><br>**Unit III: Stability analysis of discrete time systems**<br><br>Jury stability test, Stability analysis using bi-linear transformation, Time response of discrete systems, Transient and steady state responses, Time response parameters of a prototype second order system.<br><br>**Unit IV: Design of sampled data control systems**<br><br>Root locus method, controller design using root locus, root locus based controller design using MATLAB, nyquist stability criteria, bode plot, lead compensator design using bode plot, lag compensator design using bode plot, lag-lead compensator design in frequency domain.<br><br>**UNIT V: Deadbeat response design**<br>Design of digital control system with deadbeatresponse, Practical issues with deadbeat response design, sampled data control systems with deadbeat response.<br><br>**Unit VI: Discrete state space model**<br><br>Introduction to state variable model, various canonical forms, characteristic equation, state transition matrix, solution to discrete state equation.<br><br>**Unit VII: Controllability, observability and stability of discrete state space models**<br><br>Controllability and observability, stability, Lyapunov stability theorem.<br><br>**Unit VIII: State feedback design**<br><br>Pole placement by state feedback, set point tracking controller, full order observer, reduced order observer, output feedback design-Theory, examples.<br><br>**Unit IX: Introduction to optimal control**<br><br>Basics of optimal control, performance indices, linear quadratic regulator (LQR) design. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEB 351** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **Yes** | **No** |
| **Type of Course** | Theory and Practical | | | |
| **Course Title** | **Power Electronics** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | The course aims at familiarizing the students with the operating characteristics of semiconductor devices, triggering circuits and their applications for power control. The course also deals with the detailed analysis and operation of power controllers. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) + 24(P)** |
| **Prerequisite course code as per proposed course numbers** | EEB 100 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Modern Power Electronics |
| | Author | B. K. Bose |
| | Publisher | IEEE Press |
| | Edition | |
| 2. | Title | Power Electronics-Circuits, Devices & Applications |
| | Author | M.H. Rashid |
| | Publisher | Pearson Education |
| | Edition | |

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|---|---|
| **Content** | **Unit I: Characteristics of Various Solid State Devices**<br>Introduction, power semiconductor devices: power diode, power transistor, MOSFET, Thyristor & its two transistor model, Triac, Gate turn off thyristor (GTO), insulated gate bipolar transistor (IGBT), comparison of switching power devices, turn on & turn off characteristics, driver circuits.<br>**Unit II: AC to DC Converters**<br>Commutation, single phase and three phase bridge rectifiers, semicontrolled & fully controlled rectifiers, dual converters, effect of load and source inductance.<br>**Unit III: DC to DC Converters**<br>Principle of operation, control strategies, step-up, step-down choppers, types of chopper circuits, steady state analysis, multiphase chopper.<br>**Unit IV: DC to AC Inverters**<br>Voltage source inverters, single phase inverter, three phase inverter, harmonic reduction techniques and PWM techniques, current source inverter.<br>**Unit V: AC to AC Converters**<br>Single phase & 3-phase AC voltage controllers using thyristors , phase control and integral cycle control, AC choppers, single phase cyclo-converters, applications, effects of harmonics.<br>**<u>Power Electronics Laboratory:</u>**<br>Study of characteristics of power semiconductor switching devices (SCR, Triac, MOSFET, IGBT), Study of two-pulse fully controlled rectifier, feeding R, RL and RLC (DC-motor) loads, Study of a six-pulse half controlled rectifier feeding R, RL and RLE loads, Study of a six-pulse fully controlled rectifier feeding R and RL loads- Closed-loop control of a six-pulse fully controlled rectifier, Study of a 1-phase inverter with square wave, quasi-square wave and SPWM control, Speed control of induction motor with V/f control method using 3-phase inverter, Open –loop control of a separately excited DC motor drive with a 6-phase fully controlled rectifier, Study of characteristics of a class –D commutated thyristorized step-down chopper, Study of AC chopper with R and RL loads to achieve power control, Study of performance of a PWM controlled AC-DC converter, Study of performance of a 1-phase cyclo-converter. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory for overall grading |

| **Course no: EEL 352** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **Yes** | | **No** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Switch Gear and Protection** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To introduce the concept and necessity of protection in generation and transmission, and applications of switchgears including internal operation of different types of circuit breakers. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
| **Contact Hours** | **3** | **1** | **0** | **4** | **36(L) + 12(T)** |
| **Prerequisite course code as per proposed course numbers** | EEL 302 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Fundamentals of power system protection |
| | Author | Y. G. Paithankar and S. R. Bhide |
| | Publisher | Prentice Hall |
| | Edition | |
| 2. | Title | Switchgear and Power System Protection |
| | Author | Ravindra P.Singh |
| | Publisher | PHI Learning Private Ltd |
| | Edition | |
| 3. | Title | Power System Protection and Switchgear |
| | Author | Badri Ram, D N Vishwakarma |
| | Publisher | TMH |
| | Edition | |

| **Content** | **Unit I: Protection Schemes**<br><br>Principles and need for protective schemes, nature and causes of faults, types of faults, methods of neutral grounding, zones of protection and essential qualities of protection<br><br>**Unit II: Electromagnetic Relays** |
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| | Operating principles of relays, universal relay, torque equation, R-X diagram, electromagnetic relays, over current, directional, distance, differential, negative sequence, thermal and under frequency relays, distance protection- impedance relay, reactance relay, mho relay, input quantities for various types of distance relays, effect of arc resistance, power swings, line length and source impedance on the performance of distance relays, selection of distance relays.<br><br>**Unit III: Apparatus Protection**<br><br>Current transformers and potential transformers and their applications in protection schemes protection of transformer, generator, motor, busbars and transmission line.<br><br>**Unit IV: Static Relays and Numerical Protection**<br><br>Static relays, phase, amplitude comparators, synthesis of various relays using static comparators, block diagram of numerical relays–overcurrent protection, transformer differential protection, distant protection of transmission lines.<br><br>**Unit V: Circuit Breakers**<br><br>Physics of arcing phenomenon and arc interruption, DC and AC circuit breaking, re-striking voltage and recovery voltage, rate of rise of recovery voltage, resistance switching, current chopping, interruption of capacitive current, types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breaker, comparison of different circuit breakers, rating and selection of circuit breakers. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEP 353** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | No | No | Yes | | No |
| **Type of Course** | Laboratory | | | | |
| **Course Title** | **Simulation Tools for Electrical Engineering** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | The student will be able to use various simulation tools available for Electrical Engineering | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn: NO** | | **Spring: YES** | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total teaching hours** |
| **Contact Hours** | 0 | 0 | 3 | 2 | 36 |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |
| **Text Books:** | | | | | |
| **Content** | This lab is designed to introduce various simulation software available for electrical engineering | | | | |
| **Course Assessment** | Lab: Continuous Evaluation 50% and End Semester 50% | | | | |

| Course no: HML351 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | | | |
| **Type of course** | Theory | | | |
| **Course Title** | Engineering Economics and Accountancy | | | |
| **Course Coordinator** | Dr. Shakira Khan | | | |
| **Course objectives:** | The subject will provide the knowledge of economics, finance and accountancy for the better decision making of the economic alternatives and investment alternatives in the field of engineering and anywhere else. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
| **Contact Hours** | 3 | 0 | 0 | 3 | 36 |
| **Prerequisite course code as per proposed course numbers** | Nil | | | | |
| **Prerequisite credits** | Nil | | | | |
| **Equivalent course codes as per proposed course and old course** | Nil | | | | |
| **Overlap course codes as per proposed course numbers** | Nil | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Engineering Economics Principles, |
| | Author | Henry Malcom Steiner |
| | Publisher | McGraw Hill Publications |
| | Edition | |
| 2. | Title | Dewett K.K., |

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|---|---|---|
| | Author | Modern Economic Theory |
| | Publisher | Sultan Chand & Co. |
| | Edition | |
| 1.<br>3 | Title | Indian Economy |
| | Author | Agrawal AN |
| | Publisher | Wiley Estern Ltd, New Delhi |
| | Edition | |
| 4 | Title | Accounting Part-1 |
| | Author | Jain and Narang |
| | Publisher | Kalyani Publisher |
| | Edition | |
| 5 | Title | Fundamentals of Engineering Economics |
| | Author | Kumar P. |
| | Publisher | Wiley India Pvt. Ltd. New Delhi. |
| | Edition | 2012 |
| **Reference Book:** | | |
| 1 | Title | Engineering Economics |
| | Author | Panneerselvam R |
| | Publisher | PHI Learning Pvt. Ltd., New Delhi. |
| | Edition | 2013 |
| 2 | Title | Financial Management |
| | Author | Tulsian P.C. |
| | Publisher | S. Chand and Company Pvt. Ltd. |
| | Edition | 2009 |
| **Content** | **Unit I: Engineering Economics**<br><br>Introduction to Engineering Economics – Fundamental concepts-Time value of money – Cash flow and Time Diagrams – Choosing between alternative investment proposals. (6 hours) | |

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| | **Unit II: Capital Budgeting**<br><br>Methods of Economic analysis (Pay back, ARR, NPV, IRR and B/C ratio). Depreciation and methods of calculating depreciation (Straight line, Sum of the years digit method, Declining Balance Method, Annuity Method, Sinking Fund method.) (7 hours)<br><br>**Unit III: Indian economy and Economic Development**<br><br>National Income Accounting – Methods of Estimation – Various Concepts of National Income – Significance of National Income Estimation and its limitations. Inflation: Definition- Measures to Control (Monetary and Fiscal policy). New Economic Policy 1991 Breakeven Analysis – Meaning and its application, Limitation. (8 hours)<br><br>**Unit IV: Financial Accounting**:<br><br>Accounting Principles, procedure-Double entry system – Journal, ledger, Trial balance – Cash Book – Preparation of Trading and Profit and Loss account – Balance Sheet. Cost Accounting - Introduction-Classification of costs – Methods of Costing-Techniques of Costing. E-commerce: Importance and Need.<br><br>(8 hours)<br><br>**Unit V: Managerial Economics**<br><br>Scope of Managerial Economics: Theory of Demand and Theory of Supply. Law of demand and Law of Supply. Techniques of Managerial Economics; Theory of firm, Theory of Market Structure. Applications of Managerial Economics.<br><br>(7 hours) |
| **Curse Assessment** | Continuous Evaluation: 20%<br><br>Mid Semester: 30%<br><br>End Semester: 50% |

| Course no: HMP 352 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **NO** | **YES** | **NO** | **NO** |
| **Type of Course** | Practical | | | |
| **Course Title** | **TECHNICAL COMMUNICATION** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | The course aims to inculcate soft skills and technical writing in students. The practical sessions will prepare students to face job interviews and Group Discussion. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **0** | **0** | **2** | | 24 |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | New International Business English, |
| | Author | Jones, L &R. Alexander |
| | Publisher | UK: CUP |
| | Edition | 2006 |
| 2. | Title | Effective Technical Communication |
| | Author | Rizvi, M. A. |
| | Publisher | New Delhi: McGraw Hills Education |
| | Edition | 2005 |

**Content**

**Unit I: WRITTEN COMMUNICATION**

Writing Resume, Curriculum Vitae, and Bio-data (Design, Style); Writing Cover letter, Job Applications, Statement of Purpose (SoPs), Life Essay etc.

Writing Technical Correspondences: Report Writing, Process Writing, Technical Description: Instructions, manuals etc.Proposals writing, Journal Articles and Conference Papers, Review and Research Articles. (Focus would be given to Grammar, Foreign Words &Phrases, Appropriate use of Prepositions and other aspects).

**Unit II: ORGANISATIONAL COMMUNICATION**

Samples of technical letters (Letter of Inquiry, Replies to Inquiry Letters, Letters Placing Orders, Instruction Letters, Letters Urging Action, Complaint

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| | Letters, and Adjustment Letters)<br><br>E-mail Correspondences: Format, Standard Practices and Strategies<br><br>**Unit III: PRESENTATION SKILLS**<br><br>Oral presentation Skills: How to make presentation (Focus on Paralinguistic features of speech: Pause, Voice, Stress, and Intonation etc. and Non-verbal cues: Body-languageetc.).<br><br>Preparing the Presentation: Develop the central idea, main ideas and supporting materials, visual aids.<br><br>Rehearsing the presentation: Improving Delivery and handling stage Fright<br><br>**Unit IV: Group Discussion Skills**<br><br>Techniques for Group Discussion<br><br>Subject Knowledge, Communication Skills, Leadership Skills, Group Behaviour<br><br>Group Contribution: Contributing Systematically; Creating Cooperative Environment, Optimal Participation, Handling Conflict, Effective Closure<br><br>Individual Contribution: Topic analysis; Discussing Opinion, Problems, Case Studies<br><br>Exchanging Opinions, Suggestions and Proposals<br><br>**Unit V: Job Interviews**<br><br>Pre-interview Presentation Techniques<br><br>Self-Analysis, Research the Organisation<br><br>Job Analysis, Revise your Subject Knowledge, Develop your Interview file.<br><br>Interview questions: types, Answering Strategies<br><br>**Good manners and Positive Behaviour** |
| **Course Assessment** | Labortatory: Continuous Evaluation 50% End Semester 50% |

**Elective - III**

| **Course no: EEL 361** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Integrated Circuits & Applied Instrumentation(ICAI)** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn about signal conditioning circuits and design and applications of Operational amplifiers | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | ECB 304 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Operational Amplifiers and Linear Integrated Circuits |
| | Author | R.F. Coughlin |
| | Publisher | Pearson Education (P) Ltd. |
| | Edition | |
| 2. | Title | Op-Amp and Linear Integrated Circuits |
| | Author | R.A. Gayakwad, |
| | Publisher | Pearson Education |
| | Edition | |
| 3. | Title | Linear Integrated Circuits |
| | Author | D.R. Choudhary |
| | Publisher | New Age International (P) Limited |
| | Edition | |

**Content**

**Unit I: Design and Applications of Op-Amps**

Operational amplifiers, its transfer characteristics, characterization of Op-amp parameters (Slew rate, offset error, CMRR) comparator characteristics, limitation of Op-amp as comparator, Voltage limiters, zero crossing detector, precision rectifier, peak detector, window detector. Inverting and non-inverting configuration amplifiers, analog integrator and differentiator, logarithmic amplifier, instrumentation amplifier AD 620, isolation amplifiers.

**Unit II: Signal Conditioning Circuits**

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|---|---|
| | Basic bridge amplifier and its use with strain gauge and temperature sensors, filters in instrumentation circuits, universal trigonometric function generator AD639, Phase-sensitive detectors, Phase-locked loops, signal converters A/D and D/A techniques and chips (ADC 0804, 0808/9 DAC 800, AD558 etc.), sample and hold circuits, 555-Timers, linear IC voltage regulators, Opto-isolators and their use in instrumentation system, keypad and LCD interfacing techniques.<br><br>**Unit III: Case Studies**<br><br>Case Studies on Op-Amp based design circuits. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 362 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Real Time Control in Power System** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To impart knowledge to the students about real time security monitoring and control (computer and operator) of power system for economic and reliable operation. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Power System control – Technology |
| | Author | Torsten Cegrell |
| | Publisher | Prentice Hall International Ltd |
| | Edition | |
| 2. | Title | Power Generation operation and control |
| | Author | Allen J. Wood and Bruce F. Wollenberg |
| | Publisher | John Wiley & Sons |
| | Edition | |
| 3. | Title | Computer Aided Power Systems Operation and Analysis |
| | Author | R. N. Dhar |
| | Publisher | Tata McGraw Hill |
| | Edition | |

**Content**

**Unit I: Computer Control of Power Systems**

Need for real time and computer control of power systems, operating states of a power system, introduction to SCADA- grid operation & control, need and advantages of SCADA- SCADA - Supervisory control and Data Acquisition systems implementation considerations, energy control centers, software requirements for implementing the above functions, RTU- SCADA functions, control Functions.

**Unit II: State Estimation**

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| | Different types of State Estimations, theory of WLS state estimation, sequential and non-sequential methods to process measurements, bad data observability, bad data detection, identification and elimination.<br><br>**Unit III: Security and Contingency Evaluation**<br><br>Security concept, security analysis and monitoring, contingency analysis for generator and line outages by iterative linear power flow method, fast decoupled model, and network sensitivity methods.<br><br>**Unit IV: Man – Machine Communication**<br><br>Operator's Console, VDU display and its use, operator dialogs, mimic diagram functions, printing facilities, remote terminal unit (RTU) & communication practices, major components: RTU Panel, Interface Panel, D20M main processor, analog card, status card, control card, modems-types of communications- types of network elements in LAN & WAN.<br><br>**Unit V: Sub-load Dispatch Center ( Sub-LDC)**<br><br>Elements of SLDC- workstations- front end processor- routers- function of SLDC- introduction to SCADA PROTOCOLS and communication standards for electrical power systems.<br><br>**Unit VI: Real Time Software**<br><br>Classification, structure, tools, language requirements of RTS computer control of electrical power systems, state load dispatch center (SLDC): inter Connectivity of Sub-LDCs & SLDCs, hierarchy of data transfer, functions & responsibilities of SLDC, real time operation carried at SLDC. Southern regional load dispatch center (SRLDC), Functions & responsibilities of SRLDC, operations carried at SRLDC. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 363** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Process Control** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To introduce the basic principles & importance of process control in industrial process plants. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 252 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Chemical Process Control |
| | Author | Stephanopoulis, G |
| | Publisher | Prentice Hall of India |
| | Edition | New Delhi, 1990 |
| 2. | Title | Automatic Process Control, |
| | Author | Eckman. D.P |
| | Publisher | Wiley Eastern Ltd. |
| | Edition | New Delhi, 1993 |
| 3. | Title | Process Control |
| | Author | Pollard A |
| | Publisher | Heinemann educational books |
| | Edition | London, 1971 |
| 4. | Title | Process Control |
| | Author | Harriott. P |
| | Publisher | Tata Mc - Graw hill |
| | Edition | |

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| **Content** | **Unit I: Introduction**<br><br>Need for process control – mathematical model of first order level, pressure and thermal processes– higher order process – interacting and non-interacting systems – continuous and batch processes– self-regulation – servo and regulator operations.<br><br>**Unit II: Control Actions and Controllers**<br><br>Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers to realize various control actions.<br><br>**Unit III: Optimum Controller Settings**<br><br>Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – Tuning –Process reaction curve method – Ziegler Nichols method – Damped oscillation method.<br><br>**Unit IV: Multi loop Control**<br><br>Feed-forward control – ratio control- cascade control – inferential control – split-range control – introduction to multivariable control – examplesfrom distillation column and boiler systems.<br><br>**Unit V: Final Control Element**<br><br>I/P converter – pneumatic and electric actuators – valve positioner – control valves –characteristics of control valves – inherent and installed characteristics – valve body – commercial valve bodies–control valve sizing – cavitation and flashing – selection criteria. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 364** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **High Voltage Engineering** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | The course primarily aims to give the student a deeper physical understanding of high voltage technologies, generation and measurement of high voltage, as well as ageing and breakdown mechanisms are dealt with. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | PHL 100, EEL 203 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | High voltage Insulation Engineering |
| | Author | Ravindra Arora & Wolfgang Mosch |
| | Publisher | New Age International Publishers |
| | Edition | |
| 2. | Title | High Voltage Engineering |
| | Author | M.S. Naidu, V. Kamaraju |
| | Publisher | TMH |
| | Edition | |
| 3. | Title | High Voltage Technology |
| | Author | L. L. Alston |
| | Publisher | BS Publications |
| | Edition | |

**Content**

**Unit I: Introduction**

Electro static fields, their control and estimation, electric field intensity, classification of electric fields, control of electric field intensity, generation of high dc and ac voltages. Cockroft, Walton voltage multiplier circuit.

**Unit II: Electrostatic Generator**

Generation of high ac voltages by cascaded transformers, series resonant circuit, generation of impulse voltages and currents- definitions, impulse

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| | generator circuits, impulse current generation.<br><br>**Unit III: Measurement of High Voltages and Currents**<br><br>Introduction, sphere gap, electrostatic voltmeter, generating voltmeter, Fortescue method, voltage dividers, measurement of high dc, ac and impulse currents.<br><br>**Unit IV: High Voltage Testing of Electrical Equipment**<br><br>Testing of insulators, cables, bushings, power capacitors, power transformers and circuit breakers- IEC, ANSI, IEEE and Indian standards for testing electrical equipment, non-destructive test techniques, high voltage Schering bridge, partial discharges measuring techniques, breakdown mechanism of gaseous liquid and solid insulating materials. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 365** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Power System Planning and Automation** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand the different power system planning and forecasting techniques. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Forecasting methods and application |
| | Author | Makridakis, Spyros |
| | Publisher | John Wiley |
| | Edition | 1993 |
| 2. | Title | Modern Power system planning |
| | Author | X.Wang& J.R. McDonald |
| | Publisher | McGraw. Hill |
| | Edition | 1993 |
| 3. | Title | Electrical Power system planning |
| | Author | A.S Pabla |
| | Publisher | Mac Millan |
| | Edition | 1998 |
| 4. | Title | Power system planning |
| | Author | Sullivan |
| | Publisher | McGraw. Hill |
| | Edition | 1977 |
| 5. | Title | Electricity distribution network design |
| | Author | Lakervi E, E J Holmes |
| | Publisher | IEE |
| | Edition | 2nd edition, 2003 |
| **Content** | **Unit I: Forecasting – Needs and Uses**<br><br>Current Status Of Forecasting, Fundamentals Of Quantitative Foreca | |

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| | Explanatory And Time Serious Forecasting, Least Square Estimates, Peak Forecasting, Accuracy Of Forecasting Methods, Regression Methods, Box Je Time Serious Methods.<br><br>**Unit II: Short and Long Term Forecasting Techniques**<br><br>Problems facing electricity industry, Long term forecasting techniques, Me of long term forecasting, Spatial load forecasting, Multivariate procedures, term forecasting techniques<br><br>**Unit III: Forecasting and Planning**<br><br>The role of forecasting in planning, Comparison and selection of foreca methods, The accuracy of forecasting methods, Pattern of the Data and its e on individual forecasting methods, Time horizon effects on forecasting meth<br><br>**Unit IV: Generation Planning**<br><br>Fundamental economic analysis, Generation planning optimized accordi generating unit categories, distribution & Transmission system planning. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 368** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Electro-Magnetics for Electrical Machines** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand the importance of eddy currents and their effects on the design of Poly phase induction motors | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251, EEB 301 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Electromangetics for Electrical Machines |
| | Author | Saurabh Kumar Mukerji, Ahmad Shahid Khan, Yatendra Pal Singh |
| | Publisher | CRC Press |
| | Edition | |
| 2. | Title | Electromagnetic Field Theory Fundamentals |
| | Author | Guru, B. H. And Hiziroglu, H.R |
| | Publisher | PWS Publishing company, Boston |
| | Edition | |
| 3. | Title | Eddy Currents in Linear and Non-Linear Media |
| | Author | Subbarao, V |
| | Publisher | Omega Scientific Publishers, New Delhi, India |
| | Edition | |
| 4. | Title | Two-Dimensional Fields in Electrical Engineering |
| | Author | Bewley, L. V |
| | Publisher | Dover, New York |
| | Edition | |

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| **Content** | **Unit I : Eddy currents in Magnetic Cores**<br><br>Introduction, Eddy current machines (Solid Rotor Induction Machines) – Two-dimensional Model, Eddy currents in large plates due to alternating excitation current – Single phase excitation, poly-phase excitation, Eddy currents in cores with rectangular cross-sections, Eddy currents in cores with Triangular Cross-sections, Eddy currents in cores with regular polygonal cross-sections, Eddy currents in circular cores, Distribution of current density in Circular Conductors, Eddy currents in Laminated rectangular cores<br><br>**Unit II : Laminated-Rotor Poly-phase Induction Machines**<br><br>Introduction, Two-Dimensional Fields in Anisotropic Media, Cage or Wound Rotor Induction Machines, Induction Machines with skewed rotor slots – Air-gap Field, Fields in the anisotropic rotor region, Determination of arbitrary constants.<br><br>**Unit III : Unlaminated Rotor Poly-phase Induction Machines**<br><br>Introduction, tooth-ripple harmonics in solid-rotor induction machines – Physical Description, Field Distribution in Stator Slots, Field Distribution in the Air-gap, Field Distribution in Solid Rotor, machine performances, Three-dimensional fields in solid-rotor induction machines – Idealized Model, Field Distributions, Effects of Finite Machine Length, Effect of Different rotor and stator lengths, performance parameters |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 369** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Special Electrical Machines-I** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand and analyse the behaviour and construction of various special purpose machines | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Total Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251, EEB 301 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Special Electrical Machines |
| | Author | E.G. Janardanan |
| | Publisher | PHI publication |
| | Edition | |
| 2. | Title | Electric Machinery and Transformers |
| | Author | Bhag S. Guru, Huseyin R. Hiziroglu |
| | Publisher | Oxford |
| | Edition | |

**Content**

**Unit I: Permanent Magnet Synchronous Motor (PMSM)**

Construction, Principle of Operation, EMF Equation of PMSM, Torque Equation, Phasor Diagram, Circle Diagram of PMSM, Comparison of Conventional and PM Synchronous Motors, Control of PMSM, Application of PMSM

**Unit II: Synchronous Reluctance Motor (SyRM)**

Construction of SyRM, Working of SyRM, Phasor diagram and Torque Equation of SyRM, control of SyRM, Advantages of SyRM, Applications of SyRM

**Unit III: Single phase special Electric machines**

AC Series Motor – Construction, Principle of Working, EMF and Torque Equation, Phasor Diagram, Torque-Speed Characteristics, Repulsion Motor

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| | – Construction and Working, Types of Repulsion motors, Torque Equation of Repulsion Motor, Characteristics, Phasor Diagram, Hysteresis Motor, Single-phase reluctance motor, Universal Motor – Types and Construction, Principle of Operation, Speed Control of Universal Motor<br><br>**Unit IV: Servo Motors**<br><br>DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque-speed characteristics, Transfer Function<br><br>**Unit V: Linear Electric Machines**<br><br>Linear Induction motor, Linear Synchronous Motor, DC Linear Motor, Linear Reluctance and Levitation Machines |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEB 401 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Theory and Practical | | | |
| **Course Title** | **Electrical Drives** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand basic of DC/AC electrical drives, their speed control and braking techniques | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **2** | **4** | **36(L) 24(P)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251<br>EEB 301<br>EEB 351 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Fundamentals of Electrical Drives |
| | Author | G. K. Dubey |
| | Publisher | Alpha Science International, Ltd |
| | Edition | 2nd Ed. |
| 2. | Title | Power electronic control of AC motors |
| | Author | J. M. D. Murphy and F. G. Turnbull |
| | Publisher | Pergamon press |
| | Edition | 1st Ed. and Revised |
| 3. | Title | Electric Drives |
| | Author | Ion Boldea and S. A. Nasar |
| | Publisher | CRC press |
| | Edition | 3rd Ed. |

**Content**

**Unit I: Introduction**

Electrical drives, advantages of electrical drives, parts of electrical drives – electrical motors, power modulators, sources, control unit.

**Unit II: Dynamics of Load System**

Fundamental torque equations, speed torque conventions and multiquadrant operation, equivalent values of drive parameters – loads with rotational motion and translational motion, measurement of moment of inertia – reduced voltage and retardation test on induction motor, components of load torques, nature and classification of load torques, calculation of time and energy loss in

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| | transient operations, steady state stability, load equalisation.<br><br>**Unit III: Control Aspects and Sensing**<br><br>Modes of operation, speed control and drives classifications, closed loop control of drives – current limit control, Torque control, speed control, speed sensing, current sensing, phase locked loop control, closed loop position control.<br><br>**Unit IV: Rating and Heating of Motors**<br><br>Thermal model, classes of duty, determination of motor rating – continuous duty, short time duty, intermittent duty.<br><br>**Unit V: DC Motor Drives**<br><br>DC motor and their performance, starting, braking, transient analysis, speed control, methods of armature voltage control, ward Leonard drives, transformer and uncontrolled rectifier control, 1-phase controlled and semi controlled rectifier fed DC motor, 3- phase half controlled, semi controlled and fully controlled rectifier fed DC motor drive, chopper controlled DC motor drive.<br><br>**Unit VI: Induction Motor Drive**<br><br>Three phase induction motor analysis and performance, starting, speed control and braking, stator voltage control, variable frequency control, VSI and CSI control, rotor resistance control, pole amplitude modulation, slip power recovery – Scherbius and Kramer drive.<br><br>**Laboratory:**<br><br>Measurement of Moment of Inertia of a 3-phase induction motor using retardation Test, To perform rheostatic braking of a DC Shunt motor and observe the impact of increasing resistance on braking time, To perform counter-current braking of a DC –Shunt type motor and observe the impact of plugging resistance on braking time, To validate armature and flux control of a DC – shunt type motor using rheostats, To validate two-quadrant operation of a DC – shunt type motor using Ward-Leonard Method of speed control, To validate the speed control of a DC-shunt type motor by using DC-DC chopper circuit, To perform DC-dynamic braking of a 3-phase induction motor and observe the impact of DC current on braking time, To perform counter-current braking of a 3-phase induction motor and observe the impact of braking resistance on braking time, To validate V/F control of a 3-phase induction motor using 3-phase Voltage Source Inverter, To perform speed control of a 3-phase slip-ring Induction motor by rotor resistance variation. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%<br>Lab: Continuous Evaluation 50% End Semester 50%<br>60% weightage to theory and 40 % weightage to laboratory for overall grading |

| **Course no: EEP 402** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Practical | | | |
| **Course Title** | **Power System Lab** | | | |
| **Course Coordinator** | | | | |

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|---|---|---|---|---|---|
| **Course objectives:** | To understand basic of Power Systems, operations of the relays, techniques and Principle of Differential Protection. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** Yes | | **Spring** | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **0** | **0** | **2** | **1** | **24 (P)** |
| **Prerequisite course code as per proposed course numbers** | EEL253<br>EEL302 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Power System Analysis |
| | Author | H. Saadat |
| | Publisher | Tata McGraw-Hill Publishing Company Limited |
| | Edition | 3rd Ed. |
| 2. | Title | Computer Techniques in Power System Analysis |
| | Author | M. A. Pai |
| | Publisher | Tata McGraw-Hill Publishing Company Limited |
| | Edition | 3rd Ed. |
| 3. | Title | Reactive Power Control in Electric Systems |
| | Author | T. J. E.Miller |
| | Publisher | John Wiley and Sons |
| | Edition | 1st Ed. (1982) |

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| **Content** | To study the qualities of a power system protection scheme and protection devices, Apply a relay for phase sequence, phase failure and voltage asymmetry to a three-phase circuit, Apply a max/min voltage relay in a three-phase network, Apply a max/min frequency relay to a power production plant, Apply a maximum current (over current & short circuit) relay to a three-phase line, To use a timer with different time functions to extend the protection relays operation, To use an auxiliary relay as interface for remote optical/acoustic signalling of the protection relays operation, Connection of the voltage transformers with open delta of three-phase lines, Connection diagram of the open delta voltage transformers paired to a maximum voltage and over-current relay for opening the circuit in case of fault to ground and overload/short-circuit, Principle of Differential Protection. |
| **Course Assessment** | Lab: Continuous Evaluation 50% End Semester 50% |

**ELECTIVE - IV**

| **Course no: EEL 411** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Theory | | | |
| **Course Title** | **Utilization of Electrical Energy** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This subject gives a comprehensive idea in utilization of electrical power such as drives, electric heating, electric welding and illumination, electric traction. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Utilization of Electric Energy |
| | Author | E. Openshaw Taylor and Orient Longman |
| | Publisher | Orient Longman Pvt Ltd |
| | Edition | 1st Ed. Reprints |
| 2. | Title | Utilization of Electrical Power including Electric drives and Electric traction |
| | Author | N. V. Suryanarayana |
| | Publisher | New Age International (P) Limited |
| | Edition | 1st Revised Ed. Reprints |
| 3. | Title | Electric Drives |
| | Author | Ion boldea and S. A. Nasar |
| | Publisher | CRC press |
| | Edition | 3rd Ed. |

**Content**

**Unit I: Electrical Heating and Welding**

Advantages and methods of electric heating, resistance heating induction heating and dielectric heating, selection of frequency of induction and dielectric heating, welding process, different types of resistance and arc welding.

**Unit II: Electrolysis Process**

Principle of electrolysis, electroplating, metal extraction and metal processing, electromagnetic stirs.

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| | **Unit III: Illumination Terminology**<br><br>Laws, coefficient of utilization and depreciation factor, polar curves, photometry, integrating sphere, Stroboscopic effect, sources of light, discharge lamps, MV and SV lamps, comparison between tungsten filament lamps and fluorescent tubes, basic principles of light control, types and design of lighting schemes, lighting calculations.<br><br>**Unit IV: Electric Traction**<br><br>Systems of electric traction and track electrification, review of existing electric traction systems in India, mechanics of traction movement, speed-time curves for different service, adhesive weight and braking retardation, specific energy consumption for given run, coefficient of adhesion, train lighting, systems of train lighting. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 412 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Theory | | | |
| **Course Title** | **DSP and its Application to Power Electronics** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To realize real time DSP based microcontroller application to Power System and Power Electronic domains | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | ECB 204 EEB 303<br>EEB 351 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Discrete Time Signal Processing |
| | Author | A. V. Oppenheim, R. W. Schafer |
| | Publisher | PHI. |
| | Edition | 3rd Ed. |
| 2. | Title | Optimum Signal Processing |
| | Author | S. J. Orfanidis |
| | Publisher | McGraw-Hill |
| | Edition | 2nd Ed. |
| 3. | Title | Introduction to DSP |
| | Author | Proakis, Manolakis |
| | Publisher | PHI/ Pearson. |
| | Edition | 3rd Ed. |

**Contents**

**Unit I: Introduction**

Fixed and floating-point processors Number formats and operations: Fixed point 16 bit numbers representations of signed integers and fraction, Floating Point Numbers. Review of commonly used DSP processors in power electronics applications, Introductions to TMS320C2000.

**Unit II: DSP Architecture, peripherals and programming**

Introduction to Digital control using DSP, Overview of TMS320XXXXX Digital signal controller family – Features, Architecture, Interrupt and Reset, Memory map - On-chip memories: Flash, RAM, and Boot ROM – External memory Interface. Clock system- Digital I/O -CPU Timers – Analog to Digital Converter (ADC), Pulse Width Modulator (PWM), High Resolution PWM, Capture Module,

| | |
|---|---|
| | Quadrature Encoder Pulse Module. Controller Area Network, Serial Communication Interface, Serial Peripheral Interface, I2C and Multi-channel Buffered Serial port. Programming: assembler, linker processes, code structure, Code composer studio.<br><br>**Unit III: Mathematic Tools for Real time DSP implementation**<br><br>Review of numerical integration: Euler's implicit and explicit method, Heun's Method, Trapezoidal Method. Implementation of low pass filter. Review of reference frame transformation theory. Design of controllers for closed loop applications in power electronics: PI, Type II and Type III controllers.<br><br>**Unit IV: DSP Applications in Power Electronics and Power systems.**<br><br>Speed control of Induction motor, BLDC motor, Digital control of DC/DC converter, LED Lighting. Issues of harmonics and unbalanced currents in power systems, Implementation of Active filters in DSP under balanced and unbalanced condition, harmonic oscillator and 3 phase lock loop, Static VAR Compensator, Hardware in Loop simulations. Design of a DSP controlled Solar PV based Converter/Inverter system. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 413 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Theory | | | |
| **Course Title** | **Power System Operation & Control** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To provide students the knowledge of the engineering and economic aspects of planning, operation, security, controlling power generation and transmission systems in electric utilities. | | | |
| **POs** | Upon completion of this course, students will be able to develop generation dispatching schemes, apply control and selection methods on a power system. | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253 EEL 302 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Power System Analysis |
| | Author | Grainger J. J. and Stevenson W. D. |
| | Publisher | McGraw-Hill International Book Company, 2008. |
| | Edition | 1st Ed. |
| 2. | Title | Power System Analysis Operation and Control |
| | Author | A. Chakrabarti, S. Halder |
| | Publisher | PHI, 2010. |
| | Edition | 3rd Ed. |
| 3. | Title | Power System operation and Control |
| | Author | K. Uma Rao |
| | Publisher | Wiley India. |
| | Edition | 1st Ed. |

| | |
|---|---|
| **Contents** | **Unit I: Economic Load Dispatch**<br><br>Economic dispatch of thermal units and methods of solution, Transmission losses, B matrix loss formula, Composite generation production cost function-solution by gradient search techniques, Nonlinear function optimization<br><br>**Unit II: Automatic generation and Voltage Control**<br><br>Introduction, load frequency problem-Megawatt frequency (or P-f) control channel, MVAR-voltages (or Q-V) control channel-Dynamic interaction between P-f and Q-V loops. Mathematical model of speed-governing system-Turbine models, division of power system into control areas, P-f control of single control area (the uncontrolled and controlled cases)-P-f control of two area systems (the uncontrolled cases and controlled cases), Economic Dispatch and AGC, EMS, SCADA.<br><br>**Unit III: Methods of Voltage Control**<br><br>Reactive power and its relation to voltage control, location of voltage control equipment, methods of voltage control, excitation control, voltage regulators, tap changing transformers, booster transformers, induction regulators, reactive power injection and voltage control by synchronous condenser<br><br>**Unit IV: Unit Commitment and Hydro Thermal Scheduling**<br><br>*Unit commitment:* Constraints in Unit commitment, Spinning reserve, Thermal and hydro constraints, Unit commitment solution methods- Priority list methods, Dynamic programming solution, Short and long range hydro-thermal scheduling, hydroelectric plant models, scheduling problems, *Hydro thermal scheduling*; Short range hydro-thermal scheduling: Gradient approach, Pumped storage hydro plants, Dynamic programming solution to the hydrothermal scheduling problems.<br><br>**Unit V: Power System Security**<br><br>Factors affecting power system security, Contingency analysis: Detection of network problems, Correcting the generation approach: Sensitivity methods, compensated factors, correcting the generation dispatch using linear programming. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 414 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Theory | | | |
| **Course Title** | **Switched Mode Power Conversion** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To acquaint the students with working, analysis and design of different types of dc to dc converters. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 351 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | --- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Fundamentals of Power Electronics |
| | Author | Robert Erickson and Dragon Maksivimovic |
| | Publisher | Springer Publications |
| | Edition | 2nd Ed. |
| 2. | Title | Power Electronics |
| | Author | Issa Batarseh |
| | Publisher | John Willey |
| | Edition | 2nd Ed. |
| 3. | Title | Elements of Power Electronics |
| | Author | Philip T. Krein |
| | Publisher | Oxford University Press |
| | Edition | 2nd Ed. |

**Content**

**Unit I: Introduction:**

Basic concepts of Switched Mode power converters, DC-DC converters Characteristics, constituent elements, operating principles.

**Unit II: Steady State Analysis and Isolated Bridge Converters:**

Half bridge and full-bridge converters, Power circuit and steady state analysis, utilization of magnetic circuits and comparison with previous topologies. stress and sizing of elements, control methods, duty ratio, current programmed, frequency programmed and sliding mode control.

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|---|---|
| | **Unit III: Single-Switch Isolated Converters:**<br><br>Requirement for isolation in the switch-mode converters, transformer connection, Forward and flyback converters, power circuit and steady-state analysis. Push-Pull Converters-Power circuit and steady-state analysis, utilization of magnetic circuits in single switch and push-pull topologies.<br><br>**Unit IV: Dynamic Analysis of DC-DC Converters:**<br><br>Formulation of dynamic equation of buck and boost converters, averaged circuit models, linearization technique, small-signal model and converter transfer functions and frequency domain models.<br><br>**Unit V: Controller Design:**<br><br>Review of frequency-domain analysis of linear time-invariant systems, concept of bode plot, phase and gain margins, bandwidth, controller specifications, proportional (P), proportional plus integral (PI), proportional plus integral plus integral controller (PID), selection of controller parameters.<br><br>**Unit VI: Resonant Converters:**<br><br>Classification of Resonant converters-Basic resonant circuits- Series resonant circuit-parallel resonant circuits- Resonant switches. Concept of Zero voltage switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. Concept of Zero current switching, principle of operation, analysis of M-type and L-type Buck or boost Converters. |
| **Curse Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 415 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | No | Yes |
| **Type of course** | Theory | | | |
| **Course Title** | **Special Electrical Machines-II** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand and analyse the behaviour and construction of various special purpose machines | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** Yes | | **Spring** | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251 EEB 301 | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Special Electrical Machines |
| | Author | E. G. Janardanan |
| | Publisher | PHI publication |
| | Edition | 3rd Ed. |
| 2. | Title | Electric Machinery and Transformers |
| | Author | Bhag S. Guru, Huseyin R. Hiziroglu |
| | Publisher | Oxford |
| | Edition | 2nd Ed. |

**Content**

**Unit I: Permanent Magnet Synchronous Motor (PMSM)**

Construction, Principle of Operation, EMF Equation of PMSM, Torque Equation, Phasor Diagram, Circle Diagram of PMSM, Comparison of Conventional and PM Synchronous Motors, Control of PMSM, Application of PMSM

**Unit II: Synchronous Reluctance Motor (SyRM)**

Construction of SyRM, Working of SyRM, Phasor diagram and Torque Equation of SyRM, control of SyRM, Advantages of SyRM, Applications of SyRM

**Unit III: Single phase special Electric machines**

AC Series Motor – Construction, Principle of Working, EMF and Torque Equation, Phasor Diagram, Torque-Speed Characteristics, Repulsion Motor – Construction and Working, Types of Repulsion motors, Torque Equation of Repulsion Motor, Characteristics, Phasor Diagram, Hysteresis Motor, Single-phase reluctance motor, Universal Motor – Types and Construction, Principle of Operation, Speed Control of Universal Motor

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|---|---|
| | **Unit IV: Servo Motors**<br><br>DC Servo Motors – Construction, Principle of Operation, AC Servo Motors – Construction & Working, Analysis of Two-phase AC Servo Motor, Torque-speed characteristics, Transfer Function<br><br>**Unit V: Linear Electric Machines**<br><br>Linear Induction motor, Linear Synchronous Motor, DC Linear Motor, Linear Reluctance and Levitation Machines. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 451 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | No | No | Yes | No |
| **Type of course** | Theory | | | |
| **Course Title** | **HVDC & Flexible AC Transmission Systems** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To provide an in-depth understanding of different aspects of high voltage direct current power transmission system.<br>To familiarize students with FACTS devices, their control techniques and applications. | | | |
| **POs** | | | | |

| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
|---|---|---|---|---|---|
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **1** | **0** | **4** | **36(L)+ 12(T)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | HVDC Power Transmission Systems–Technology and System Interactions |
| | Author | K.R.Padiyar |
| | Publisher | New Age International Publishers |
| | Edition | 3rd Ed. |
| 2. | Title | Understanding FACTS–Concepts and Technology of Flexible AC Transmission Systems |
| | Author | Narain G.Honorani, Laszlo Gyugyi |
| | Publisher | Wiley-IEEE Press |
| | Edition | 2nd Ed. |

**Content**

**Unit I: HVDC Transmission**

Introduction, comparison of ac and HVDC, economic & terminal equipment of HVDC transmission systems: types of HVDC Links, apparatus required for HVDC System, comparison of AC & DC transmission, application of DC transmission system, planning & modern trends in D. C. transmission.

**Unit II: HVDC Transmission Analysis**

HVDC converters, pulse number, analysis with and without overlap, converter bridge characteristics, characteristics of 6 Pulse & 12 Pulse converters.

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| | **Unit III: HVDC System Control**<br><br>Principles of dc link control, starting and stopping of dc link, power control, harmonics & filters, introduction- generation of harmonics types, power flow analysis in ac/dc systems.<br><br>**Unit IV: Flexible AC Transmission Systems (FACTS)**<br><br>Concept of FACTS, flow of power in an ac system, dynamic stability consideration- basic types of FACTS controllers, shunt compensator: SVC & STATCOM - objectives of shunt compensation- methods of controllable VAR generation- switching converter type VAR generators-basic operating principle and control approaches, static series compensators -GCSC,TSSC,TCSC & SSSC - objectives of series compensator, variable impedance type series compensators- basic operating control schemes- power angle characteristics, control range and VA rating- external control. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

**ELECTIVE - V/ ELECTIVE - VI/ELECTIVE - VII**

| **Course no: EEL 461** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Computer Applications in Power Systems** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | The course is designed to give students the required knowledge for design, analysis of electric power grids. It also deals with soft computing techniques in power systems contingency analysis for power system. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL253, EEL302, EEL352. | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Computer methods in power systems analysis |
| | Author | Stagg and El Abiad |
| | Publisher | McGraw Hill ISE |
| | Edition | 1968 and Reprints |
| 2. | Title | Computer techniques in power system |
| | Author | M. A. Pai |
| | Publisher | Tata McGraw Hill |
| | Edition | 3rd Edition |

**Content**

**Unit I: Network Matrix Formation**

Incidence and network matrices, graphs, incidence matrices formation of network matrix, Y-bus by singular transformation, algorithms for formation of Z-bus matrix, characteristic and application of Y bus and Z bus, short circuit calculations using Z-bus.

**Unit II: Representation of Transformers**

Representation of On load tap changing transformer and phase shifting transformer,π representation of off-nominal tap transformers.

| | |
|---|---|
| | **Unit III: Load Flow Techniques**<br><br>Technique in load flow studies, sparsity technique for Y-bus and Gauss-Seidal method- comparison of GS, NR, FDC models- distribution system, introduction to real time control of power system, linear wls state estimation, D.C power flow based wls equations, SCADA transient<br><br>**Unit IV: Stability Analysis**<br><br>Representation of power system elements- numerical integration methods- transient stability algorithm using modified Euler's method and fourth order RungeKutta method.<br><br>**Unit V: Sensitivity and Security Analysis**<br><br>Sensitivity factors, line outage distribution factor, generation shift distribution factor, compensated shift factor, contingency ranking and analysis, power system security and security levels, application of soft computing techniques in power systems |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 462** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Power Quality** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To understand the various power quality phenomenon, their origin and monitoring and mitigation methods. Understand the effects of various power quality phenomenon in various equipment. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL253, EEB 251, EEB301. | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Electrical Power Systems Quality |
| | Author | Dugan Roger C |
| | Publisher | Mc Graw Hill |
| | Edition | 3rd Edition |
| 2. | Title | Power Systems Quality Assessment |
| | Author | J.Arillaga, N.R.Watson, S.Clon |
| | Publisher | John Wiley |
| | Edition | 2nd Edition |
| 3. | Title | Understanding Power quality Problems: Voltage Sags and Interruptions |
| | Author | Bollen Math H.J |
| | Publisher | IEEE Press / Johnwiley& Sons, Inc.,Publication |
| | Edition | 2001and Reprints |

| **Reference Books:** | | |
|---|---|---|
| 1. | Title | Power Quality |
| | Author | Sankaran C. |
| | Publisher | CRC Press |
| | Edition | 2001 and Reprints |

| | |
|---|---|
| **Content** | **Unit I: Introduction**<br><br>Power quality definitions, power quality – voltage quality, power quality evaluation procedure, terms and definitions general classes of power quality problems, sources of pollution, international power quality standards and regulations, transients long duration voltage variations, short-duration voltage variations voltage, imbalance waveform distortion, voltage fluctuation, power quality terms, cbema and iti curves, voltage sags, dips and interruptions sources of sag and interruptions estimating voltage sag performance.<br><br>**Unit II: Fundamental Principles of Protection**<br><br>Solution at the end-user level, motor starting sag, transient over voltages, sources of transient over voltages, principles of over voltage, protection devices for over voltage protection, utility capacitor-switching transients, utility system lightning protection, ferro-resonance, switching transient problems with loads computer tools for transients analysis.<br><br>**Unit III: Fundamentals of Harmonics**<br><br>Harmonic distortion, voltage versus current distortion, harmonics versus transients, harmonic indexes, harmonic sources from commercial loads, harmonic sources from industrial loads, effects of harmonic distortion, inter-harmonics, evaluations principles for controlling harmonics, harmonic filter design: a case study, long-duration voltage variations, principles of regulating voltage devices for voltage regulation, utility voltage regulator, application of capacitors for voltage regulation, end-users capacitors application, regulating utility voltage with distributed resources, power quality monitoring considerations, historical perspective of power quality measuring instruments, assessment of power quality measurement, data application of intelligent systems.<br><br>**Unit IV: Power Quality Measurement:**<br><br>Measuring and solving power quality problems, Power quality measurement device and its measurement, test: location, duration, instrument set-up and its guidelines. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no:**<br>**EEL 463** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Wind Energy Conversion Systems** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To impart knowledge about wind energy resources and application technologies. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB351 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Wind Energy conversion Systems |
| | Author | L.L.Freris |
| | Publisher | Prentice Hall |
| | Edition | 1990 and Reprints |
| 2. | Title | The generation of Electricity by wind power |
| | Author | E.W.Golding |
| | Publisher | Redwood burn Ltd., Trowbridge |
| | Edition | 1976 and Reprints |
| 3. | Title | Grid Integration of WECS |
| | Author | S.Heir |
| | Publisher | Wiley |
| | Edition | 2014 and Reprints |
| **Reference Books:** | | |
| 1. | Title | Wind power generation |
| | Author | Nick Jackinse |
| | Publisher | IET |
| | Edition | 2009 and Reprints |
| 2. | Title | Analysis of electrical machinery |
| | Author | P. C. Krause |
| | Publisher | Wiley-IEEE Press |
| | Edition | 3rd Edition |

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|---|---|---|
| 3. | Title | Variable speed generators |
| | Author | Ion Boldea |
| | Publisher | Taylor & Francis group |
| | Edition | 2006 and Reprints |
| **Content** | **Unit I: Introduction**<br><br>Brief history about wind turbine, installed wind turbine worldwide, their usage and electricity generation capability. Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory- Power coefficient- Sabinin's theory-Aerodynamics of Wind turbine<br><br>**Unit II: Wind Turbines**<br><br>Construction, working, principle, different types turbine blades, their structure, horizontal and vertical wind turbine system, power in the wind, various factors affecting the power in the wind. Impact of tower height, Betz experiment, coefficient of performance, tip speed ratio, Weibull distribution function, Rayleigh probability distribution function, cumulative distribution function, average wind speed, capacity factor, wake effect. HAWT-VAWT-Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations-Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control-stall control-Schemes for maximum power extraction.<br><br>**Unit III: Fixed Speed Systems**<br><br>Generating Systems- Constant speed constant frequency systems - Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction<br><br>Generator, principle and working, equivalent circuit and derivation of circuit parameters, Model of Wind Speed, Model wind turbine rotor, Drive Train model, Generator model for Steady state and Transient stability analysis.<br><br>**Unit IV: Variable Speed Systems**<br><br>Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator, Doubly fed induction machine (DFIG) – power injected from network in to rotor and from rotor to network, equivalent circuit, induction machine – dynamic modelling. DFIG - PMSG -Variable speed generators modeling - Variable speed variable frequency schemes.<br><br>**Unit V: Grid Connected Systems**: Stand alone and Grid Connected WECS system- Grid connection Issues-Machine side & Grid side controllers-WECS in various countries. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% | |

| Course no: EEL 464 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | DE (Y/N) |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Logic and Distributed Control System** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To illustrate the concept of programmable logic controllers and distri-buted Control system. Students will have the knowledge of data acquisition System and able to write Programs using ladder diagrams, real time applications of DCS and communication standards. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | Lecture | Tutorial | Practical | Credits | Teaching Hours |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Programmable Logic Controllers – Principles and Applications |
| | Author | John. W.Webb Ronald A Reis |
| | Publisher | Prentice Hall Inc., New Jersey |
| | Edition | Third edition |
| 2. | Title | Distributed Control Systems |
| | Author | Lukcas M.P |
| | Publisher | Van Nostrand Reinhold Co., NewYork, 1986. |
| | Edition | Second |
| 3. | Title | Elements of Process Control Applications |
| | Author | Deshpande P.B and Ash R.H |
| | Publisher | ISAPress, New York, 1995. |
| | Edition | Second |

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Process Control Instrumentation Technology,</td></tr>
<tr><td>Author</td><td>Curtis D. Johnson</td></tr>
<tr><td>Publisher</td><td>Prentice Hall of India, New Delhi, 1999</td></tr>
<tr><td>Edition</td><td>Fourth edition</td></tr>
<tr><td>Content</td><td colspan="2">Unit I:<br><br>Review of computers in process control: Data loggers, Data Acquisition Systems (DAS), Direct Digital Control (DDC). Supervisory Control and Data Acquisition Systems (SCADA), sampling considerations. Functional block diagram of computer control systems. alarms, interrupts. Characteristics of digital data, controller software, linearization. Digital controller modes: Error, proportional, derivative and composite controller modes.<br><br>Unit II:<br><br>Programmable logic controller (PLC) basics: Definition, overview of PLC systems, input/output modules, power supplies, isolators. General PLC programming procedures, programming on-off inputs/ outputs. Auxiliary commands and functions: PLC Basic Functions: Register basics, timer functions, counter functions.<br><br>Unit III:<br><br>PLC intermediate functions: Arithmetic functions, number comparison functions, Skip and MCR functions, data move systems. PLC Advanced intermediate functions: Utilizing digital bits, sequencer functions, matrix functions. PLC Advanced functions: Alternate programming languages, analog PLC operation, networking of PLC, PLC-PID functions, PLC installation, troubleshooting and maintenance, design of interlocks and alarms using PLC. Creating ladder diagrams from process control descriptions.<br><br>Unit IV:<br><br>Distributed control systems (DCS): Definition, Local Control (LCU) architecture, LCU languages, LCU - Process interfacing issues, communication facilities, configuration of DCS, displays, redundancy concept - case studies in DCS.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%.</td></tr>
</table>

| **Course no: EEL 465** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Optimal Control** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To apply the knowledge and tools of optimal theory to Control Systems. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | NIL | | | | |
| **Prerequisite Credits** | NIL | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Optimal Control Theory |
| | Author | Donald E.Kirk |
| | Publisher | Prentice Hall Inc., Englewood Cliffs, New Jersey |
| | Edition | First |
| 2. | Title | Gopal M |
| | Author | Modern Control System Theory |
| | Publisher | Willey Eastern Ltd., New Delhi |
| | Edition | 1995 |

**Content**

**Unit I: Introduction**

Definitions of Optimal Control, Performance Index, constraints, formulation of optimal control problem, selection of a performance index Classification of optimal control problems.

**Unit II: Calculus of Variations and Optimal Control**

Optimum of a Function and a functional, The Basic Variational Problem, Euler Lagrange's equation for scalar case and its generalization to vector case, Lagrange Multiplier method, Fixed and free end problems, Transversality conditions, Dynamic optimization with equality and inequality constraints.

**Unit III: Linear Quadratic Optimal Control Systems**

Problem Formulation, Finite-Time Linear Quadratic Regulator, LQR System for General Performance Index, Analytical Solution to the Matrix Differential

| | |
|---|---|
| | Riccati Equation, Infinite-Time LQR System, Stability Issues of Time-Invariant Regulator, Linear Quadratic Tracking System: Finite-Time Case, LQT System: Infinite-Time Case.<br><br>**Unit IV: Pontryagin Minimum Principle**<br><br>Pontryagin Minimum Principle, Dynamic Programming, Principle of Optimality, Optimal Control Using Dynamic Programming, Optimal Control of Discrete-Time Systems, Optimal Control of Continuous-Time Systems, The Hamilton-Jacobi-Bellman Equation, LQR System Using H-J-B Equation.<br><br>**Unit V: Dynamic Programming**<br><br>The principle of optimality; Dynamic programming applied to a routing problem; Functional equation of dynamic programming; Recurrence relation of dynamic programming. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. |

| **Course no: EEL 466** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **CAD for Electric Machines** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To learn the design of Various three-phase as well as single phase AC machines | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251,<br>EEB 301, | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Computer Aided Design of Electrical Machinery |
| | Author | Veinot Cyril G |
| | Publisher | MIT press London, UK |
| | Edition | |
| 2. | Title | Performance Design of AC Machinery |
| | Author | Say M.G. |
| | Publisher | CBS |
| | Edition | 3rd Edition |
| 3. | Title | Design of Electrical Machines |
| | Author | Deshpandey M.V. |
| | Publisher | PHI Learning |
| | Edition | |

| | |
|---|---|
| **Content** | **Unit – I Design of Synchronous Machine**<br><br>Features of construction of low speed and medium speed machine, design consideration of turbo and water wheel alternators, output co-efficient and choice of main dimensions, design of stator winding, and design of field systems, regulation, losses and efficiency, cooling systems.<br><br>**Unit – II Design of 3-phase induction motor**<br><br>Design consideration of ac motors, calculation of main dimensions, design of stator winding, effect of air-gap on performance.<br><br>Rotor Design: Design of slip ring and squirrel cage rotor, components of leakage reactance, calculation of leakage reactance and its effect on its performance<br><br>**Unit – III Design of Single phase induction motor**<br><br>Calculation of main dimensions of stator, complete design of stator with its punching details, design of main and auxiliary winding, design of rotor, performance calculation of designed rotor and performance by equivalent circuit approach.<br><br>**Unit – IV Computer Aided Design**<br><br>Philosophy and economics of computer aided design, advantages, limitations, Analysis and Synthesis Methods, and Selection of input data and<br><br>design variables, flow-charts for design of induction motor and synchronous machines, Optimization of design constrained and unconstrained optimization problem. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 467** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Intelligent Control** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To introduce the basic concepts of intelligent controllers and its applications in Control. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 252 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Introduction to Artificial Neural Systems |
| | Author | Jacek.M.Zurada |
| | Publisher | Jaico Publishing House |
| | Edition | 1999 and Reprints |
| 2. | Title | Neural Networks And Fuzzy Systems |
| | Author | Kasko B |
| | Publisher | Prentice-Hall of India Pvt. Ltd. |
| | Edition | 1994 and Reprints |
| 3. | Title | Fuzzy sets, uncertainty and Information |
| | Author | Klir G.J. & Folger T.A. |
| | Publisher | Prentice-Hall ofIndiaPvt. Ltd. |
| | Edition | 1993 and Reprints |
| **Reference Books:** | | |
| 1. | Title | Genetic algorithms in Search, Optimization and Machinelearning |
| | Author | Goldberg D.E. |
| | Publisher | Addison Wesley |
| | Edition | 1989 and Reprints |

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|---|---|
| **Content** | **Unit-I: I INTRODUCTION**<br><br>Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning System, rule-based systems, the AI approach, Knowledge representation, Expert systems.<br><br>**Unit-II: ARTIFICIAL NEURAL NETWORKS**<br><br>Concept of Artificial Neural Networks and its basic mathematical model, McCulloch-Pitts neuron model, simple perceptron, Adaline and Madaline, Feed-forward Multilayer Perceptron, Learning and Training the neural network, Data Processing: Scaling, Fourier transformation, principal-component analysis and wavelet transformations, Hopfield network, Self-organizing network and Recurrent network, Neural Network based controller<br><br>**Unit-III: GENETIC ALGORITHM**<br><br>Basic concept of Genetic algorithm and detail algorithmic steps, adjustment of free parameters. Solution of typical control problems using genetic algorithm. Concept on some other search techniques like tabu search and ant-colony search techniques for solving optimization problems.<br><br>**Unit IV**: **FUZZY LOGIC SYSTEM**<br><br>Introduction to crisp sets and fuzzy sets, basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modelling and control. Fuzzification, inferencing and defuzzification. Fuzzy knowledge and rule bases. Fuzzy modelling and control schemes for nonlinear systems. Self-organizing fuzzy logic control. Fuzzy logic control for nonlinear time-delay system.<br><br>**Unit V**: **APPLICATIONS**<br><br>GA application to power system optimisation problem, Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural-Network interconnection systems. Implementation of fuzzy logic controller using Matlab fuzzy-logic toolbox. Stability analysis of fuzzy control systems. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| Course no: EEL 468 | Open course (YES/NO) | HM Course (Y/N) | DC (Y/N) | | DE (Y/N) |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **System Identification and Adaptive Control** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To learn the techniques of system identification and to be able to design adaptive control for systems. | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 252 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | System Identification: Theory for the user |
| | Author | Ljung .L |
| | Publisher | Prentice Hall, Englewood Cliffs |
| | Edition | 2nd Edition |
| 2. | Title | Adaptive Control |
| | Author | Astrom .K |
| | Publisher | Pearson Education Asia Pte Ltd. |
| | Edition | 2ndEdition |

**Content**

**Unit I: System Identification**

Introduction, dynamic systems, models, system identification procedure. Simulation and Prediction. Non-parametric time and frequency domain methods. Linear dynamic system Identification: Overview, excitation signals, general model structure, time series models.

**Unit II: Parameter Estimation**

Parameter estimation methods, minimizing prediction errors, linear regressions and Least squares method, Instrumental – variable method, prediction error method. Recursive algorithms.

**Unit III: Adaptive Control**

Properties of Adaptive systems, Close loop and open loop adaptive control. Self-tuning controller. Auto tuning for PID controllers: Relay feedback. Pole

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| | placement control, minimum variance control, generalized predictive control, Pole placement design.<br><br>**Unit IV: Industrial Applications**<br><br>Industrial Adaptive control, Process control, Automobile control, Ship steering, Ultra-filtration, Future trends. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% |

| **Course no: EEL 469** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | | **DE (Y/N)** |
|---|---|---|---|---|---|
| | **No** | **No** | **No** | | **Yes** |
| **Type of Course** | Theory | | | | |
| **Course Title** | **Power Electronics For Renewable Energy Systems** | | | | |
| **Course Coordinator** | | | | | |
| **Course objectives:** | To provide knowledge about various renewable energy technologies, their potential and applications | | | | |
| **POs** | | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | | |
| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 351 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Power Electronics Hand book |
| | Author | Rashid .M. H |
| | Publisher | Academic press |
| | Edition | 2001 and Reprints |
| 2. | Title | Non-conventional energy sources |
| | Author | Rai. G.D |
| | Publisher | Khanna publishes |
| | Edition | 1993 and Reprints |
| 3. | Title | Solar energy utilization |
| | Author | Rai. G.D |
| | Publisher | Khanna publishes |
| | Edition | 1993 and Reprints |
| **Reference Books:** | | |
| 1. | Title | Wind energy system |
| | Author | Gray, L. Johnson |
| | Publisher | prentice hall linc |
| | Edition | 1995 and Reprints |

| | | |
|---|---|---|
| 2. | Title | Non-conventional Energy sources |
| | Author | B.H.Khan |
| | Publisher | Tata McGraw-hill Publishing Company, New Delhi |
| | Edition | 2nd Edition |
| **Content** | **Unit I: Introduction :** Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.<br><br>**Unit II: Electrical Machines for Renewable Energy Conversion :**Review of reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.<br><br>**Unit III : Power Converters** :<br><br>**Solar:** Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection Of inverter, battery sizing, array sizing.<br><br>**Wind:** three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.<br><br>**Unit IV: Analysis of Wind and PV Systems** : Stand alone operation of fixed and variable speed wind energy conversion systems and solar system-Grid connection Issues -Grid integrated PMSG and SCIG Based WECS Grid Integrated solar system<br><br>**Unit V: Hybrid Renewable Energy Systems** : Need for Hybrid Systems-Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT). | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50% | |

| **Course no: EEL 470** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Electrical Machine Modeling and Analysis** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | The objective of this course is to learn Modeling of DC and AC machines, to learn reference frame theory and its usage in machine analysis | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEB 251, EEB 301. | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Electric Motor Drives – Modeling, Analysis & Control |
| | Author | R. Krishnan |
| | Publisher | Pearson Publications |
| | Edition | 1st edition, 2002 |
| 2. | Title | Analysis of Electrical Machinery and Drive systems |
| | Author | P. C. Krause, Oleg Wasynczuk, Scott D. Sudhoff |
| | Publisher | IEEE Press |
| | Edition | 2ndEdition |
| 3. | Title | Electric Machinery |
| | Author | Fitzerald& Kingsley |
| | Publisher | McGraw-Hill Education |
| | Edition | 7th Edition |

<table>
<tr><td colspan="3">Reference Books:</td></tr>
<tr><td rowspan="4">1.</td><td>Title</td><td>Dynamic simulations of Electric Machinery using MATLAB/ Simulink</td></tr>
<tr><td>Author</td><td>Chee Mun Ong</td></tr>
<tr><td>Publisher</td><td>Prentice Hall</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td rowspan="4">2.</td><td>Title</td><td>The General Theory of electrical machines</td></tr>
<tr><td>Author</td><td>B P Adkins</td></tr>
<tr><td>Publisher</td><td>Pergamon press London</td></tr>
<tr><td>Edition</td><td></td></tr>
<tr><td rowspan="4">3.</td><td>Title</td><td>Generalized Theory of Electrical Machines</td></tr>
<tr><td>Author</td><td>P. S. Bhimbhra</td></tr>
<tr><td>Publisher</td><td>Khanna publications</td></tr>
<tr><td>Edition</td><td>5th edition 1995.</td></tr>
<tr><td>Content</td><td colspan="2">Unit I: Basic concepts of Modeling<br><br>Basic Two-pole Machine representation of Commutator machines, 3-phase synchronous machine with and without damper bars and 3-phase induction machine, Kron’s primitive Machine – voltage, current and Torque equations.<br><br>Unit II: DC Machine Modeling:<br><br>Mathematical model of separately excited D.C motor – Steady State analysis- Transient State analysis- Sudden application of Inertia Load-Transfer function of Separately excited D.C Motor, Mathematical model of D.C series motor, Shunt motor-linearization techniques for small perturbations.<br><br>Unit III: Reference frame Theory<br><br>Real time model of a two phase induction machine – Transformation to obtain constant matrices – three phase to two phase transformation – Power equivalence.<br><br>Unit IV: Dynamic modeling of three phase Induction Machine<br><br>Generalized model in arbitrary reference frame- Electromagnetic torque derivation of commonly used Induction Machine models, Stator reference frame model, Rotor reference frame model, Synchronously rotating reference model equations in flux linkages per unit model.<br><br>Unit V: Small Signal Modeling of Three Phase Induction Machine<br><br>Small Signal equations of Induction Machine- derivation – DQ flux linkage model derivation. Control Principle of Induction machine.<br><br>Unit VI: Symmetrical and Unsymmetrical 2 phase Induction Machine<br><br>Analysis of symmetrical 2-phase induction machine, voltage and torque equations for unsymmetrical 2 phase induction machine, voltage and torque equations in stationary reference frame variables for unsymmetrical 2 phase induction machine. Analysis of steady state operation of unsymmetrical 2 phase induction machine. Single phase induction motor- Cross field theory of single phase induction machine.</td></tr>
<tr><td>Course Assessment</td><td colspan="2">Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%</td></tr>
</table>

| **Course no: EEL 471** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **BASICS OF ROBOTICS** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This course provides an overview of robot mechanisms, dynamics, and intelligent controls. Student learns about robot drives and transmission system, programming etc. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Robotics Technology and Flexible Automation |
| | Author | Deb S. R. and Deb S |
| | Publisher | Tata McGraw Hill Education Pvt. Ltd |
| | Edition | Second |
| 2. | Title | Introduction to Robotics |
| | Author | John J.Craig |
| | Publisher | PEARSON |
| | Edition | Second |
| 3. | Title | Industrial Robots - Technology, Programming and Applications |
| | Author | Mikell P. Groover et. Al. |
| | Publisher | McGraw Hill, New York |
| | Edition | Third |

**Reference Books:**

| | | |
|---|---|---|
| 1. | Title | Robotics Engineering – An Integrated Approach |
| | Author | Richard D Klafter, Thomas A Chmielewski, Michael Negin |
| | Publisher | Eastern Economy Edition, Prentice Hall of India Pvt. Ltd |
| | Edition | Third |
| 2. | Title | Robotics : Control, Sensing, Vision and Intelligence |
| | Author | Fu K S, Gonzalez R C, Lee C.S.G |
| | Publisher | McGraw Hill |

| | | |
|---|---|---|
| | Edition | Second |
| **Content** | **Unit I: Introduction**<br><br>Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots.<br><br>**Unit II: Robot Kinematics and Dynamics**<br><br>Positions, Orientations and frames, Mappings: Changing descriptions from frame to frame, Operators: Translations, Rotations and Transformations - Transformation Arithmetic - D-H Representation - Forward and inverse Kinematics Of Six Degree of Freedom Robot Arm – Robot Arm dynamics<br><br>**Unit III: Robot Drives and Power Transmission Systems**<br><br>Robot drive mechanisms, hydraulic – electric – servomotor- stepper motor - pneumatic drives, Mechanical transmission method - Gear transmission, Belt drives, cables, Roller chains, Link - Rod systems - Rotary-to-Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearing screws.<br><br>**Unit IV: Manipulators**<br><br>Construction of Manipulators, Manipulator Dynamic and Force Control, Electronic and Pneumatic manipulators.<br><br>**Unit V: Robot End Effectors**<br><br>Classification of End effectors – Tools as end effectors. Drive system for grippers-Mechanical- adhesive-vacuum-magnetic-grippers. Hooks & Scoops. Gripper force analysis and gripper design. Active and passive grippers.<br><br>**Unit VI: Path Planning & Programming**<br><br>Trajectory planning and avoidance of obstacles, path planning, skew motion, joint integrated motion – straight line motion-Robot languages, computer control and Robot software. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. | |

| **Course no: EEL 472** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Inverters and Resonant Pulse Converters** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | This course provides a strong foundation on inverters and resonant pulse converters/inverters and their control in modern Power Electronic Systems. Understand the working principle of an inverter and its classification. Understand different inverter control techniques along with their advantages and drawbacks. Understand and analyze different types of PWM along with its application and importance. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Power Electronics - Circuits, Devices and Applications |
| | Author | M. H. Rashid |
| | Publisher | P.H.I Private Ltd. |
| | Edition | Second Edition |
| 2. | Title | Power Electronics- Converters, Applications and Design |
| | Author | N. Mohan et.al. |
| | Publisher | John Wiley & Sons (Asia) Private Ltd.,Singapore, 1996. |
| | Edition | Fourth |
| 3. | Title | Modern Power Electronics and AC Drives |
| | Author | Bimal K Bose |
| | Publisher | PHI |
| | Edition | Second |

**Reference Books:**

| | | |
|---|---|---|
| 1. | Title | Fundamental of Power Electronics |
| | Author | R W Erickson and D Makgimovic |
| | Publisher | Springer, |
| | Edition | 2nd Edition |
| 2. | Title | Elements of Power Electronics |
| | Author | P. T. Krein |
| | Publisher | OUP |
| | Edition | First |

| | | |
|---|---|---|
| 3. | Title | Power Electronics - Principles and Applications |
| | Author | Joseph Vithayathil, |
| | Publisher | McGraw Hill Inc., New York, 1995. |
| | Edition | Second |
| 4. | Title | Power Electronics |
| | Author | Vedam Subrahmanyam, " |
| | Publisher | New Age International (P) Limited, New Delhi, 1996. |
| | Edition | Third |
| 5. | Title | Power Electronic Converters, |
| | Author | R. Bausiere & G. Seguier, |
| | Publisher | Springer- Verlag, 1987. |
| | Edition | Second |
| **Content** | **Unit I : Inverters**<br><br>Single and three phase bridge inverters with R, RL and RLE loads, Voltage control, Harmonic reduction, square wave inverters, PWM inverters, modulation techniques, SPWM, Selective Harmonic Elimination PWM and delta modulation. Blanking time. Harmonic spectrum and comparison among different PWM techniques. Boost inverter. Current source inverters, Inverter circuit design.<br><br>**Unit II: Resonant Pulse Converters**<br><br>Series and parallel resonant inverters - zero current and Zero voltage switching resonant converters, frequency response. Two quadrant zero voltage switching resonant converters, Resonant dc link inverters, design and analysis, soft switching, load dependent problem.<br><br>**Unit III: Multi level inverters**<br><br>types, operations & features**.** Modulation Techniques: Space vector based, Voltage level based methods.<br><br>**Unit IV: Dynamics of above converters**<br><br>Modeling and control of inverters, resonant pulse converters, Application of microcomputer.<br><br>**Unit V: Design**<br><br>Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuits. Design of inverters, resonant pulse converters. PLL / Micro computer based inverters. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. | |

| **Course no: EEL 473** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Cycloconverters and AC voltage controllers** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To provide a strong foundation on ac to ac converters and their design in modern Power Electronic Systems. Students will be able to understand the working principle of cycloconverters and ac voltage controllers along with its classification, understand and implement different control techniques along with their advantages and drawbacks, understand and analyze matrix converter along with its application and importance. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Power Electronics - Circuits, Devices and Applications |
| | Author | M. H. Rashid |
| | Publisher | P.H.I Private Ltd. |
| | Edition | Second Edition |
| 2. | Title | Power Electronics- Converters, Applications and Design |
| | Author | N. Mohan et.al. |
| | Publisher | John Wiley & Sons (Asia) Private Ltd.,Singapore, 1996. |
| | Edition | Fourth |
| 3. | Title | Modern Power Electronics and AC Drives |
| | Author | Bimal K Bose |
| | Publisher | PHI |
| | Edition | Third |

| **Reference Books:** | | |
|---|---|---|
| 1. | Title | Fundamental of Power Electronics |
| | Author | R W Erickson and D Makgimovic |
| | Publisher | Springer, |
| | Edition | 2nd Edition |
| 2. | Title | Elements of Power Electronics |
| | Author | P. T. Krein |
| | Publisher | OUP |
| | Edition | Second |
| 3. | Title | Power Electronics - Principles and Applications |
| | Author | Joseph Vithayathil, |
| | Publisher | McGraw Hill Inc., New York, 1995. |
| | Edition | First |
| 4. | Title | Power Electronics |
| | Author | Vedam Subrahmanyam, " |
| | Publisher | New Age International (P) Limited, New Delhi, 1996. |
| | Edition | Third |
| 5. | Title | Power Electronic Converters, |
| | Author | R. Bausiere & G. Seguier, |
| | Publisher | Springer- Verlag, 1987. |
| | Edition | First |
| **Content** | **Unit I : Cycloconverters**<br><br>Single phase and three phase cycloconverters with R, RL and RLE loads – Voltage control , Harmonic analysis, operation waveforms designs. Effects of the source and load impedances.<br><br>**Unit II : AC Voltage Controllers:**<br><br>Single phase and three phase ac voltage controllers with R, RL and RLE loads, Voltage control, Harmonic analysis, operation waveforms PWM, Matrix converter, design.<br><br>**Unit III: Dynamics of Above Converters:**<br><br>Modelling and control of cyclo-converters, ac voltage controllers. Applications. Different modulation techniques used.<br><br>**Unit IV: Design**:<br><br>Method for control design: averaging method, small signal analysis, linearization, challenge. Geometric control: hysteresis control, boundary control. Triggering circuit. Design of cyclo-converters, ac voltage controllers circuits. PLL / Micro computer based cycloconverters, AC voltage controllers. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. | |

| **Course no: EEL 474** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Solid State Power Controllers** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | Operation, control and application of different FACTS devices and custom power devices. The students should be able to understand the importance of controllable parameters and benefits of FACTS controllers, know the significance of shunt, series compensation and role of FACTS devices on system control, analyze the functional operation and control of TSC, TCR and FC-TCR, describe the principles, operation and control of UPFC and IPFC. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

**Text Books:**

| | | |
|---|---|---|
| 1. | Title | Understanding FACTS – Concepts and Technology of Flexible AC Transmission Systems", |
| | Author | Narain G. Hingorani and Laszlo Gyugyi, " |
| | Publisher | Standard Publishers, New Delhi, 2001. |
| | Edition | Second |
| 2. | Title | Thyristor Based FACTS Controller for ElectricalTransmission Systems |
| | Author | R. Mohan Mathur and Rajiv K. Varma |
| | Publisher | Wiley Interscience Publications, 2002 |
| | Edition | Second |
| 3. | Title | Flexible ac transmission systems (FACTS) |
| | Author | Song, Y.H. and Allan T. John, |
| | Publisher | Institution ofElectrical Engineers Press, London, 1999. |
| | Edition | Second |

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|---|---|
| **Content** | **Unit I: Review of Concepts**<br><br>Electrical Transmission Network – Necessity – Power Flow in AC System – Power Flow and Dynamic stability considerations of a transmission interconnection – relative importance of controllable parameter – opportunities for FACTS – possible benefits for FACTS Technology – FACTS Controllers – Types, brief description and definitions. Power Quality problems in distribution systems, harmonics, harmonics creating loads, modeling, harmonic propagation, Series and parallel resonances, harmonic power flow, Mitigation of harmonics, filters, passive filters, Active filters, shunt, series hybrid filters, voltage sags & swells, voltage flicker. Mitigation of power quality problems using power electronic conditioners.<br><br>**Unit II: Static VAR Compensation**<br><br>Need for compensation – introduction to shunt and series compensation – objectives of shunt and series compensation – configuration and operating characteristics – Thyristor Controlled Reactor (TCR) – Thyristor Switched Capacitor (TSC) – Fixed Capacitor - Thyristor Controlled Reactor (FC – TCR) – Comparison of TCR, TSC and FC –TCR.<br><br>**Unit III: Series Compensators**<br><br>Commutation in DC motors, difference between mechanical and electronic Commutators, Hall sensors, Optical sensors, Multiphase Brushless motor, Square – Wave permanent magnet brushless motor drives, torque and EMF equation, torque – speed characteristics of Permanent Magnet Brush less DC Motors – controllers PM DC Motor.<br><br>**Unit IV: Static Voltage and Phase Angle Regulators**<br><br>Objectives of voltage and phase angle regulators – approaches to Thyristor – Controlled Voltage and Phase Angle Regulator.<br><br>**Unit V: Emerging Facts Controllers**<br><br>Construction and principle of operation of Linear Induction Motor - Universal Motor - Hybrid Motor – Linear Synchronous motor – Applications.<br><br>**Unit VI: UPFC and IPFC**<br><br>The Unified Power Flow Controller - **:** Principles of operation and characteristics, operation, comparison with other FACTS devices - control of P and Q - dynamic performance - Special Purpose FACTS Controllers - Interline Power Flow Controller - operation and control. independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters. |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. |

| **Course no: EEL 475** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **Power System Stability & Control** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To impart knowledge to the students about real time security monitoring and control (computer and operator) of power system for economic and reliable operation. The student will be able to understand about supervisory control and data acquisition, real time software and state estimation and security management | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | EEL 253<br>EEL 302<br>EEL 352 | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Power system stability and control |
| | Author | P. Kundur, |
| | Publisher | Tata- McGraw Hill. |
| | Edition | Second Edition |
| 2. | Title | Power System Stability |
| | Author | Kimbark |
| | Publisher | Vol-I,II,III, Wiley India |
| | Edition | First |
| 3. | Title | Topics on small signal stability analysis |
| | Author | K. R. Padiyar, M. A. Pai, K. Sen gupta |
| | Publisher | Tata-McGraw Hill |
| | Edition | First |
| **Reference Books:** | | |
| 1. | Title | Power system stability |
| | Author | M. A. Pai and Peter W. Sauer |
| | Publisher | Pearson Education. |
| | Edition | Third |

| | | |
|---|---|---|
| 2. | Title | Power system dynamics |
| | Author | K. R. Padiyar |
| | Publisher | BSP publications |
| | Edition | Second |
| **Content** | **Unit I: Introduction to Power System Stability Problems**<br><br>Definition of stability, classification of stability, rotor angle stability, frequency stability, voltage stability, mid-term and long term stability, classical representation of synchronous machine in a single machine infinite bus system (SMIB), equal area criterion to asses stability of a SMIB system, limitations of classical model of synchronous machines.<br><br>**Unit II: Modeling of Power System Components for Stability Analysis**<br><br>Synchronous machine modeling: sub-transient model, two axis model, one axis (flux decay) model, classical model, excitation systems modeling: DC excitation, AC excitation and static excitation, prime mover and energy supply systems modeling, transmission line modeling, load modeling, methods of representing synchronous machines in stability analysis.<br><br>**Unit III: Small Signal Stability**<br><br>Fundamental concepts, state space representation, modal analysis: eigen properties, participation factors, stability assessment, effects of excitation system on stability, power system stabilizer and its design, angle and voltage stability of multi-machine power systems and phenomenon of sub synchronous resonance.<br><br>**Unit IV: Transient Stability**<br><br>Fundamentals of transient stability, numerical solutions: simultaneous implicit and partitioned explicit methods, simulation of dynamic response, analysis of unbalanced faults, direct method of transient stability, transient energy function method, Methods of improving transient stability.<br><br>**Unit V: Voltage Stability**<br><br>Classification of voltage stability, modeling requirements, voltage stability analysis: static and dynamic, sensitivity analysis, modal analysis, voltage collapse, prevention of voltage collapse. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. | |

| **Course no: EEL 476** | **Open course (YES/NO)** | **HM Course (Y/N)** | **DC (Y/N)** | **DE (Y/N)** |
|---|---|---|---|---|
| | **No** | **No** | **No** | **Yes** |
| **Type of Course** | Theory | | | |
| **Course Title** | **EHV AC/DC Transmission** | | | |
| **Course Coordinator** | | | | |
| **Course objectives:** | To expose students to the advanced concepts in EHV AC/ DC transmission systems, their analysis and control. Upon completion of this course, students will be able to critically evaluate AC and DC transmission systems with all aspects, evaluate and analyze modern and classical EHV AC/ DC systems. | | | |
| **POs** | | | | |
| **Semester** | **Autumn:** No | | **Spring:** Yes | |

| | **Lecture** | **Tutorial** | **Practical** | **Credits** | **Teaching Hours** |
|---|---|---|---|---|---|
| **Contact Hours** | **3** | **0** | **0** | **3** | **36(L)** |
| **Prerequisite course code as per proposed course numbers** | | | | | |
| **Prerequisite Credits** | | | | | |
| **Equivalent course codes as per proposed course and old course** | | | | | |
| **Overlap course codes as per proposed course numbers** | -- | | | | |

| **Text Books:** | | |
|---|---|---|
| 1. | Title | Direct current Transmission |
| | Author | E W Kimbark |
| | Publisher | Vol. I, Wiley Interscience |
| | Edition | First |
| 2. | Title | High Voltage Direct Current Transmission |
| | Author | J. Arrillaga |
| | Publisher | Peter. Peregrines |
| | Edition | Second |
| 3. | Title | HVDC Power Transmission Systems |
| | Author | KR Padiyar |
| | Publisher | New Age International (P) Ltd., Publishers, |
| | Edition | 3rd Edition. |
| **Reference Books:** | | |
| 1. | Title | EHV AC Transmission engineering |
| | Author | Begamudre |
| | Publisher | Willey Easter Ltd. |
| | Edition | 2nd Ed. |
| 2. | Title | EHV transmission reference book |
| | Author | Edison Electric Institute |

| | | |
|---|---|---|
| | Publisher | GE Co. |
| | Edition | First |
| **Content** | **Unit I: HVDC Power Transmission**<br><br>Comparison of AC and DC Transmission, Application of DC transmission, types of DC links, recent trends.<br><br>**Unit II: Analysis of HVDC Converters**<br><br>Three phase and six phase converter circuits, voltage current waveforms and ratios, apparent power factor and utilization factor, delay angle, transformer rating pulse number, commutation group, Graetz Circuit, Overlap, advance angle and extinction angle, analysis of two and three valve conduction mode, equivalent commutation resistance, reactive power requirements of HVDC converters.<br><br>**Unit III: Control of HVDC Converters**<br><br>Power flow in HVDC transmission system, constant ignition angle control, constant extinction angle control, constant current control, actual control characteristics.<br><br>**Unit IV: EHV AC Transmission Lines**<br><br>Introduction, calculation of line and ground parameters, bundled conductors, bundle spacing and bundle radius, sequence inductance and capacitance parameters, line parameters for modes of propagation, digitalization procedure, interpretation of eigen vectors, Resistance and Inductance of ground return.<br><br>**Unit V: Voltage Gradient of Conductors**<br><br>Field of a point charge and its properties, field of a sphere gap, method of image charges, field of line charges and their properties, corona inception gradient, charge potential relations for multi-conductor lines, maximum charge condition on a three phase line. Surface voltage gradients on conductors: single conductor, 2 conductor and multi conductor bundle, maximum surface voltage gradient, Mangoldt (Markt-Mengle) formula, design of cylindrical cage for corona experiments, single conductor concentric as well with eccentricity inside a cylinder. | |
| **Course Assessment** | Theory: Continuous Evaluation 25% Mid Semester 25% End Semester 50%. | |