NARAYANA ENGINEERING COLLEGE::GUDUR

AUTONOMOUS

# B. Tech (Regular-Full time)

Effective for the students admitted into I - Year from the
Academic Year **2020-21** onwards

# DEPARTMENT OF
# ELECTRICAL & ELECTRONICS ENGINEERING

**COURSE STRUCTURE AND SYLLABUS**

# NARAYANA ENGINEERING COLLEGE

## Vision of the Institute:

To be one among the premier institutions of the country for professional education in producing technocrats with competent skills, Innovative ideas and Ethical values and commitment to societal and sustainable development

## Mission of the Institute:

M1: To provide an environment most conducive to learning with state-of-the-art infrastructure, well equipped laboratories and research facilities supported by modern teaching learning practices to impart high-quality technical education.

M2: To emphasize on innovative ideas and creative thinking and prepare them to meet the growing challenges of the industry and contribute to sustainable development

M3: To inculcate the leadership qualities, multi-disciplinary approach, Ethics and lifelong learning in graduates to serve the diverse societal needs of our nation

## Department of Electrical and Electronics Engineering

### Vision of the department:

To produce technically competent Electrical and Electronics Engineers capable of meeting the evolving needs of industry and society through innovation, leadership, research, professional ethics, lifelong learning and sustainable development.

### Mission of the department:

M1: To impart strong technical knowledge and professional skills through core and industry-oriented teaching-learning practices and continuous assessment.

M2: To foster competency, creativity, and innovation among students through emerging technologies, experiential learning, and skill enhancement programs to develop sustainable solutions for real-world challenges.

M3: To cultivate professional competence, ethical values, leadership qualities, and lifelong learning, empowering students to contribute responsibly and effectively to society.

**Program Educational Outcomes:**

| PEOs | Statements |
|---|---|
| PEO1 | Technical Competence: Apply knowledge of Electrical and Electronics Engineering fundamentals to analyze, formulate, and solve complex engineering problems using appropriate theoretical and practical skills. |
| PEO2 | Professional Growth and Innovation: Pursue successful careers in industry, research, or entrepreneurship by applying technical, communication, and problem-solving skills to develop innovative solutions for real-world challenges and sustainable development. |
| PEO3 | Leadership and Ethical Responsibility: Demonstrate leadership, teamwork, effective communication, lifelong learning, and professional ethics while contributing responsibly to society and ensuring safety, reliability, and sustainable use of technology. |

**Program Specific Outcomes:**

**PSO_1: Electrical Engineering Competence:** Apply the principles of Electrical and Electronics Engineering to analyze, design, and develop innovative solutions for complex real-world engineering problems using appropriate modern techniques.

**PSO_2: Professional and Sustainable Practice:** Demonstrate interdisciplinary and professional skills by applying emerging hardware and software technologies to address complex engineering problems while upholding ethical values, societal responsibilities, teamwork, leadership, and sustainable development.

## Program Outcomes

**PO1: Engineering Knowledge:** Apply the knowledge of Mathematics, Science, Engineering fundamentals, and Engineering specialization to the solution of Complex Engineering Problems.

**PO2: Problem Analysis:** Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of Mathematics, Natural, and Engineering Sciences.

**PO3: Design/Development of Solutions:** Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**PO4: Conduct Investigations of Complex Problems:** Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**PO5: Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**PO6: The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**PO7: Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and Team Work:** Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

**PO10: Communication:** Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

**PO11: Project Management and Finance:** Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

**PO12: Life Long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

# NARAYANA ENGINEERING COLLEGE::GUDUR

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## DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

## Course Structure for B.Tech E.E.E w.e.f AY: 2020-21

## SEMESTER I

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1001 | BS | Algebra and Calculus | 3 | 1 | 0 | 4 | 4 | 40 | 60 | 100 |
| 20PH1001 | BS | Applied Physics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20ES1001 | ES | Problem Solving and Programming | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EN1001 | HS | English | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20PH1501 | BS | Applied Physics Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20ES1501 | ES | Electrical Engineering Workshop | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20ES1505 | ES | Engineering & IT Workshop | 0 | 0 | 4 | 4 | 2 | 40 | 60 | 100 |
| 20ES1506 | ES | Problem Solving and Programming Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EN1501 | HS | English Language Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20MC8001 | MC | Mandatory course I :Induction Program | Induction Program | | | | | | | |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 11 | 1 | 18 | 30 | 19.5 | 360 | 540 | 900 |

# SEMESTER II

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1003 | BS | Vector Calculus Complex Variables and Transforms | 3 | 1 | 0 | 4 | **4** | **40** | **60** | **100** |
| 20CH1001 | BS | Chemistry | 3 | 0 | 0 | 3 | **3** | **40** | **60** | **100** |
| 20ES1002 | ES | Basic Electrical Circuits | 3 | 0 | 0 | 3 | **3** | **40** | **60** | **100** |
| 20ES1007 | ES | Introduction to Python Programming | 2 | 0 | 0 | 2 | **2** | **40** | **60** | **100** |
| 20CH1501 | BS | Chemistry Lab | 0 | 0 | 3 | 3 | **1.5** | 40 | 60 | 100 |
| 20ES1507 | ES | Basic Electrical Circuits Lab | **0** | **0** | **2** | **2** | **1** | 40 | 60 | 100 |
| 20ES1504 | ES | Engineering Graphics Lab | **0** | **1** | **4** | **5** | **3** | 40 | 60 | 100 |
| 20ES1510 | ES | Introduction to Python Programming Lab | **0** | **0** | **2** | **2** | **1** | 40 | 60 | 100 |
| 20EN1502 | **HS** | Oral Communication skills lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | **11** | **2** | **16** | **29** | **19.5** | **360** | **540** | **900** |

# SEMESTER III

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1006 | BS | Probability Statistics and Numerical Methods | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20ES1011 | ES | Data Structures | 2 | 0 | 2 | 4 | 3 | 40 | 60 | 100 |
| 20ES1013 | ES | Electronic Devices and Circuits | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2001 | PC | Electrical Circuit Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2002 | PC | DC Machines and Transformers | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20ES1516 | ES | Electronic Devices and Circuits Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2501 | PC | DC Machines and Transformers Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2502 | PC | Electrical Circuits and Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6001 | SC | Career competency Development I | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6001 | SC | Value added course/Certificate course I | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| 20MC8002-12 | MC | Mandatory course II | 2 | 0 | 0 | 2 | 0 | | | |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 16 | 1 | 16 | 33 | 21.5 | 400 | 600 | 1000 |

# SEMESTER IV

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2003 | PC | Analog Electronic Circuits | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2004 | PC | Electro Magnetic Fields | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2005 | PC | Induction Motors and Synchronous Machines | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2006 | PC | Linear Control Systems | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2007 | PC | Power Generation & Transmission | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open elective I | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2503 | PC | Analog Electronics and Simulation Lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2504 | PC | Induction Motors and Synchronous Machines Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6002 | SC | Career competency Development II | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6002 | SC | Value added course/Certificate course II | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 10 | 28 | 21.5 | 400 | 600 | 1000 |

# SEMESTER V

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2008 | PC | Digital Electronics and logic design | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2009 | PC | Power Distribution & Distributed Generation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2010 | PC | Power Electronics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open elective II | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4001 -05 | PE | Professional Elective I | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2505 | PC | Control Systems and Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2506 | PC | Power Electronics & Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6003 | SC | Career competency Development III | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6003 | SC | Value added course/Certificate Course III | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| 20EE7501 | PR | Internship/skill development Training I | 0 | 0 | 0 | 0 | 1.5 | 00 | 100 | 100 |
| 20MC8002-12 | MC | Mandatory course III | 2 | 0 | 0 | 2 | 0 | 00 | 00 | 00 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 11 | 29 | 21.5 | 360 | 640 | 1000 |

## SEMESTER VI

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2011 | PC | Electrical Measurements & Instrumentation | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2012 | PC | Modern Power System Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2013 | PC | Switch Gear and Protection | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open Elective III | 3 | 0 | 3 | 3 | 3 | 40 | 60 | 100 |
| 20EE4006 -10 | PE | Professional Elective II | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4011 -15 | PE | Professional elective III | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2507 | PC | Measurements & Instrumentation Lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2508 | PC | Power Systems Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6004 | SC | Career competency Development IV | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6004 | SC | Value added course/Certificate course IV | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 13 | 28 | 21.5 | 400 | 600 | 1000 |

## SEMESTER VII

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20HS5001-8 | HE | Humanities and Social Science Elective | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2014 | PC | Solid State Electric Drives | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2015 | PC | Power System Operation and Control | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open Elective IV | 2 | 0 | 2 | 4 | 3 | 40 | 60 | 100 |
| 20EE4016-20 | PE | Professional elective IV | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4021-25 | PE | Professional elective V | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2509 | PC | Electronic systems design lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2510 | PC | Power Systems Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6005 | SC | Career competency Development V | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6501 | SC | Skill development Training | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE7502 | PR | Internship II/on job training/Com Ser | 0 | 0 | 3 | 3 | 1.5 | 00 | 100 | 100 |
| 20MC8002-12 | MC | Mandatory course IV | 2 | 0 | 0 | 2 | 0 | 00 | 00 | 00 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 18 | 0 | 17 | 35 | 23 | 400 | 700 | 1100 |

## SEMESTER VIII

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE7503 | **PR** | Project work, seminar and internship | 0 | 0 | 0 | 0 | 12 | 60 | 140 | 200 |
| | | Activity Point Programme | During the Semester | | | | | 20 points | | |
| | | | **0** | **0** | **0** | **0** | **12** | **60** | **140** | **200** |

# OPEN ELECTIVES (OE) Offered by EEE Department

| Department | Course Code | Open Elective |
|---|---|---|
| Electrical & Electronics Engineering | 20EE3001 | Artificial Neural Networks and Fuzzy Logic |
| | 20EE3002 | Energy Auditing and Conservation |
| | 20EE3003 | Electrical Measurements and Instrumentation |
| | 20EE3004 | Energy Storage Technologies |
| | 20EE3005 | Electrical Technology |
| | 20EE3006 | Industrial Automation Engineering |
| | 20EE3007 | Industrial Electrical Systems |
| | 20EE3008 | Renewable Energy Sources |
| | 20EE3009 | Research Methodology |

# PROFESSIONAL ELECTIVES (PE)

| Elective Track/Group | Professional Elective-1 | Professional Elective-2 | Professional Elective-3 | Professional Elective-4 | Professional Elective-5 |
|---|---|---|---|---|---|
| Advanced Power systems | Industrial Electrical Systems (20EE4001) | Power System Planning (20EE4006) | Reactive Power Compensation and Management (20EE4011) | Power Quality (20EE4016) | Smart Grid Technologies (20EE4021) |
| Control Systems | System Modeling and Identification (20EE4002) | Advanced Control systems (20EE4007) | Digital Signal Processing (20EE4012) | Multivariable Control System (20EE4017) | Real Time Control System (20EE4022) |
| Electromechanical Systems | Machine Modeling and Analysis (20EE4003) | Electrical Machine Design (20EE4008) | Programmable Control Devices and Applications (20EE4013) | Hybrid Electrical Vehicles (20EE4018) | Automotive Electrical Engineering (20EE4023) |
| Energy Systems | Renewable Energy Conversion Systems (20EE4004) | Solar and Fuel Cell Energy Systems (20EE4009) | Wind and Biomass Energy Systems (20EE4014) | Utilization of Electrical Energy (20EE4019) | Energy Audit &Demand side Management (20EE4024) |
| Power Electronics | Advanced Power Electronics (20EE4005) | Advanced Electrical Drives (20EE4010) | HVDC & FACTS (20EE4015) | Advanced Power Converters (20EE4020) | Advanced Power Semiconductor Devices and Protection (20EE4025) |

# LIST OF HONOR SUBJECTS

| S.NO | Course Name | Course Code | L-T-P | Credits |
|---|---|---|---|---|
| **POOL-1 (Power Systems)** | | | | |
| 1 | Advanced power system | 20EEH001 | 3-1-0 | 4 |
| 2 | Advanced Power system protection | 20EEH002 | 3-1-0 | 4 |
| 3 | Power system dynamics and control | 20EEH003 | 3-1-0 | 4 |
| 4 | Restructured power system | 20EEH004 | 3-1-0 | 4 |
| **POOL-2 (Power Electronics)** | | | | |
| 1 | Analysis of Power Electronic Converters | 20EEH005 | 3-1-0 | 4 |
| 2 | Application of Power Converters | 20EEH006 | 3-1-0 | 4 |
| 3 | Power Electronic Applications to Renewable Energy | 20EEH007 | 3-1-0 | 4 |
| 4 | Switched Mode Power Conversion | 20EEH008 | 3-1-0 | 4 |
| **POOL-3 (Renewable Energy Sources)** | | | | |
| 1 | Advanced Electrical Vehicles | 20EEH009 | 3-1-0 | 4 |
| 2 | Grid Integration of Renewable Energy systems | 20EEH010 | 3-1-0 | 4 |
| 3 | High Power Battery Technologies | 20EEH011 | 3-1-0 | 4 |
| 4 | Renewable Energy Technologies | 20EEH012 | 3-1-0 | 4 |
| **POOL-4 (Integrated Circuits)** | | | | |
| 1 | CAD for VLSI | 20EEH013 | 3-1-0 | 4 |
| 2 | CMOS Analog and digital VLSI design | 20EEH014 | 3-1-0 | 4 |
| 3 | Digital Design through Verilog HDL | 20EEH015 | 3-1-0 | 4 |
| 4 | VLSI design | 20EEH016 | 3-1-0 | 4 |

# LIST OF MINOR SUBJECTS

| S.NO. | Course Name | Course Code | L-T-P | Credits |
|---|---|---|---|---|
| 1 | Electrical Measurements | 20EEM001 | 3-1-0 | 4 |
| 2 | Electrical Technology | 20EEM002 | 3-1-0 | 4 |
| 3 | Instrumentation | 20EEM003 | 3-1-0 | 4 |
| 4 | Network Analysis | 20EEM004 | 3-1-0 | 4 |
| 5 | Power Distribution system | 20EEM005 | 3-1-0 | 4 |
| 6 | Power system Generation | 20EEM006 | 3-1-0 | 4 |
| 7 | Power Transmission system | 20EEM007 | 3-1-0 | 4 |
| 8 | Renewable Energy Resources | 20EEM008 | 3-1-0 | 4 |

## PROFESSIONAL ELECTIVES (PE)

| SEMESTER | SUBJECT | COURSE CODE | CREDITS |
|---|---|---|---|
| **V Sem** | Professional Elective I | 20EE4001-05 | 3 |
| **VI Sem** | Professional Elective II | 20EE4006-10 | 3 |
| | Professional Elective III | 20EE4011-15 | 3 |
| **VII Sem** | Professional Elective IV | 20EE4016-20 | 3 |
| | Professional Elective V | 20EE4020-25 | 3 |
| | **TOTAL** | | **15** |

## OPEN ELECTIVES (OE)

| SEMESTER | SUBJECT | CREDITS |
|---|---|---|
| **IV Sem** | Open Elective I | 3 |
| **V Sem** | Open Elective II | 3 |
| **VI Sem** | Open Elective III | 3 |
| **VII Sem** | Open Elective IV | 3 |
| | **TOTAL** | **12** |

## SKILL ORIENTED COURSE (SC)

| SEMESTER | SUBJECT | COURSE CODE | CREDITS |
|---|---|---|---|
| III Sem | Career Competency Development I | 20CD6001 | 1 |
| | Value Added Course/Certificate Course I | 20CC6001 | 1 |
| IV Sem | Career Competency Development II | 20CD6002 | 1 |
| | Value Added Course/Certificate Course II | 20CC6002 | 1 |
| V Sem | Career Competency Development III | 20CD6003 | 1 |
| | Value Added Course/Certificate Course III | 20CC6003 | 1 |
| VI Sem | Career Competency Development IV | 20CD6004 | 1 |
| | Value Added Course/Certificate Course IV | 20CC6004 | 1 |
| VII Sem | Career Competency Development V | 20CD6005 | 1 |
| | Skill Development Training | 20CC6501 | 1 |
| | TOTAL | | 10 |

## PROJECT (PR)

| SEMESTER | SUBJECT | COURSE CODE | CREDITS |
|---|---|---|---|
| **V Sem** | Internship I/on job training/Com Ser Project | 20EE7501 | 1.5 |
| **VII Sem** | Internship II/on job training/Com Ser Project | 20EE7502 | 1.5 |
| **VIII Sem** | Project work, seminar and internship | 20EE7503 | 12 |
| | **TOTAL** | | **15** |

## HUMANITIES AND SOCIAL SCIENCES (HS)

| SEMESTER | Course Code | SUBJECT | CREDITS |
|---|---|---|---|
| I | 20EN1001 | English | 2 |
| | 20EN1501 | English Language Lab | 1.5 |
| II | 20EN1502 | Oral Communication skills lab | 1 |
| VII | 20HS5001-8 | Humanities and social Science Elective | 2 |
| | | **TOTAL** | 6.5 |

## BASIC SCIENCES (BS)

| SEMESTER | Course Code | SUBJECT | CREDITS |
|---|---|---|---|
| I | 20MA1001 | Algebra and Calculus | 4 |
| | 20PH1001 | Applied Physics | 3 |
| | 20PH1501 | Applied Physics Lab | 1.5 |
| II | 20CH1001 | Chemistry | 3 |
| | 20MA1003 | Vector Calculus, Complex Variables and Transforms | 4 |
| | 20CH1501 | Chemistry lab | 1.5 |
| III | 20MA1006 | Probability Statistics and Numerical Methods | 3 |
| | | **TOTAL** | 20 |

## ENGINEERING SCIENCES (ES)

| SEMESTER | Course Code | SUBJECT | CREDITS |
|---|---|---|---|
| I | 20ES1001 | Problem Solving and Programming | 3 |
| | 20ES1501 | Electrical Engineering Workshop | 1 |
| | 20ES1505 | Electrical Engineering &IT Workshop | 2 |
| | 20ES1506 | Problem Solving and Programming Lab | 1.5 |
| II | 20ES1002 | Basic Electrical Circuits | 3 |
| | 20ES1007 | Introduction to Python Programming | 2 |
| | 20ES1507 | Basic Electrical Circuits Lab | 1 |
| | 20ES1504 | Engineering Graphics Lab | 3 |
| | 20ES1510 | Introduction to Python Programming Lab | 1 |
| III | 20ES1011 | Data Structures | 3 |
| | 20ES1013 | Electronics Devices and Circuits | 3 |
| | 20ES1516 | Electronics Devices & Electrical Circuits lab | 1.5 |
| | | **Total** | 25 |

## PROFESSIONAL CORE (PC)

| SEMESTER | Course Code | SUBJECT | | CREDITS |
|---|---|---|---|---|
| III | 20EE2002 | DC Machines and Transformers | | 3 |
| | 20EE2001 | Electrical Circuit Analysis | | 3 |
| | 20EE2501 | DC Machines and Transformers Lab | | 1.5 |
| | 20EE2502 | Electrical Circuits and Simulation Lab | | 1.5 |
| | | | 9 | |
| IV | 20EE2003 | Analog Electronic Circuits | | 2 |
| | 20EE2004 | Electro Magnetic Fields | | 3 |
| | 20EE2005 | Induction Motors and Synchronous Machines | | 3 |
| | 20EE2006 | Linear Control Systems | | 3 |
| | 20EE2007 | Power Generation & Transmission | | 3 |
| | 20EE2503 | Analog Electronics and Simulation Lab | | 1 |
| | 20EE2504 | Induction Motors and Synchronous Machines Lab | | 1.5 |
| | | | 16.5 | |
| V | 20EE2008 | Digital Electronics and logic design | | 3 |
| | 20EE2009 | Power Distribution & Distributed Generation | | 3 |
| | 20EE2010 | Power Electronics | | 3 |
| | 20EE2505 | Control Systems and Simulation Lab | | 1.5 |
| | 20EE2506 | Power Electronics & Simulation Lab | | 1.5 |
| | | | 12 | |
| VI | 20EE2011 | Electrical Measurements & Instrumentation | | 2 |
| | 20EE2012 | Modern Power System Analysis | | 3 |
| | 20EE2013 | Switch Gear & Protection | | 3 |
| | 20EE2507 | Measurements & Instrumentation Lab | | 1 |
| | 20EE2508 | Power Systems Lab | | 1.5 |
| | | | 10.5 | |
| VII | 20EE2014 | Solid State Electric Drives | | 3 |
| | 20EE2015 | Power System Operation & Control | | 3 |
| | 20EE2509 | Electronic systems design lab | | 1 |
| | 20EE2510 | Power Systems Simulation Lab | | 1.5 |
| | | | 8.5 | |
| | | TOTAL | | 56.5 |

| S NO | SUBJECT AREA | CREDITS PER SEMESTER | | | | | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | IV | V | VI | VII | VIII | |
| 1 | HS | 3.5 | 1 | | | | | 2 | | 6.5 |
| 2 | BS | 8.5 | 8.5 | 3 | | | | | | 20 |
| 3 | ES | 7.5 | 10 | 7.5 | | | | | | 25 |
| 4 | PC | | | 9 | 16.5 | 12 | 10.5 | 8.5 | | 56.5 |
| 5 | PE | | | | | 3 | 6 | 6 | | 15 |
| 6 | OE | | | | 3 | 3 | 3 | 3 | | 12 |
| 7 | SC | | | 2 | 2 | 2 | 2 | 2 | | 10 |
| 8 | PR | | | | | 1.5 | | 1.5 | 12 | 15 |
| 9 | MC | | | | | | | | | No credit |
| | **TOTAL** | **19.5** | **19.5** | **21.5** | **21.5** | **21.5** | **21.5** | **23** | **12** | **160** |

# DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

## SEMESTER I

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1001 | BS | Algebra and Calculus | **3** | **1** | **0** | **4** | **4** | **40** | **60** | **100** |
| 20PH1001 | BS | Applied Physics | **3** | **0** | **0** | **3** | **3** | **40** | **60** | **100** |
| 20ES1001 | ES | Problem Solving and Programming | **3** | **0** | **0** | **3** | **3** | **40** | **60** | **100** |
| 20EN1001 | HS | English | **2** | **0** | **0** | **2** | **2** | **40** | **60** | **100** |
| 20PH1501 | BS | Applied Physics Lab | **0** | **0** | **3** | **3** | **1.5** | 40 | 60 | 100 |
| 20ES1501 | ES | Electrical Engineering Workshop | 0 | 0 | 2 | 2 | **1** | 40 | 60 | 100 |
| 20ES1505 | ES | Engineering & IT Workshop | 0 | 0 | 4 | 4 | **2** | 40 | 60 | 100 |
| 20ES1506 | ES | Problem Solving and Programming Lab | **0** | **0** | **3** | **3** | **1.5** | 40 | 60 | 100 |
| 20EN1501 | HS | English Language Lab | **0** | **0** | **3** | **3** | **1.5** | 40 | 60 | 100 |
| 20MC8001 | **MC** | Mandatory course I :Induction Program | Induction Program | | | | | | | |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | **11** | **1** | **18** | **30** | **19.5** | **360** | **540** | **900** |

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20MA1001 | **Algebra &Calculus (CSE, ECE, EEE, CE, ME)** | | | | | | | R-2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 1 | 0 | 64 | 4 | 40 | 60 | 100 |

**Pre-requisite: Intermediate Mathematics**

**Course Objectives:**

1. To familiarize the students with the theory of matrices and quadratic forms
2. To analyze first order ordinary differential equations.
3. To enlighten the learners in the concepts of higher order differential equation an its applications
4. To explain the series expansions using mean value theorems and the concepts of multivariable differential calculus.
5. To summarize the procedure to solve the partial differential equations.
6. To explain the student with mathematical tools needed in evaluating multiple integrals and its applications.

| **Course Outcomes**: After successful completion of the course, the student will be able to | | **Blooms taxonomy Level** |
|---|---|---|
| **CO 1** | **Solve** the system of Linear Equations | **BL-3** |
| **CO 2** | **Solve** first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases. | **BL-3** |
| **CO 3** | **Obtain** the complete solution of a higher order differential equations | **BL-2** |
| **CO 4** | **Make use of** the Taylor's and Maclaurin's Series and Maxima, Minima for the given function | **BL-3** |
| **CO 5** | **Apply** a range of techniques for solutions of first order Linear and non linear Partial Differential Equations (PDE) | **BL-3** |
| **CO 6** | **Apply** the techniques of Multiple integrals for the Area of the region bounded by curves and volume | **BL-3** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | | | | | | | | | | | 2 | |
| CO2 | 3 | 3 | 1 | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 1 | | | | | | | | | | 2 | |
| CO4 | 3 | 2 | | | | | | | | | | | 2 | |
| CO5 | 3 | 3 | 1 | | | | | | | | | | 2 | |
| CO6 | 3 | 2 | | | | | | | | | | | 2 | |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Matrices** | **14 H** |
|---|---|---|

Introduction to matrices, Definition of Rank ,Definition of Echelon form , Problems, Solving System of Non-Homogeneous equations- Definition, Conditions for Consistency, Problems,

Solving System of Homogeneous equations- Definition, Problems, Eigen values & Eigen Vectors- Definition, Problems ,properties of Eigen values & Eigen Vectors(Without proof), Cayley – Hamilton Theorem -Statement(Without proof),finding inverse and power of a matrix by Cayley-Hamilton Theorem, Diagonalization of a Matrix-Definition, similarity of a matrix ,modal matrix, spectral matrix, powers of a matrix, problems on Diagonalization of a matrix, Quadratic Forms- Definition, Finding Matrix from Q.F, Index, signature, rank and nature of the quadratic forms, Reduction of Q.F. into a canonical form by linear transformation , Reduction of Q.F. into a canonical form by orthogonal transformation.

At the end of the Module 1, students will be able to:

1. Solve the system of homogenous and non-homogenous linear equations.BL-3
2. Obtain the Eigen values and Eigen vectors of a matrix.BL-2
3. Identify special properties of matrix and for using this information to study the nature of the linear equations. BL-3
4. Find the inverse and powers of a square matrix.BL-1
5. Obtain the diagonalization form of the matrix.BL-2
6. Apply the techniques of matrices in various engineering problems. BL-3

| **MODULE -2** | **First Order Ordinary Differential Equations** | **9 H** |
|---|---|---|

Exact Differential equation - Definition, condition for exactness, problems, Non - Exact Differential equations- Integrating factor , Method1:Integrating factor by inspection, problems, Method2:Finding Integrating factor , problems, Method3:Finding Integrating factor , problems, Method4:Finding Integrating factor , problems, Method5:Finding Integrating factor , problems, Linear differential Equation- Definition, Working rule to find general solution, problems, Bernoulli's differential Equation- Definition, Working rule to find general solution, problems, Applications of Differential equation of First order: Newton's law of Cooling-Explanation of the concept, problems, Law of natural growth and Decay- Explanation of the concept, problems and Simple Electric Circuits-Explanation of the concept, problems.

At the end of the Module 2, students will be able to:

1. Identify the first order ordinary differential equations. BL-3
2. Solve the first order ordinary differential equations. BL-3
3. Apply the techniques of first order ordinary differential equations in Newton's law of cooling, Natural growth & Decay problems. BL-3
4. Make Use of the first order ordinary differential equation techniques in simple electric circuits.
   BL-3

| **MODULE-3** | **Higher Order Ordinary Differential Equations** | **10 H** |
|---|---|---|

Non-Homogenous Linear Differential equation of second and higher order with constant coefficients-Definition, complete solution, operator D, rules for finding Complimentary function, problems, inverse operator, General method for finding Particular Integral**.**

Non-homogeneous Linear Differential Equations of Second & Higher order with Constant coefficients with RHS term of the type$e^{ax}$,sinax ,cosax, Polynomial in X,$e^{ax}v(x)$, X.V(x)-Explanation of the concept& problems, Method of variation of parameters- Explanation of the concept& problems, Euler- Cauchy equation- Definition, problems ,Legendre's Linear equation-Definition, problems. Applications to Higher order Differential Equations - L-C-R circuits, problems.

At the end of the Module 3, students will be able to:

1. Identify the higher order ordinary differential equations. BL-3
2. Solve the linear differential equations with constant coefficients by appropriate methods BL-3
3. Solve the linear differential equations with variable coefficients by appropriate methods BL-3
4. Make Use of the higher order ordinary differential equations techniques in electrical circuits. and in various engineering problems. BL-3

| MODULE-4 | Mean value theorems & Multivariable Calculus | 9 H |
|---|---|---|

Taylor's and Maclaurin's theorems with remainders-Statements (without proof), problems on Taylor's series , problems on Maclaurin's series, Jacobean-Definition, Properties , problems ,Functional dependence-Definition , problems ,Maxima & Minima of function of two variables - Rules , Maxima & Minima of function of two variables without constraint- problems ,Maxima & Minima of function of two variables with constraint- problems, Lagrange's Method of Undetermined multipliers, problems.

At the end of the Module 4, students will be able to:

1. Demonstrate the given function as a series of Taylor's and maclurin's with remainders.BL-2
2. Illustrate series expansions of functions using mean value theorems. BL-2
3. Apply Jacobean concept to deal with problems in change of variables.BL-3
4. Obtain the maxima and minimum values of the function for two variables.BL-2
5. Apply the mean value theorems to check the continuity of the function in the given interval BL-3

| MODULE-5 | Partial Differential Equations | 11 H |
|---|---|---|

Definition ,Formation of PDE by the Method of Elimination of arbitrary constants, problems ,Method of Elimination of arbitrary functions, problems, Method of Separation of Variables-Explanation of the concept& problems, First order linear partial differential equations-Definition, Solutions of first order linear PDE-Working rule of Lagrange's Method, problems ,First order non-linear partial differential equations- Definition, Solutions of first order non-linear partial differential equations-Standard form-I, problems , Standard form-II, problems ,Standard form-III, problems, Standard form-IV, problems.

At the end of the Module 5, students will be able to:

1. Identify the basic properties of partial differential equations. BL-3
2. Outline partial differential equations. BL-2
3. Solve the applications of PDE by using the method of separation of variablesBL-3
4. Apply the PDE techniques in various engineering fields. BL-3

| MODULE-6 | Multiple Integrals | 11 H |
|---|---|---|

Double Integrals- Introduction, Evaluation in Cartesian coordinates, problems, Evaluation in Polar coordinates, change of variables – Problems on Cartesian to Polar, Change of Order of Integration- Problems , Area enclosed by plane curves - Problems, Triple integrals- Introduction, Evaluation of Triple Integrals, Volume by Triple Integrals – Problems, Change of variables

between Cartesian, cylindrical and spherical polar coordinates- Problems.

At the end of the Module 6, students will be able to:

1. Obtain double integrals in Cartesian and polar co-ordinates. BL-2
2. Obtain the area bounded by a region using double integration techniques.BL-2
3. Solve triple integrals.BL-3
4. Obtain volumes by using triple integrals.BL-2
4. Make Use of multiple integral techniques in engineering problems.BL-3

| **Total hours:** | **64 H** |
|---|---|

**Content beyond syllabus:**

1. Orthogonal Trajectories.
2. Deflection of Beams .
3. Simultaneous Linear equations with constant coefficients
4. Taylor's series for function of two variables.
5. Homogeneous Linear Partial differential equations with constant coefficients.
6. Calculation of mass, centre of gravity, moment of inertia

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | **Matrices** | CO1 | https://youtu.be/P2pL5VThrzQ |
| 2 | **First Order Ordinary Differential Equations** | CO2 | https://youtu.be/P7gVp333B6M |
| 3 | **Higher Order Ordinary Differential Equations** | CO3 | https://youtu.be/btOCUmJkrrg |
| 4 | **Mean value theorems & Multivariable Calculus:** | CO4 | https://youtu.be/bJPuy0QZ-tE<br>https://youtu.be/0apMXhWG_W8<br>https://youtu.be/aqfSOOiO2kI |
| 5 | **Partial DifferentialEquations** | CO5 | https://youtu.be/kZ7Oa7iMiCs |
| 6 | **Multiple Integrals** | CO6 | https://youtu.be/mIeeVrv447s |

**Text Book(s):**


1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
3. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.


**Reference Book(s):**


1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.

3.B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education
4.H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.

**Online Resources/ Web Resources:**

1 http://www.macs.hw.ac.uk/~simonm/linalg.pdf

2.http://www.e-booksdirectory.com/details.php?ebook=7400re

3 http://www.efunda.com/math/math_home/math.cfm

4.http://www.ocw.mit.edu/resources/#Mathematics

5 .http://www.sosmath.com/

6.http://www.mathworld.wolfram.com/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20PH1001 | APPLIED PHYSICS | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Fundamental concepts of Physics

**Course Objectives:**

1. To identify the importance of the optical phenomenon i.e. interference and diffraction related to its Engineering applications
2. To enable the students in understanding the importance of quantum physics
3. To learn the dynamics of free electrons in metals by applying Free electron theories on metals.
4. To explain and provide the knowledge about semiconductors
5. To teach the concepts related to superconductivity & nano materials which leads to their fascinating applications.
6. To impart knowledge in basic concepts of LASERs along with its Engineering applications

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Explain optical phenomenon i.e. interference, diffraction using Huygen's wave theory. |
| **CO 2** | Comprehend and explain the concepts of matter waves, wave functions and its interpretation to understand the matter at atomic scale. |
| **CO 3** | Comprehend Free electron theories on metals and apply them to learn the dynamics of free electrons in metals |
| **CO 4** | Compute carrier concentration in semiconductors and to understand carrier transport mechanism in semiconductors |
| **CO 5** | Understand the concepts of superconductors and nano materials to familiarize their applications in relevant fields. |
| **CO 6** | Realize importance of LASERs in Engineering and Medical applications. |

**CO-PO Mapping**

| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 1 | | | | | | | | | 2 | 2 | |
| **CO2** | 3 | 2 | | | | | | | | | | 2 | 2 | |
| **CO3** | 2 | 2 | | | | | | | | | | 1 | 2 | |
| **CO4** | 3 | 2 | | | | | | | | | | 2 | 2 | |
| **CO5** | 3 | 2 | | | | 1 | | | | | | 2 | 2 | |
| **CO6** | 3 | 2 | | | | 1 | | | | | | 2 | 2 | |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**WAVE OPTICS** **9 H**

Interference-Principle of Superposition, Interference of light, Conditions for sustained Interference ,derivation of conditions for constructive and destructive interference of reflected light from a thin film, Newton's Rings-experimental arrangement, Determination of Wavelength; Engineering applications of Interference

Diffraction-distinction between interference and diffraction, differences between Fresnel & Fraunhoffer diffractions, Fraunhoffer Diffraction at single slit(derivation, energy distribution curve) , Fraunhoffer Diffraction at a Double slit (derivation, energy distribution curve),Theory of Diffraction Grating -Determination of Wavelength; Engineering applications of diffraction

At the end of the Module 1, students will be able to:

1. explain the need of coherent sources and the conditions for sustained interference BL-2
2. describe the theory of interference of reflected light from a thin film BL-2
3. explain the theory of Fraunhoffer Diffraction of light at single and multiple slits BL-2
4. identify engineering applications of interference and diffraction BL-3
5. analyze the differences between interference and diffraction (L4)

**MODULE -2**

**INTRODUCTION TO QUANTUM MECHANICS** **8 H**

Matter waves -de-Broglie hypothesis - properties, G.P.Thomson experiment, Phase and group velocities—Expression for group velocity; Heisenberg's uncertainty principle; Schrodinger's time dependent and independent wave equations – Physical significance of wave function-important characteristics of wave function, free particle energy, wave function, momentum; operators and expectation values, Eigen values and Eigen functions of a particle confined to one dimensional infinite square well (potential well).

At the end of the Module 2, students will be able to:

1. understand the concept of matter waves BL-2
2. Recognize the difference between phase velocity and group velocity BL-2.
3. understand Physical significance of wave function BL-2
4. Identify the importance of Schrodinger's wave equation in describing the motion of elementary particles BL-3 **.**

**MODULE-3**

**FREE ELECTRON THEORY OF METALS** **8 H**

Classical free electron theory-assumptions, expression for electrical conductivity, merits and demerits; Quantum free electron theory of metals-expression for electrical conductivity; Fermi-Dirac distribution, Mathiesson rule, causes of electrical resistance in metals, Bloch's theorem (Qualitative), Kronig - Penny Model (Qualitative), effective mass and Brillouin zones, Classification of solids into conductors, semiconductors and insulators based on energy band gap.

At the end of the Module 3, students will be able to:

1. explain Classical, Quantum free electron theory of metals BL-2.
2. apply these theories to explain electrical conductivity in metals BL-3

3. explain formation of energy bands in solidsBL-2 .
4. Understand the band structure of a solid and Classify materials as metals, insulators, or semiconductors, and sketch a schematic band diagram for each one BL-2.

**MODULE-4**

**INTRODUCTION TO SEMICONDUCTORS 8 H**

Origin of energy bands , Intrinsic semiconductors - density of charge carriers(derivation),Fermi energy , Electrical conductivity; extrinsic semiconductors - P-type & N-type , Density of charge carriers , Dependence of Fermi energy on carrier concentration and temperature; Direct and Indirect band gap semiconductors, Hall effect- Hall coefficient (derivation), Applications of Hall effect ; Drift and Diffusion currents , Einstein coefficients, Continuity equation(derivation) , Applications of Semiconductors.

At the end of the Module 4, students will be able to:

1. outline the properties of n-type and p-type semiconductors BL-2.
2. interpret the direct and indirect band gap semiconductors BL-2.
3. identify the type of semiconductor using Hall effect BL-3 .
4. identify applications of semiconductors in electronic devices BL-3

**MODULE-5**

**SUPERCONDUCTORS AND NANOMATERIALS 8 H**

Superconductors- Properties, Meissner's effect, BCS Theory, Josephson effect (AC &DC), Types of Super conductors, Applications of superconductors. Nano materials – Significance of nanoscale , Properties of nanomaterials: Physical, mechanical, Magnetic, Optical ; Synthesis of nanomaterials: Top-down-Ball Milling, Bottom-up –Chemical vapour deposition ; Applications of Nano materials.

At the end of the Module 5, students will be able to:

**1.** explain how electrical resistivity of solids changes with temperatureBL-2
**2.** classify superconductors based on Meissner's effect BL-2
**3.** explain Meissner's effect, BCS theory & Josephson effect in superconductors BL-2
**4.** identify the nano size dependent properties of nanomaterials BL-3
**5.** illustrate the methods for the synthesis and characterization of nanomaterials BL-2
**6.** Apply the basic properties of nanomaterials in various Engineering branches BL-3

**MODULE-6**

**LASERS & OPTICAL FIBERS 7 H**

Lasers: Spontaneous & stimulated emission of radiation, Population inversion, Pumping methods, Properties of lasers- monochromaticity, coherence, directionality, brightness, Types of lasers: Nd-YAG Laser, He–Ne Laser, Semiconductor laser; Applications.
Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile-advantages of optical fibres.

At the end of the Module 6, students will be able to:

1. describe Spontaneous & stimulated emission of radiation BL-2
2. Understand the basic concepts of LASER light Sources BL-2

3. describe the construction and working of different types of Lasers BL-2
4. identify the applications of lasers in various fields BL-3

**Content beyond syllabus:Polarization of light.**

**Self-Study:**

Contents to promote self-Learning:

| S.NO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Wave Optics | CO1 | **https://youtu.be/n65gZGwiZtk** |
| 2 | Introduction To Quantum Mechanics | CO2 | **https://youtu.be/w7Wf3Wr0guA?list=PL1955A15B7F282A7F** **https://youtu.be/NfkJKIoExYo?list=PL1955A1B7F282A7F** |
| 3 | Free Electron Theory Of Metals | CO3 | **https://youtu.be/L-eOdZFt9BY** **https://youtu.be/G2zgAs5O7I8** |
| 4 | Introduction To Semiconductors | CO4 | **https://youtu.be/BQijtvYxgIM** **https://youtu.be/rzxCRJcFaIw** |
| 5 | Superconductors And Nanomaterials | CO5 | https://youtu.be/GglT1RoBPzg https://youtu.be/iiT_KJJ1Uhs |
| 6 | Lasers | CO6 | **https://youtu.be/eoOM0Gx6GJc** **https://youtu.be/RyY4PEpV2RQ** |

| **Total hours:** | **48 hours** |
|---|---|

**Text Book(s):**


1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy" AText book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.
2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.
3. S.O.Pillai, "Solid State Physics", 8th edition, New Age International Publishers, 2018..


**Reference Book(s):**


1. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education,2018
2. N. Subrahmanyam, BrijLal, *A Textbook of Optics*, S. Chand, New Delhi, 2015
3. Kittel, C. ―Introduction to Solid State Physics‖. Wiley, 2005.
4. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
5. Ajoy Ghatak, *Optics*, 5th Edition, McGraw Hill, 2012
6. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
7. William T. Silfvast, "Laser Fundamentals" 2nd edition, Cambridge University Press, 2004.
8. T. Pradeep, "A Text Book of Nanoscience and Nanotechnology", Tata Mc Graw Hill, 2003


**Online Resources:**

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

**Web Resources:**

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1001 | **PROBLEM SOLVING AND PROGRAMMING** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Mathematics Knowledge, Analytical and Logical skills

**Course Objectives:**

1. To understand various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn the syntax and semantics of a C Programming language.
5. To learn structured programming approach for problem solving.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Identify methods to solve a problem through computer programming. BL-3 |
| **CO 2** | Understand the use of basic elements of C language. BL-2 |
| **CO 3** | Understand the difference and the usage of various control statement. BL-2 |
| **CO 4** | Apply the modular approach for solving the problems. BL-3 |
| **CO 5** | Apply the Arrays and Pointers for solving problems. BL-3 |
| **CO 6** | Explain User-Defined Data Types and Files. BL-2 |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | | | | | | | | | | | 1 | |
| **CO2** | 1 | 2 | 1 | | | | | | | | | | 1 | |
| **CO3** | 1 | 2 | 1 | | 2 | | | | | | | | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 1 | 1 | | | | | | | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 1 | | | | | | | | 1 | 2 | |
| **CO6** | 2 | 2 | 2 | 1 | | | | | | | | 1 | 2 | |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Fundamentals of Computers and Programming** | **8H** |
|---|---|---|

**Fundamentals of computers:**History of Computers, Generations of Computer, The Computer System - The Input-Process-Output Concept, Components of Computer System, Operating System - Introduction, Objectives, Functions.

**Introduction to Programming, Algorithms and Flowcharts:** Programs and Programming, Programming languages, Compiler, Interpreter, Structured Programming Concept, Algorithms, Flowcharts, How to Develop a Program.

**Fundamental Algorithms:** Exchanging the values of Two Variables, Counting, Summation of a set of numbers, Factorial computation, Generation of the Fibonacci Sequence, Reversing the digits of an integer.

At the end of the Module 1, students will be able to:

1. Illustrate the working of a Computer. BL-2
2. Solve problems using language independent notations. BL-3
3. Understand the compilers and interpreters. BL-2
4. Understand Structured Programming. BL-2
5. Develop algorithms and flowcharts for problems.BL-3

| **MODULE -2** | **Basic Elements of C** | **7 H** |
|---|---|---|

**Basics of C:** Introduction**,** Character Set, Structure of a C Program, A Simple C Program, Variables, Data Types and Sizes, Declaration, How does The Computer Store Data in

Memory, Identifiers, Keywords, Constants, Assignment, and Initialization.
**Operators and Expressions:** Arithmetic Operators, Relational Operators, Logical Operators, Bitwise Operators, Conditional Operator, Comma operator, size of operator, Expressions, L values and R values, Expression Evaluation- Precedence and Associativity, Type Conversion.

At the end of the Module 2, students will be able to:
1. Understand the basic structure of a program in C. BL-2
2. Understand tokens in C language.BL-2
3. Illustrate the working of expressions.BL-2
4. Understand the precedence and Associativity rules of operators. BL-2
5. Understand the rules of type conversion. BL-2

| MODULE-3 | Data Input / Output and Control Statements | 8 H |
|---|---|---|

**Input and Output:** Basic Screen and Keyboard I/O in C, Formatted Input and Output, Unformatted Input and Output Functions
**Control Statements:** Selection Statements - if, Nested if, if-else, Nested if-else, else-if ladder,switch Looping Statements - while, do-while, for, Nested loops, Unconditional Statements -go to, break, continue, return.

At the end of the Module 3, students will be able to:
1. Explain the Formatted and Unformatted I/O functions. BL-2
2. Understand Selection Statements. BL-2
3. Understand Looping Statements. BL-2
4. Explain Unconditional Statements. BL-2

| MODULE-4 | Functions and Program Structure | 8 H |
|---|---|---|

**Functions:** Introduction, Using Functions, Passing Arguments to a Function, Working with Function, Scope and Extent, Recursion, The C Preprocessor.
**Program Structure:** Storage classes, Automatic variables, External variables, Static variables, Register variables, Multi file programs.

At the end of the Module 4, students will be able to:
1. Understand the basic concept of functions. BL-2
2. Understand concept of Recursion and Preprocessor. BL-2
3. Explain storage specifiers. BL-2

| MODULE-5 | Arrays and Pointers | 9 H |
|---|---|---|

**Arrays and Strings:** Introduction, One-Dimensional Array, Multidimensional Arrays, Passing Arrays to Function, Strings - Declaration, Initialization, Printing Strings, String Input, Character Manipulation, String Manipulation, Arrays of Strings.
**Pointers:** Fundamentals, Pointer Declarations, Operations on pointers, Passing Pointers to a Function, Pointers and Arrays, Arrays of Pointers, Pointer to Pointer, Pointer to Functions, Command line arguments, Dynamic Memory Management.

At the end of the Module 5, students will be able to:
1. Understand the concept of Arrays. BL-2
2. Understand the concept of pointers. BL-2
3. Explain Dynamic Memory Management. BL-2

| MODULE-6 | User-Defined Data Types and Files | 8 H |
|---|---|---|

**Structures and Unions:** Basics of Structures, Nesting of Structures, Arrays of Structures, Structures and Pointers, Structures and Functions, Self-Referential Structures, Unions, Bit-fields, Enumerations, type def.
**Files:** Introduction, Using Files in C, Working with Text Files, Random Accesses to Files of Records.

At the end of the Module 6, students will be able to:
1. Explain user defined data types. BL-2
2. Understand the concept of Self-Referential Structures. BL-2
3. Understand the working of files. BL-2

| Total hours: | 48 HOURS |
|---|---|

**Content Beyond Syllabus:**
1. Analysis of Algorithms

2. Binary Files
3. Variable Length Argument Lists

**Self-Study:**

Contents to promote self-Learning:

| SNo | Module | Reference |
|---|---|---|
| **1** | Fundamentals of Computers and Programming | https://nptel.ac.in/courses/106/106/106106127/ [ Lec1 ] https://nptel.ac.in/courses/106/105/106105214/ [ Week 1 - Lec 1 To 2 ] https://nptel.ac.in/courses/106/105/106105171/ [ Week 1 - Lec 1 To 4 ] |
| **2** | Basic Elements of C | https://nptel.ac.in/courses/106/105/106105171/ [ Week 1 - Lec5 ] https://nptel.ac.in/courses/106/105/106105171/ [ Week 2 - Lecture 7 To 10 ] https://nptel.ac.in/courses/106/105/106105171/ [ Week 3 - Lec 11 To 14 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec2 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec3 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec4 ] |
| **3** | Data Input / Output and Control Statements | https://nptel.ac.in/courses/106/106/106106127/ [ Lec5 ] https://nptel.ac.in/courses/106/105/106105171/ [ Week 3 - Lec15 ] https://nptel.ac.in/courses/106/105/106105171/ Week 4 - Lec 16 To 20 ] [ Week 5 - Lec 21 To 25 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec 6 &7 ] |
| **4** | Functions and Program Structure | https://nptel.ac.in/courses/106/105/106105171/ [ Week 7 - Lec35 ] [ Week 8 - Lecture 36 To 40 ] https://nptel.ac.in/courses/106/105/106105171/ [ Week 11 - Lec 53 To 54 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec 20 To 27 ] |
| **5** | Arrays and Pointers | https://nptel.ac.in/courses/106/105/106105171/ [ Week 6 - Lec 26 To 30 ][ Week 7 - Lec 32 To 34,48 ] [ Week 12 - Lec 58, 59, 61 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec 9 To 19 ] |
| **6** | User-Defined Data Types and Files | https://nptel.ac.in/courses/106/105/106105171/ [ Week 11 - Lec 55, 56, 57, 60 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec 36, 37, 38 ] https://nptel.ac.in/courses/106/106/106106127/ [ Lec60 ] |

**Text Book(s):**

1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press.
2. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

**Reference Books :**


1. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.
2. Ajay Mittal, Programming in C: A Practical Approach , 3/e, Pearson Publication
3. SCHILDT and HERBERT, C: The Complete Reference,4th Edition, McGraw Hill, 2020
4. SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., Problem Solving with C,2nd Edition, PHI Learning, 2018
5. Paul Deitel, Deitel& Harvey Deitel, C How to Program,6th Edition, Pearson Education
6. Jeri R. Hanly, Elliot B. Koffman, Ashok Kamthane and A.Ananda Rao, Programming in C and Data Structures, 1st Edition, Pearson Education, 2010.
7. H.Cheng, C for Engineers and Scientists, Mc.Graw-Hill International Edition Education / PHI, 2009
8. Yashavant P. Kanetkar, Let us C, 16th Edition, BBP Publications, Delhi, 2017.
9. R.G. Dromey, "How to Solve it by Computer". Pearson,2014.
10. Anita Goel, Computer Fundamentals, Pearson Publication,2010.


**Online Resources / Web Resources:**

1. https://nptel.ac.in/courses/106/105/106105171/
2. https://nptel.ac.in/courses/106/106/106106127/
3. https://www.youtube.com/playlist?list=PLVlQHNRLflP8IGz6OXwlV_lgHgc72aXlh
4. https://www.youtube.com/watch?v=8PopR3x-VMY
5. https://www.youtube.com/watch?v=vl794HKeXug
6. https://books.goalkicker.com/CBook/
7. https://www.tutorialspoint.com/cprogramming/index.htm
8. https://www.programiz.com/c-programming
9. https://www.javatpoint.com/c-programming-language-tutorial
10. https://www.edureka.co/blog/c-programming-tutorial/
11. https://data-flair.training/blogs/c-tutorial/
12. https://www.programmingsimplified.com/c-program-examples
13. https://www.w3schools.in/category/c-tutorial/
14. C Programming Notes for Professionals book : https://books.goalkicker.com/CBook/

| NARAYANA ENGINEERING COLLEGE :: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EN1001 | ENGLISH | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 2 | 0 | 0 | 32 | 2 | 40 | 60 | 100 |

**Pre-requisite: Knowledge of fundamentals of English Language & Grammar**

**Course Objectives:**

1. To enhance the linguistic and communicative competence.
2. To improve the Language proficiency of students in English with an emphasis on Vocabulary, Reading and Writing skills.
3. To provide knowledge of grammatical structures & rules and encourage their appropriate use.
4. To expose the students to Reading skills and apply the skill & strategies of a successful reader
5. To acquaint the students with effective strategies of paragraphs, note making, text editing, review writing and formal correspondence such as letter writing, e mail, and memos.
6. To aid the students acquire appropriate and adequate knowledge on writing Technical Reports.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Acquire in depth knowledge on formulating appropriate sentences with grammatical accuracy and vocabulary building. **BL-2** |
| **CO 2** | Understand the factors that influence in use of grammar and learn to use sentences unambiguously. **BL-2** |
| **CO 3** | Impart effective strategies for professional written communication using devices of coherence & cohesion with adequate support & detail. **BL-3** |
| **CO 4** | Provide knowledge of use of phrases & clauses and improve effective writing Note making & Paraphrasing. **BL-2** |
| **CO 5** | Understanding the grammar rules for synthesis of sentences and use prewriting strategies to plan to write dialogues, reviews and edit the text effectively. **BL-2** |
| **CO 6** | Master the skills and sub skills of reading and use strategies for reading effectively and provide knowledge on the structure and format of technical writing. **BL-3** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 1 | | | | | | | | | 2 | | 2 | 1 | |
| CO2 | 1 | | | | | | | | | 2 | | 2 | 1 | |
| CO3 | 1 | | | | | | | | | 3 | | 2 | 1 | |
| CO4 | 1 | | | | | | | | | 2 | | 3 | 1 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO5** | **1** | | | | | | | | | **3** | | **3** | 1 | |
| **CO6** | **1** | | | | | | | | | **3** | | **3** | 1 | |
| 1: Low, 2-Medium, 3-High | | | | | | | | | | | | | | |

| **COURSE CONTENT** | | |
|---|---|---|
| **Module – I** | | **6 H** |
| **Grammar :** Parts of speech: Noun (Countables & Uncountables, Singulars & Plurals, Kinds of Nouns), Pronoun, Verb, Adverb, Adjective - Kinds of Sentences & Sentence Structures – Question forms – Word order in Sentence<br>**Vocabulary Building** : Concept of word formation – Synonyms & Antonyms – Homonyms & Homophones – Prefixes & suffixes – Commonly confused Words – One word substitutes – Idioms & Phrasal Verbs<br>**At the end of the Module 1, students will be able to:**<br>• Acquire in depth knowledge on basic grammar concepts.<br>• Understand the meaning of suffixes & Prefixes, idioms and phrasal verbs.<br>• Learn meaning and usage of Vocabulary. | | |
| **Module – II** | | **8 H** |
| **Grammar** : Subject Verb agreement – Pronoun-antecedent agreement – Verbs: auxiliary verbs (Primary & Modal)- Tenses<br>**Writing** : Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts - Sentence Structure – Joining the sentences - sequencing the ideas - introduction and conclusion – Punctuation.<br>**At the end of the Module II, students will be able to:**<br>• Learn to use sentences clearly.<br>• Understand the usage of grammar.<br>• Learn the importance of use of Auxiliary verbs. | | |
| **Module – III** | | **10 H** |
| **Grammar** : Direct & Indirect Speech – Active and Passive Voice – Comparison of Adjectives – Articles – Prepositions<br>**Writing** : Paragraph Writing - Phrases & Clauses – Conditionals - Business letters and Emails and Memos - Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order | | |
| **At the end of the Module III, students will be able to:**<br>• Understand and learn the nuance of writing business letters, e-mails, memos and effective paragraphs<br>• Learn to use devices of coherence & cohesion with adequate support & detail<br>• Learn the use of prepositions and active & passive voice in engineering and scientific contexts. | | |

| Module – IV | | 10 H |
|---|---|---|

**Grammar :** Phrasal Verb – Cause and effect – Verb noun Collocations & adjective-noun collocations – correcting common errors in grammar and usage - Misplaced modifiers, idiomatic expressions
**Writing :** Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing - Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures.

**At the end of the Module IV, students will be able to:**

- Understand the usage of phrases and clauses in sentences
- Learn grammatical rules to encourage their appropriate use in writing
- Learn to write effective note making and paraphrase

| Module – V | | 8 H |
|---|---|---|

**Grammar :** Question formation (Wh- questions, Yes or No questions, Tag questions)-If Clauses—Simple, Compound, Complex Sentences - Correcting common errors in grammar and usage
**Writing :** Editing short texts - Dialogue writing - Writing Definitions (short and long) – compare and contrast paragraphs- Writing of Reviews : Book / Play / Movie - focus on appropriate vocabulary and structure - language items like special vocabulary and idioms used

**At the end of the Module V, students will be able to:**

- Acquire the knowledge of applying the grammatical rules for synthesis of sentences
- Learn to write dialogues for various contexts
- Learn to edit the text and writing reviews

| Module – VI | | 6 H |
|---|---|---|

**Reading Skills :** Types of reading: Skimming, Scanning, Intensive & Extensive Reading - Effective Reading-Tips
Reading Comprehension
Scramble Sentences
Complete the passage using contextual clues
Identifying Main Ideas using Scanning Technique
Identifying Specific Ideas using Skimming Technique
**Writing :** Describing – Report Writing: definition - purpose – types – structure - formal and informal reports - stages in developing report- proposal, progress and final reports –examples

**At the end of the Module VI, students will be able to:**

- Master the skills and sub skills of reading
- Learn the structure and format of technical reports
- Learn to write description of things, process, places and persons

**Content beyond syllabus:**

**Self-Study:**
Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Vocabulary for Aptitude & | CO1 | https://youtu.be/uzvZa2qEuWo |

| | | | |
|---|---|---|---|
| | Recruitment Tests \| Campus Jobs | | |
| 2 | Tips to Improve Verbal and Written Communication Skills | CO2 | **https://youtu.be/6Y3NY0ERBxY** |
| 3 | How to write professional emails in English | CO3 | **https://youtu.be/3Tu1jN65slw** |
| 4 | Introduction to Collocation | CO4 | **https://youtu.be/-ouWOpo2Uh8** |
| 5 | **Error Spotting Questions in Campus Recruitment Tests** | CO5 | https://youtu.be/Rz6-qjNrzCU |
| 6 | Reading Skills: How To Skim, Scan and Read for Detail Effectively | CO6 | https://youtu.be/SRHNKzXxu6o |

**Text Books:**

- *Green, David Contemporary English Grammar –Structures and Composition, MacMillan India, 2014*
- *Raymond Murphy's English Grammar with CD, Murphy, Cambridge University Press,2012*
- *Michael Swan, (2017) Practical English Usage (Practical English Usage), 4th edition, UK:Oxford University Press.*
- *Ashraf, M Rizvi. Effective Technical Communication. Tata McGraw-Hill, 2006.*

***Reference Books***

- *English Conversation Practice –Grant Taylor, Tata McGraw Hill, 2009.*
- *Hewings, Martin. Cambridge Academic English (B2). CUP, 2012*
- *Meenakshi Raman and Sangeeta Sharma, Professional Communication, Second Edition, Oxford University Press, India, 2017*
- *Michael McCarthy, Felicity O'Dell, (2015) English Vocabulary in Use Advanced (South Asian Edition), UK: Cambridge University Press*
- *Spoken English, R.K. Bansal & JB Harrison, Orient Longman,2013, 4Th edition***.**

**WEB RESOURCES:**

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

***Grammar/Vocabulary***

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

***Reading***

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

***Listening***

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

***Speaking***

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

***All Skills***

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

***Online Dictionaries***

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20PH1501 | **Applied Physics lab** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 48 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To provide student to learn about some important experimental techniques in physics with knowledge in theoretical aspects so that they can excel in that particular field. To prepare students for performing requirement analysis and design of variety of applications.
2. To enable the students to understand the concepts of interference and diffraction and their applications.
3. To educate students to recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies
4. To make the students to understand the important parameters of optical fibres and metals

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | learn important concepts of physics through involvement in the experiments by applying theoretical knowledge. |
| **CO 2** | understand the concepts of interference and diffraction and their applications. |
| **CO 3** | recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies |
| **CO 4** | understand the important parameters of optical fibres and metals |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 1 | | | | | | | | | | 2 | 2 | |
| **CO2** | 2 | 1 | | | | 1 | | | | | | 2 | 2 | |
| **CO3** | 2 | 1 | | | | 1 | | | | | | 2 | 2 | |
| **CO4** | 2 | 1 | | | | | | | | | | | 2 | |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task -1** Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall effect. | |
| The objective :To determine<br>a) sign of the charge carriers,<br>b) charge carrier concentration,<br>c) mobility of the charge carriers of a given semiconductor | CO 1 |
| **Task - 2 To determine the resistivity of semiconductor by Four probe method** | |
| Objective: To determine the resistivity of semiconductor by Four probe method | CO 1 |
| **Task -3** Determine the energy gap of a given semiconductor diode. | |

| | |
|---|---|
| | |
| Objective: To plot characteristics between reverse saturation current and 103 /T and find out the approximate value of Energy Band Gap in PN junction diode | CO 1 |
| **TASK -4** Measurement of radius of curvature of a lens by Newton's rings method. | |
| Objective: To determine the wavelength of sodium light by Newton's Ring method The key idea behind Newtons ring experiment is the thin film formation between a plane-convex lens and a glass plate. Due to this thin film of air a path difference occurs in the waves which reflect from the lower surface of the lens and the top surface of the glass plate. As a result of it, they superimpose and develop the interference pattern. | CO 2 |
| **TASK -5. Determine the thickness of the wire using wedge shape method** | |
| Objective: To calculate the thickness of a thin wire by forming interference fringes using an air wedge arrangement. The key idea behind this experiment is the formation of thin wedge shaped film between two plane glass plates. Due to this thin film of air, a path difference occurs between waves reflected from top and bottom surface of the film. On superimposition of these waves an interference pattern containing a number of straight line fringes will be produced | CO 2 |
| **TASK-6 Determination of wavelength by plane diffraction grating normal incidence method** | |
| Objectives:<br>1.To understand the types of diffraction<br>2.To familiarize with the principle of diffraction in plane transmission grating<br>3.To know the procedure for standardization of the grating<br>4.To determine the wavelengths of prominent spectral lines of mercury spectrum.<br>An arrangement, which is equivalents in its action to a large number of parallel slits of same width separated by equal opaque spaces is called diffraction grating. It is constructed by ruling fine equidistant parallel lines on an optically plane glass plate with the help of a sharp diamond point. | CO 2 |
| **TASK -7 Dispersive power of a diffraction grating** | |
| objective: To determine Dispersive power of a diffraction grating<br>When white light passes through a grating, different wavelengths undergo different angles of diffraction. Hence white light split up into different colours and diffraction spectra of different orders will be produced. The angular dispersion or dispersive power of a grating is defined as the rate of change of angle of diffraction with the change of wavelength in a particular order of the spectrum. | CO 2 |
| **TASK -8 Determination of wavelength of LASER light using diffraction grating** | |
| Objectives :1. To determine the concept of diffraction<br>2. To determine the wavelength of the given Laser source. | CO 3 |
| **TASK -9 . Laser: Diffraction at a single slit** | |
| Objective: Determination of width of a given single slit using laser diffraction method<br>Laser beam has high monochromaticity,coherence and directionality. Hence it forms a clear diffraction pattern and we can measure width of a single slit accurately. | CO 3 |
| **TASK -10 Laser: Diffraction at a double slit** | |

| | |
|---|---|
| Objective: Determination of width of a given double slit using laser diffraction method.<br>With this experiment we can demonstrate diffraction nature of lasers and measure width of a double slit accurately. | CO3 |
| **Additional Experiments:** | |
| **TASK -11 To determine the numerical aperture and acceptance angle of a given optical fibre** | |
| Objective: To determine the numerical aperture and acceptance angle of a given optical fiber.<br>In optical fibres light travel by multiple total internal reflections. Numerical aperture represents light gathering powerof optical fibre. Acceptance angle represents maximum limiting angle at one end of optical fibre for the liglht ray to travel by multiple total internal reflections through the core region of thefibre.<br>1. Optical fibers may be used for accurate sensing of physical parameters and fields like pressure, temperature and liquid level.<br>2. For military applications like fiber optic hydrophones for submarine and underwater sea application and gyroscopes for applications in ships, missiles and aircrafts. | CO 4 |
| **TASK -12:** Determination of Fermi energy of a metal. | |
| Objective: To determine Fermi energy of a metal.<br>Fermi energy represents highest energy level occupied by the electron at 0 K in a metal. | CO4 |
| Virtual lab: 1) Laser beam divergence and spot size<br>https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1<br>2. Michelson's Interferometer- Wavelength of laser beam<br>https://vlab.amrita.edu/?sub=1&brch=189&sim=1106&cnt=1<br>3. Anderson's Bridge<br>https://vlab.amrita.edu/?sub=1&brch=192&sim=859&cnt=1 | |

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Newton rings | | **https://youtu.be/PU-SeNfIRcs** |
| 2 | Diffraction grating experiment - Wavelength of mercury spectrum | | **https://youtu.be/N0lxwqANsd4** |
| 3 | Experiment - Laser Grating-Determination of Wavelength of Given Laser Source | | **https://youtu.be/764Fr0mnOrO** |

**Text Book(s):**

1. C. L. Arora, “Practical Physics”, S. Chand & Co., New Delhi, 3rd Edition, 2012.
2. Vijay Kumar, Dr. T. Radhakrishna, “Practical Physics for Engineering Students”, S M Enterprises, 2nd Edition, 2014.

**Reference Book(s):**


1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers, 2017.
2. C.H. Bernard and C.D. Epp, John Wiley and Sons, "Laboratory Experiments in College Physics" Inc., New York, 1995.
3. Dr.Ruby Das, C.S.Robinson, Rajesh Kumar and Prasanth Kumar “A text book of Engineering Physics Practical”, 1st edition, Sahu University Science Press, 2010.
4. Jayaraman, “Engineering Physics Laboratory Manual”, 1st edition, Pearson Education, 2014.


**Web Resources:**

1. https://www.scribd.com/doc/143091652/ENGINEERING-PHYSICS-LAB.
2. https://www3.nd.edu/~wzech/LabManual_0907c.pdf.
3. https://www.morebooks.de/store/gb/book/engineering-physics-lab-manual/isbn/978-3-330-34402.

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1501 | ELECTRICAL ENGINEERING WORKSHOP | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 2 | 32 | 1 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To know about different tools, abbreviations and symbols in Electrical Engineering
2. To learn about types of measuring instruments to measure electrical quantities
3. To gain knowledge on different types of earthing and earth resistance
4. To study different types of wiring

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Demonstrate knowledge on different tools, abbreviations and symbols used in Electrical Engineering |
| **CO 2** | Measure different electrical quantities using measuring instruments |
| **CO 3** | Explain how to trouble shoot the electrical equipments (like fan, grinder, motor, etc.) |
| **CO 4** | Understand about wiring and earthing for residential houses |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | 1 | 2 | 3 |
| CO2 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | 1 | 2 | 3 |
| CO3 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | 1 | 2 | 3 |
| CO4 | 2 | 2 | 2 | 1 | 1 | 1 | | | | | | 1 | 2 | 3 |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task - 1 - STUDY OF INTRODUCTION TO ELECTRICAL TOOLS, SYMBOLS AND ABBREVIATIONS** | **CO1** |
| **Objective:**To Study the electrical tools, symbols and abbreviations in electrical engineering. | |
| **Task - 2 - MAKING "T" JOINT AND STRAIGHT JOINT OF WIRES** | **CO 4** |
| **Objective:** To make "T" joint and straight joint of wires for domestic wiring.. | |
| **Task -3 - MEASUREMENTS OF ELECTRICAL QUANTITIES (VOLTAGE, CURRENT, POWER, POWER FACTOR IN RLC CIRCUITS)** | **CO 2** |
| **Objective:**To measure voltage, current, power, power factor for a given RLC circuit. | |
| **TASK -4 - STUDY OF MEASUREMENTS OF ENERGY (USING SINGLE PHASE METER) BY CONNECTING DIFFERENT LOADS** | **CO 2** |
| **Objective:**To study the testing a single phase energy meter for measuring the power. | |

| | |
|---|---|
| **TASK -5 - MEASUREMENT OF EARTH RESISTANCE** | **CO 4** |
| **Objective:** To measure the earth resistance. | |
| **TASK-6 - RESIDENTIAL WIRING (USING ENERGY METER, FUSES, SWITCHES, INDICATOR, LAMPS, etc.)** | **CO 4** |
| **Objective:** To design different types of residential wirings and know the performance of residential wiring | |
| **TASK -7 - FLUORESCENT LAMP WIRING** | **CO 4** |
| **Objective:** To prepare wiring for a fluorescent tube light with switch control | |
| **TASK -8 - SOLDERING & DESOLDERING PRACTICE** | **CO 3** |
| **Objective:** To understand and know the Introduction to Soldering and disordering practice. | |
| **TASK -9 - MEASUREMENT OF WIRE GUAGES USING GUAGE METER** | **CO 3** |
| **Objective:** To Measure the of wire gauges using gauge meter. | |
| **TASK -10 - DEMONSTRATION OF TRANSFORMER AND INDUCTION MOTOR** | **CO 3** |
| **Objective:** To verify different components of transformer and induction motor and their applications. | |
| **TASK -11 - LT SWITCHGEAR'S & MCB'S** | **CO 3** |
| **Objective:** To understand different types of low tension switchgear equipments and MCB's | |
| **TASK -12 - TROUBLE SHOOTING OF ELECTRICAL EQUIPMENTS (FAN, IRON BOX, MIXER,GRINDER, etc.)** | **CO 3** |
| **Objective:**To understand and know the trouble shooting of electrical equipment's. | |

| | |
|---|---|
| **Additional Experiments:** | |
| **TASK -13 - STUDY OF VARIOUS ELECTRICAL GADGETS (CFL AND LED)** | **CO 1** |
| **Objective:-** To study about CFL (Compact Fluorescent Lamp) and LED (Light Emitting Diode) used for lighting purposes. | |
| **TASK - 14- STUDY OF PHOTO VOLTAIC (PV) CELL** | **CO 4** |
| **Objective:** To study about Photo Voltaic Cell and its applications. | |
| **TASK - 15 - IDENTIFICATION OF COLOR CODE, RESISTORS, ICS, TRANSISTORS, CAPACITORS, DIODES, SCRS, IGBTS ETC.** | **CO 1** |
| **Objective:-** To study about the Identification of color code, resistors, ICs, Transistors, capacitors, diodes, SCRs, IGBTs etc. | |
| | |

**Self-Study:**

Contents to promote self-Learning:

| SNO | CO | Reference |
|---|---|---|

| | | | | |
|---|---|---|---|---|
| | 1 | **CO 1** | Lab manual of Electrical Engineering by TTTI, Chennai. | |
| | 2 | **CO 2** | Lab manual of Electrical Engineering by TTTI, Chennai. | |
| | 3 | **CO 3** | Lab manual of Electrical Engineering by TTTI, Chennai. | |
| | 4 | **CO 4** | Lab manual of Electrical Engineering by TTTI, Chennai. | |

**Text Book(s)/ Reference Book(s):**

1. Lab manual of Electrical Engineering by TTTI, Chennai.

**Online/Web Resources:**

https://www.roboversity.com/workshops

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1505 | ENGINEERING & ITWORK SHOP | | | | | | | R2020 |
| PART – A ENGINEERING WORK SHOP | | | | | | | | |
| I-B.Tech | Hours / Week | | | Total hrs | Credits | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 4 | 64 | 2 | 40 | 60 | 100 |

**Pre-requisite:** Basic mathematics.

**Course Objectives:**

1. To know basic workshop processes and adopt safety practices while working with various tools and equipments
2. To identify, select and use various marking, measuring, holding, striking and cutting tools & equipments.
3. Toknowabouttheinternalpartsofacomputer,assemblingacomputerfromtheparts,preparing a computer for use by installing the operating system
4. To gain knowledge about the usage of tools like Word processors, Spreadsheets, Presentations
5. To learn about Networking of computers and use Internet facility for Browsing andSearching

**CourseOutcomes**:Aftersuccessfulcompletionofthecourse,thestudentwillbeableto:

| | |
|---|---|
| **CO1** | Apply tools for making models in respective trades of engineering workshop. |
| **CO2** | Apply basic electrical engineering knowledge to makes imple house wiring circuits and check their functionality.BL-3 |

| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 2 | | | | | | | | | | | 2 | |
| CO 2 | 3 | 2 | | | | | | | | | | | 2 | |

**COURSE CONTENT (TRADES FOR PRACTICE)**

**Trade -1 Carpentry (6 H)**

Familiaritywithdifferenttypesofwoodsandtoolsusedinwoodworkingandmakefollowingjointsfromoutof 300x40x25mmsoftwoodstock.

a) Half–Lapjoint.
b) Mortiseand Tenon joint

**Trade-2 Fitting (6 H)**

i.]Familiarity with different types of tools used in fitting and do the fitting exercises out of 80 x 50 x 5 mm M.S. stock

a) V-fit b) Dovetail fit

**Trade - 3 Sheet Metal Work (6 H)**

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from out of 22 or 20 guage G.I. sheet

a) Tapered tray b) Conical funnel

**Trade - 4 Electrical House Wiring (6 H)**

Familiarities with different types of basic electrical circuits and make thefollowing Electrical connections

a) Two lamps in series
b) Two way switch
c) Tube light
d) Two lamps in parallel with 3 pin plug and switches

**Trade 5 - Welding**

Familiarity with different types of tools used in welding and do the following welding exercises

1. Single V butt joint
2. Lap joint

**Text Book(s):**


1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjar Roy S.K. "Elements of WorkshopTechnology"Vol-I2008&Vol-II2010MediaPromoters&Publishers Pvt.Limited,Mumbai.
2. KalpakjianS.andStevenS.Schmid,"ManufacturingEngineeringand Technology" 4th Edition, Pearson Education IndiaEdition,2002.
3. P. Kannaiah&K. L. Narayana "Workshop manual" 2nd Ed., ScitechpublicationsPvt.Ltd.,Hyderabad,2008.


**Reference Book(s):**


1. Gowri P., Hariharan and Suresh Babu A., "Manufacturing Technology-I", Pearson Education2008.


**WebResources:**

1. https://www.muet.edu.pk/sites/default/files/images/users/41/Workshop%20Intro.pdf
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=98826

| PART-B IT WORKSHOP LAB | |
|---|---|
| **Course Objectives:**<br>1. To provide Technical training on Productivity tools like Word processors, Spreadsheets, Presentations.<br>2. To make the students know about the internal parts of a computer, assembling, installing the operating system.<br>3. To teach connecting two or more computers. | |
| **Course Outcomes**: After successful completion of the course, the student will be able to: | |
| **CO 3** | Understand to disassemble and assemble a Personal Computer and prepare the computer ready to use. BL-2 |

| CO-PO Mapping | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO | | | | | | | | | | | PSO | |
| CO | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO3 | 3 | 2 | | 1 | | | | | | | | | 2 | |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| COURSE CONTENT | CO |
|---|---|
| **Task-1 Learn about Computer (4H)** | |
| Identify the internal parts of a computer and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report. | CO 1 |
| **Task -2 Assembling a Computer (4H)** | |
| Disassemble and assemble the PC back to working condition. Troubleshoot the computer and identify working and non-working parts. Identify the problem correctly by various methods available (eg: beeps). Record the process of assembling and trouble-shooting a computer. | CO 1 |
| **Task-3 Install Operating system (2H)** | CO 1 |
| Install Linux, any other operating system (including proprietary software) and make the system dual boot or multi boot. Record the entire installation process. | |
| **TASK-4 Operating system features (2H)** | CO 1 |
| Record various features that are supported by the operating system(s) installed. Submit a report on it. Access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Install new application software and record the installation process. | |
| **TASK-5 Word Processor (6H)** | CO 2 |
| Create documents using the word processor tool. Tasks to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Prepare project cover pages, content sheet and chapter pages at the end of the task using the | |

| | |
|---|---|
| features studied. Submit a report of the word processor considered.<br>Create documents using the word processor tool. Mail Merge in word processor for creating appointment orders for 10 employee records in excel. | |
| **TASK-6 Spreadsheet (4H)** | CO 2 |
| To create, open, save the spreadsheet and format them as per the requirement. Some of the tasks to be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells, working with pivot tables and charts. Submit a report of the Spreadsheet application considered. | |
| **TASK-7 Presentations (6H)** | CO 2 |
| To create, open, save and run the presentations, Select the style for slides, format the slides with different fonts, colors, create charts and tables, insert and delete text, graphics and animations, bulleting and numbering, hyperlink, set the time for slide show, Record slide show. Submit a report of the Presentation tool considered. | |
| **TASK-8 Wired network & Wireless network (4H)** | CO 3 |
| Select a LAN cable, Identify the wires in the cable, Define the purpose of each wire, Study the RJ45 connecter, Use crimping tool to fix the cable to the connecter, Test the cable using LAN tester, Connect two or more computers using cross and straight cables,<br>Configure the computers, share the data between the computers. | |

| | |
|---|---|
| **Additional Experiments:** | |
| **TASK -1 IoT** | CO 3 |
| Raspberry Pi Study the architecture of Raspberry pi, configure software, Install SD card, Connect the cables, Install Raspbian (or any other) operating system, Configure Wi-Fi, Remotely connect to your Raspberry Pi. | |
| **TASK -2 OUTLOOK, MACROS** | CO 3 |
| Practice the following tasks and submit report<br>A. Configure outlook and access mails.<br>B. Create Macros in word and spreadsheet tools | |
| | |
| | |

**Text Book(s):**

1. B.Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance",2nd edition, Tata McGraw-Hill, 2002
2. "MOS study guide for word, Excel, Powerpoint& Outlook Exams", Joan Lambert, Joyce Cox, PHI.
3. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.

**Reference Book(s):**

1. Rusen, "Networking your computers and devices", PHI
2. Bigelows, "Trouble shooting, Maintaining & Repairing PCs", TMH.

**On-line/Web Resources:**

https://turbofuture.com/computers/Dissassembling-and-Assembling-the-computer-system
https://www.instructables.com/id/Disassemble-a-Computer/
https://www.windowscentral.com/how-do-clean-installation-windows-10
https://www.tutorialspoint.com/ms_excel_online_training/index.asp
https://www.raspberrypi.org

| NARAYANA ENGINEERING COLLEGE::GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1506 | **Problem Solving and Programming Lab** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 48 | 1.5 | 40 | 60 | 100 |

**Pre-requisite:** Mathematics Knowledge, Analytical & Logical Skills

**Course Objectives:**

1. To work with the compound data types
2. To explore dynamic memory allocation concepts
3. To able to design the flowchart and algorithm for real world problems
4. To able to write C programs for real world problems using simple and compound data types
5. To employee good programming style, standards and practices during program development

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Translate algorithms into programs ( In C language) ( BL - 2) |
| **CO 2** | Code and debug programs in C program language using various constructs.(BL-3) |
| **CO 3** | Solve the problems and implement algorithms in C. (BL - 3) |
| **CO 4** | Make use of different data types to handle the real time data (BL - 3) |

**CO-PO Mapping**

| | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | 2 | | | | | | | | | | | 1 | |
| **CO2** | 2 | 2 | 2 | | | | | | | | | | 2 | 1 |
| **CO3** | 2 | 2 | 3 | 1 | 2 | | | | | | | | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 1 | 1 | | | | | | | | 2 | 2 |

1: Low, 2-Medium, 3- High

| **COURSE CONTENT** | **CO** |
|---|---|
| **TASK-1 (3H)** | |
| 1. Practice DOS and LINUX Commands necessary for execution of C Programs.<br>2. Study of the Editors, Integrated development environments, and Compilers in chosen platform.<br>3. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment. | CO 1 |
| **TASK-2 (6H)** | |
| 1. Practice programs: Finding the sum of three numbers, exchange of two numbers, largest of two numbers, to find the size of data types, Programs on precedence and associativity ofoperators, sample programs on various library functions. | CO 1 |
| **TASK-3 (6H)** | |
| 1. Write a C program to calculate the factorial of a given number<br>2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 & 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a Cprogram to generate the first n terms of the sequence.<br>3. Write a program to find the roots of a Quadratic equation. | CO1 |
| **TASK-4 (6H)** | |
| 1. Write a program to generate the series of prime numbers in the given range.<br>2. Write a program to reverse the digits of a number. | CO 2 |

| | |
|---|---|
| 3. Write a C program to find the sum of individual digits of a positive integer. | |
| **TASK-5 (3H)** | |
| 1. Write a program to check for number palindrome.<br>2. Write a program to find the maximum of a set of numbers.<br>3. Write a C program to find the GCD (greatest common divisor) of two given integers | CO 2 |
| **TASK-6 (3H)** | |
| 1. Write a program to find the sum of positive and negative numbers in a given set of numbers.<br>2. Write C code to reverse the elements of the array. For example, [1,2,3,4,5] should become<br>[5,4,3,2,1]<br>3. Write a C program to find factorial of a given integer number using recursion | CO 3 |
| **TASK-7 (6H)** | |
| 1. Write a C program that use pointers to find Addition of Two Matrices<br>2. Write a C program that use functions to find Multiplication of Two Matrices | CO 3 |
| **TASK-8 (3H)** | |
| 1. Write a program to accept a line of characters and print the number of Vowels, Consonants, blank spaces, digits and special characters.<br>2. Write a C program to check whether a given string is a palindrome or not, without using anybuilt-in functions. | CO 3 |
| **TASK-9 (6H)** | |
| 1. Illustrate the use of auto, static, register and external variables.<br>2. Write a program to read and print student information using structures<br>3. Write a C program to define a union and structure both having exactly the same numbers using the sizeof operators print the sizeof structure variables as well as union variable | CO 4 |
| **TASK-10 (6H)** | |
| 1. Write a program to split a "file" into two files, say file1 and file2. Write lines into the 'file' from standard input. Read the contents from 'file' and write odd numbered lines into file1 and even numbered lines into file2.<br>2. Write a program to merge two files. | CO 4 |

| **Additional Experiments:** | |
|---|---|
| **TASK-1** | |
| 1. Programs on bitwise operators.<br>2. Programs on bit fields. | CO4 |
| **TASK-2** | |
| 1. Write a program to read a set of strings and sort them in alphabetical order.<br>2. Programs on implementation of structures using files. | CO 4 |

| **Virtual Labs:** |
|---|
| 1. Problem Solving Lab (IIIT HYDERABAD) : http://ps-iiith.vlabs.ac.in/ |
| **List of Experiments** |

| | |
|---|---|
| 1. Numerical Representation<br>2. Beauty of Numbers<br>3. More on Numbers<br>4. Factorials<br>5. String Operations | 6. Recursion<br>7. Advanced Arithmetic<br>8. Searching and Sorting<br>9. Permutation<br>10.Sequences |
| 2. Computer Programming Lab (IIIT HYDERABAD) : http://cse02-iiith.vlabs.ac.in/ | |
| **List of Experiments** | |
| 1. Numerical Approximation<br>2. Functions<br>3. Advanced Control Flow<br>4. Arrays<br>5. Structures | 6. Basic Control Flow<br>7. Pointers<br>8. Recursion<br>9. Expression Evaluation |

**Text Book(s):**

1. "How to Solve it by Computer", R.G. Dromey, 2014, Pearson.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education, 1st Edition, 2010.

**Reference Book(s):**

1. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition, Pearson.
2. "Let us C", Yeswant Kanetkar, BPB publications
3. "Pointers in C", Yeswant Kanetkar, BPB publications, 16th Edition, 2017
4. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan& Richard F. Gilberg, 3rd Edition, Cengage Learning
5. C Programming A Problem-Solving Approach, Behrouz A. Forouzan & E.V. Prasad, F. Gilberg, 3rd Edition, Cengage Learning
6. Programming with C RemaTheraja, Oxford, 2018
7. Programming in C, 3rd Edition, 2015, Ashok N. Kamthane, Pearson Education
8. Programming in C, 3/e : A Practical Approach by Ajay Mittal, Pearson Publication
9. Problem Solving with C by SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., PHI Learning, 2nd Edition, 2018
10. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press, 2001
11. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

**Web Resources:**

1. https://www.includehelp.com/c-programs/advacnce-c-examples.aspx
2. https://www.programiz.com/c-programming/examples
3. https://www.javatpoint.com/c-programs
4. https://www.w3resource.com/c-programming-exercises/
5. https://www.sanfoundry.com/simple-c-programs/
6. https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx
7. http://www.c4learn.com/c-programs/tag/c-programs-typical-programs

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EN1501 | **ENGLISH LANGUAGE LAB** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 48 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Basic English Grammar**

**Course Objectives:**

1. To expose the students to develop knowledge and awareness of English phonetics be able to read and produce phonemic transcriptions
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To develop strategies appropriately to improve one's ability to listen and Use listening skills to create more effective, less confrontational, more productive professional and personal communication
4. To demonstrate his/her ability to write error free written communication
5. To distinguish main ideas from specific details and make use of contextual clues to infer meanings of unfamiliar words from context
6. To provide a structured methodology for participants to prepare and deliver an effective, high impact presentation that meets the objectives and brings results

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand how speech sounds are used to create meaning. Apply their knowledge of English phonetics and phonology to improve their own pronunciation. |
| **CO 2** | Recognize and use pitch patterns to signal complete and incomplete thought groups and Speak confidently and intelligibly within groups and before an audience. |
| **CO 3** | Discuss and respond to content of a lecture or listening passage orally and/or in writing and make inferences and predictions about spoken discourse |
| **CO 4** | Produce coherent and unified paragraphs with adequate support and detail and can write a paragraph with a topic sentence, support, and concluding sentence |
| **CO 5** | To help the students to cultivate the habit of reading passages for competitive exams such as GRE, TOEFL, GMAT etc. |
| **CO 6** | Learn, practice and acquire the skills necessary to deliver effective, presentation with clarity and enable them to prepare resume with cover letter. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | | | | | | | | | 3 | | 2 | 1 | |
| **CO2** | 1 | | | | | | | | | 2 | | 3 | 1 | |
| **CO3** | 1 | | | | | | | | | 3 | | 3 | 1 | |
| **CO4** | 1 | | | | | | | | | 2 | | 3 | 1 | |
| **CO5** | 1 | | | | | | | | | 3 | | 3 | 1 | |
| **CO6** | 1 | | | | | | | | | 3 | | 3 | 1 | |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| **COURSE CONTENT** | |
|---|---|
| **Module - 1** | 8 hrs |
| Introduction to Phonetics :<br>Introduction to Sounds of Speech – Vowels – Consonants -<br>Listening with a focus on pronunciation<br>Reading Newspaper – Highlighting Vowels and Consonants | **CO1** |
| **Module – 2** | 8 hrs |
| Syllabification:<br>Word Stress, Rules of word stress<br>Practice on Intonation and Stress | **CO2** |
| **Module – 3** | 8 hrs |
| Listening Skills :<br>Types of Listening Skills<br>Active listening and anticipating the speaker<br>Listening for Specific & General Details<br>Listening Comprehension | **CO3** |
| **Module – 4** | 8 hrs |
| Defining & Describing: Objects, Places and Events<br>Video Speech Writing<br>Review Writing (Books / Movies / Products..etc.,) | **CO4** |
| **Module – 5** | 8 hrs |
| Reading Comprehension<br>Everyday English – Grammar, Vocabulary, LSRW Skills,<br>Summarizing and Note making<br>Vocabulary Building | **CO5** |
| **Module – 6** | 8 hrs |
| JAM<br>Role Play<br>Giving and Asking Directions<br>Information Transfer | **CO6** |

**Reference Books:**


- *A Textbook of English Phonetics for Indian Students 2nd Ed T. Balasubramanian.(Macmillian),2012*
- *Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.*
- *English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP*
- *Rizvi, Ashraf. M., Effective Technical Communication, Mc Graw Hill, New Delhi. 2005*
- *Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi. 2011.*


**Web Resources:**

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

*Grammar/Vocabulary*

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

*Reading*

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

*Listening*

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

*Speaking*

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

*All Skills*

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

*Online Dictionaries*

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

# DEPARTMENT OF ELECTRICAL & ELETRONICS ENGINEERING

## SEMESTER II

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1003 | BS | Vector Calculus Complex Variables and Transforms | 3 | 1 | 0 | 4 | **4** | **40** | **60** | **100** |
| 20CH1001 | BS | Chemistry | 3 | 0 | 0 | 3 | **3** | **40** | **60** | **100** |
| 20ES1002 | ES | Basic Electrical Circuits | 3 | 0 | 0 | 3 | **3** | **40** | **60** | **100** |
| 20ES1007 | ES | Introduction to Python Programming | 2 | 0 | 0 | 2 | **2** | **40** | **60** | **100** |
| 20CH1501 | BS | Chemistry Lab | 0 | 0 | 3 | 3 | **1.5** | 40 | 60 | 100 |
| 20ES1507 | ES | Basic Electrical Circuits Lab | **0** | **0** | **2** | **2** | **1** | 40 | 60 | 100 |
| 20ES1504 | ES | Engineering Graphics Lab | **0** | **1** | **4** | **5** | **3** | 40 | 60 | 100 |
| 20ES1510 | ES | Introduction to Python Programming Lab | **0** | **0** | **2** | **2** | **1** | 40 | 60 | 100 |
| 20EN1502 | **HS** | Oral Communication skills lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | **Total** | **11** | **2** | **16** | **29** | **19.5** | **360** | **540** | **900** |

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20MA1003 | VECTOR CALCULUS, COMPLEX VARIABLES & TRANSFORMS (VC-CV&TS) | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 1 | 0 | 64 | 4 | 40 | 60 | 100 |

**Pre-requisite**: Intermediate Mathematics

**Course Objectives:**

1. To illustrate the physical interpretation of gradient, divergence and curl.
2. To apply the basic concepts of vector integration and their applications.
3. To acquire the knowledge on the calculus of functions of complex variables.
4. To understand the concepts of Laplace transforms and its properties.
5. To apply the concepts of Laplace, transform to solve the ordinary differential equations.
6. To understand the concepts of Fourier series and Fourier transforms and its properties.

**Course Outcomes**: After successful completion of the course, the student will able to:

| | |
|---|---|
| **CO 1** | Utilize different operators such as gradient, curl and divergence find the function BL-3 |
| **CO 2** | Evaluate area and volumes by fundamental theorems of vector integrationBL-5 |
| **CO 3** | Apply the complex functions, Cauchy's integral Theorem to find the integral values BL-3 |
| **CO 4** | Solve the differential equation by using Laplace transforms and its techniques BL-3 |
| **CO 5** | Apply the Inverse Laplace transforms techniques to covert into time Domaine BL-3 |
| **CO 6** | Find the Fourier Series and Fourier Transform for the given functionsBL-2 |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | **3** | **2** | **2** | | | | | | | | | | 3 | |
| **CO2** | **3** | **2** | **2** | | | | | | | | | | 3 | |
| **CO3** | **3** | **3** | **1** | | | | | | | | | | 3 | |
| **CO4** | **3** | **3** | **2** | | | | | | | | | | 2 | |
| **CO5** | **3** | **3** | **2** | | | | | | | | | | 3 | 3 |
| **CO6** | **3** | **3** | **2** | | | | | | | | | | 2 | 2 |

1- Low, 2-Medium, 3- High

| COURSE CONTENT | | |
|---|---|---|
| **MODULE – 1** | **Vector Differentiation** | **8 H** |
| Introduction to vector differentiation, Definition of Scalar and Vector point functions, Definition of Vector differential operator, Gradient of a Scalar point function- Definition of Gradient of a scalar point function and properties (without proof), Definition of Directional Derivative, Definition of level surface, Different Problems, Divergence of a Vector point function- Definition, Definition of Solenoidal vector and problems, Curl of a vector point function- Definition of Curl, definition of Irrotational vector, Problems, Laplacian operator- Definition and related problems, Vector Identities- Statements(without proof) | | |
| At the end of the Module 1, students will be able to:<br>1. Apply del to scalar and vector point function BL-3<br>2. Understand the concepts of Vector Differentiation BL-2<br>3. Illustrate the physical interpretation of gradient, divergence and curl. BL-2<br>4. Calculate directional derivatives and gradients BL-1<br>5. Apply Vector Differentiation concepts in fluid mechanics problems BL-3 | | |
| **MODULE -2** | **Vector Integration** | **8 H** |
| Introduction to vector integration, Line Integrals-Explanation, Work done by a Force-Explanation, problems, Surface Integral-Explanation and formula for surface integrals (without proof), Problems, Volume integral- Explanation and formula for volume integral (without proof), Problems, Green's Theorem-Statement (without proof), Problems, Gauss divergence Theorem- Statement (without proof), Problems, Stake's-Theorem-Statement (without proof), Problems. | | |
| **At the end of the Module 2, students will be able to:**<br>1. Find the work done in moving a particle along the path over a force field BL-1<br>2. Evaluate the rate of fluid flow along and across curves BL-5<br>3. Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals BL-3<br>4. Use the Gauss divergence theorem to give a physical interpretation of the divergence of a Vector field. BL-3<br>5. Evaluate the line integrals along simple closed curves on the Plane by Green's Theorem BL-5<br>6. Apply Stokes' theorem to give a physical interpretation of the curl of a vector field. BL-3 | | |
| **MODULE-3** | **Complex Variable** | **Hours: (11L+4T)** |
| complex variables- differentiation: introduction to complex variables, functions of complex variable-definition, limit and continuity of a complex function, derivative of f(z)-definition, problems, analytic function & harmonic functions- definitions, problems, cauchy-riemann equations in cartesian coordinates-statement (without proof), problems ,cauchy-riemann equations in polar coordinates-statement (without proof), problems , conjugate harmonic functions- definition, problems, milne thomson method- working rule, problems, applications to flow problem- problems. complex variables- integration: introduction to complex integration, line integration-definition, problems, cauchy's integral theorem-statement(without proof), problems, cauchy's integral formula- statement (without proof), problems, zeros of analytic functions, singularities, poles. residues-definition, explanation. cauchy's residue theorem- statement (without proof), problems. evaluation of integrals of $\int_0^{2\pi}$ $\int_{-\infty}^{\infty}$ | | |

the type: (a) improper real integrals $\int f(x)dx$ (b) $\int f(\cos\theta,\sin\theta)d\theta$.

At the end of the Module 3, students w$^{-\infty}$ill be able to: $^{0}$

1. Understand the functions of complex variable and its properties. BL-2
2. Find derivatives of complex functions. BL-1
3. Understand the analyticity of complex functions. BL-2
4. Understand the concept of differentiability, limit, continuity of complex functions and be able to calculate limits of standard complex functions BL-2
5. Apply Cauchy's integral theorem and Cauchy's integral formula in engineering problems. BL-3
6. Understand singularities of complex functions. BL-2

| **MODULE-4** | **Laplace Transforms** | **8 H** |
|---|---|---|

Introduction to Laplace Transforms, Definition of Laplace Transforms, Sufficient conditions for the existence of the L.T of a function, Laplace Transforms of standard Functions. First Translation (or) First Shifting theorem, Problems. Second Translation (or)Second Shifting theorem, Problems. Change of scale property, Problems. L.T. of derivatives, Problems. L.T. of integrals, Problems. Multiplication by 't', Problems. L.T. of Division by 't', Problems. Evaluation of integrals by L.T. L.T. of some special functions- Unit Step Function or Heaviside's Unit Function- Definition, problems. Unit Impulse Function or Dirac Delta function- Definition, problems. Laplace Transform of Periodic Functions- Statement (without proof), Problems.

At the end of the Module 4, students will be able to:

1. Understand the concepts of Laplace transforms and convert into time to frequency demine BL-2
2. Apply Laplace transform techniques to solve Ordinary differential equations BL-3
3. Understand and recall the properties of the Heaviside (unit step) function and its applications BL-2
4. Solve the application of Dirac Delta function by using its properties BL-3

| **MODULE-5** | **Inverse Laplace Transforms** | **8 H** |
|---|---|---|

Definition of Inverse Laplace Transforms, Inverse Laplace Transforms of standard Functions (without proof), Problems. Use of Partial Fractions to find Inverse Laplace Transform- problems. First Translation (or) First Shifting theorem- Statement (without proof), problems. Second Translation (or) Second Shifting theorem Statement (without proof), Problems. Change of scale property- Statement (without proof), problems. Inverse L.T of derivatives- Statement (without proof), problems. Inverse L.T to finite integrals- Statement (without proof), problems. Multiplication by Powers of 's'-Statement (without proof), Problems. Division by 's'-Statement (without proof), problems. Convolution theorem-statement (without proof), problems, Applications to Ordinary Differential Equations-Working method Explanation, problems

At the end of the Module 5, students will be able to:

1. Understand the concepts of inverse Laplace Transforms and convert into frequency to time domine BL-2
2. Solve the wave functions by inverse Laplace transforms BL-3
3. Apply the Convolution Theorem to obtain inverse Laplace transforms BL-3
4. solve the higher order differential equations in limiting case condition by invers Laplace transforms BL-3

| **MODULE-6** | **Fourier Series and Fourier Transforms** | **8 H** |
|---|---|---|

Fourier Series: Introduction to Fourier Series, Periodic function-definition, properties(without proof), Euler's formulae(without proof), Dirichlet's conditions, Fourier series in [0,2π]-formula (without proof), Problems, Fourier series in [-π, π]- formula(without proof), Problems, Fourier series for even and odd functions in [-π, π]- formula(without proof), Problems, Half -Range Fourier sine series in(0, π)- Formula(without proof), Problems, Half -Range Fourier cosine Series in(0, π)- Formula (without derivation), Problems. Fourier Transforms: Introduction to Fourier Transforms, Fourier integral theorem Statement (without proof),Fourier sine and cosine integrals formula(without proof) , problems, Fourier Transform formula &Inverse Fourier Transform formula (without proof), Properties of Fourier Transforms (without proof), problems, Fourier Sine Transform formula & Inverse Fourier Sine Transform formula (without proof), problems, Fourier Cosine Transform formula &Inverse Fourier cosine Transform formula(without proof),problems.

At the end of the Module 6, students will be able to:

1. Find the Fourier series expansion of the given function. BL-1
2. Apply Fourier series and its properties of various engineering problems. BL-3
3. Find the periodic solutions to the differential equation by using Fourier series. BL-1
4. Understand the properties of periodic functions, represent it as a Fourier BL-2
5. Apply the concepts of Fourier transforms to Find impulse BL-3
6. Make use of the Fourier transforms and its inverse in practical applications of electronics engineering. BL-3

| | |
|---|---|
| **Total hours** | **48 H** |

**Complex Fourier series**

1. Complex Fourier series
2. Parseval's Identity for Fourier Transforms

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Vector Differentiation | CO1 | https://youtu.be/a19x_YG0oLg |
| 2 | vector integration | CO2 | https://youtu.be/pfCwRLK29h4https://youtu.be/KHiw9Vs-aLM |
| 3 | Laplace transforms | CO3 | https://youtu.be/luJMl37-nsohttps://youtu.be/EDVJotmT584 |
| 4 | Inverse Laplace transforms | CO4 | https://youtu.be/9NqdBXNyJPkhttps://youtu.be/0ZlThUd-yyw |
| 5 | Fourier series | CO5 | https://youtu.be/4cSZDHxyBf4 |
| 6 | Fourier transforms | CO6 | https://youtu.be/GtXmS5YH7XM |

**Text Book(s):**


1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publication.
3. Ramana B.V., "Higher Engineering Mathematics", McGraw Hill Publishers

**Reference Book(s):**


1. Erwin Kreyszig, “Advanced Engineering Mathematics”, John Wiley.
2. Veerarajan T., “Engineering Mathematics” , Tata McGraw-Hill.
3. Dr. M Anita, “Engineering Mathematics-I”, Everest Publishing House, Pune.


**Online Resources/ Web References:**

1. http://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering - mathematics-ktuebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks .
3. http://www.efunda.com/math/math_home/math.cfm
4. http://www.ocw.mit.edu/resources/#Mathematics
5. http://www.sosmath.com/
6. http://www.mathworld.wolfram.com /

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20CH1001 | CHEMISTRY (COMMON TO ECE,EEE&CSE) | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To impart technological aspects of modern chemistry and its applications
2. Understands the chemistry behind electrochemical energy systems
3. To train the students on the principles and applications of polymers
4. Learn analytical methods useful in characterization of compounds.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the fundamental concepts of chemistry to predict the structure and bonding of materials **(BL-1)** |
| **CO 2** | Infer the knowledge about various kinds of electro chemical cells.**(BL-2)** |
| **CO 3** | Describe various energy storage devices and emerging technologies **(BL-1)** |
| **CO 4** | Understand the mechanism and applications of different polymers in electronic devices**(BL-2)** |
| **CO 5** | Familiarize the various sources of renewable energy and their harneshing **(BL-2)** |
| **CO 6** | Apply the electromagnetic radiation to the spectroscopy methods for the analysis of engineering **(BL-3)** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | | | | | | | | | | 1 | 1 | |
| CO2 | 3 | 2 | | | | | 2 | | | | | 1 | 1 | |
| CO3 | 3 | 1 | 2 | | | 1 | 2 | | | | | 2 | 1 | |
| CO4 | 3 | 2 | | | | 2 | 1 | | | | | 1 | 1 | |
| CO5 | 3 | 1 | 1 | | | 2 | 1 | | | | | 2 | 1 | |
| CO6 | 3 | 1 | | | | | | | | | | 2 | 1 | |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | STRUCTURE AND BONDING MODELS | 8 hrs |
|---|---|---|

Planks quantum theory, photo electric effect,dual nature of matter -Debroglies equation ,Heisenberg uncertainty principle, molecular orbital theory – bonding in homo- and hetero nuclear diatomic molecules – energy level diagrams of $O_2$ and CO, etc. $\pi$-molecular orbital's of butadiene and benzene, calculation of bond order, crystal field theory – salient features – splitting in octahedral and tetrahedral geometry.

At the end of the Module 1, students will be able to:

1. Understand the fundamental concepts of chemistry to predict the structure, properties and bonding of Engineering materials**.**(BL-1)
2. Iillustrate the molecular orbital energy level diagram of different molecular species.(BL-2)

3. Apply crystal field theory for octa hydral and tetra hydral molecule.(L3)
4. out line the planks quantum theory. (BL-2)
5.Explain heisen berg uncertainty principal.(BL-2)

| MODULE -2 | ELECTRO CHEMISTRY | 8hrs |
|---|---|---|

Electrode potential, EMF of an electrochemical cell,problems on emf Nernst equation;. Electrodes – concepts, reference electrodes (standard hydrogen, Calomel electrode, and glass electrode), potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conduc to metric titrations (acid-base titrations), photovoltaic cell – working and applications .

At the end of the Module 2, students will be able to:

1. **Demonstrate** competency in the basic concepts of electrochemical cells.(BL-2)
2. **Explai**n the significance of electrode potentials (BL-2)
3. **List** the different types of electrodes . (BL-2)
4. **Differentiate** between , potentiometric and conduct metric titrations. (BL-2)
5. **Illustrate** the construction of PV cell.(BL-2)

| MODULE-3 | BATTERY TECHNOLOGY | 7 hrs |
|---|---|---|

Basic concepts, classification of batteries, Important applications of batteries, Modern batteries- zinc air, lithium cells- Li ion cell , Li- $MnO_2$ cell, ni-cd cell, lead acid storage cell . Fuel cells Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, methanol and oxygen fuel cell, SOFC - Merits of fuel cell

At the end of the Module 3, students will be able to:

1. Classify batteries into different types (BL-2)
2. Explain the concept involved in the construction of batteries . (BL-2)
3. Identify the significance of batteries. (BL-2)
4. Compare the merits of different fuel cells (BL-2)
5. Distinguish between different types of batteries (BL-2)

| MODULE-4 | POLYMER CHEMISTRY | 9 hrs |
|---|---|---|

Basic concepts of polymer, chain growth and step growth polymerization, coordination polymerization, copolymerization with specific examples and mechanisms of polymer formation. Plastics - Thermoplastics and Thermosetting, Preparation, properties and applications of –pvc, Bakelite, urea-formaldehyde, Nylons- Elastomers–Buna-S, Buna-N–preparation, properties and applications. Conducting polymers – poly acetylene, poly aniline, mechanism of conduction and applications.

At the end of the Module 4, students will be able to:

1 Identify different types of polymers.(BL-3)
2. Distinguish between thermoplastic and thermo setting resins . (BL-2)
3. Explain the preparation, properties and applications of some plastic materials (BL-2)
4. Apply the knowledge of advanced polymers, conducting polymers for different applications(BL-3)
5. Outline the properties of polymers and various additives added and different methods of forming.plastic materials (BL-2)

| MODULE-5 | ENERGY SCIENCE | 7 hrs |
|---|---|---|

fuels-classification of fuels characteristics solid fuels-coal, analysis of coal ,refining of petroleum, alternative and non conventional sources of Energy-solar, wind, Geo, Hydro power ,Bio mass advantages and disadvantages, Nuclear energy-Nuclear fission and fusion reactions Nuclear waste disposal

At the end of the Module 5, students will be able to:

1. Differentiate petroleumsynthetic petrol and have knowledge how they are produced (BL-2)
2. Elucidate alternative and non conventional energy resources. (BL-2)
3. Distinguish between Nuclear fission and fusion. (BL-2)
4. out line the fuel characteristics (BL-2)
5. Explain the nuclear waste disposal. (BL-2)

| **MODULE-6** | **INSTUMENTAL METHODS AND APPLICATIONS** | **9 hrs** |
|---|---|---|

**Electronic Spectroscopy** –EMR, Beer-Lambert's law and its, Applications, instrumentation of UV-visiblespectrophotometer.***IR Spectroscopy*** - Types of vibrations, Instrumentation of IR spectrophotometer and its applications. **Chromatography**-Introduction ,Principle and instrumentation of Gas Chromatography (GC) and thin layer chromatography, separation of gaseous mixtures and liquid mixtures

At the end of the Module 6, students will be able to:

1. Explain the different types of spectral series in electromagnetic spectrum (BL-2)
2. Understand the principles of different analytical instruments (BL-2)
3. Explain the different applications of analytical instruments (BL-2)
4. Outline the beers lamberts law (BL-2)

| **Total hours:** | **48hours** |
|---|---|

**Content beyond syllabus:**

1. Band theory, vulcanization and compounding of rubber

**Self-Study:**

Contents to promote self-Learning:

| **SNO** | **Topic** | **Reference** |
|---|---|---|
| 1 | Molecular orbital theory | https://www.youtube.com/watch?v=FMxuss0RXOU |
| 2 | Reference electrodes | https://www.youtube.com/watch?v=WMfXlncyMDc |
| 3 | battreies | https://nptel.ac.in/courses/103/108/103108162/ |
| 4 | plastics | https://www.youtube.com/watch?v=FATc12opDCA |
| 5 | Non conventional energy recourses | https://swayam.gov.in/nd1_noc20_ge06/preview |
| 6 | Fundamentals of spectroscopy | https://swayam.gov.in/nd1_noc20_cy08/preview |

**Text Book(s):**

1. P. C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Ray Publishing Company
2. K. N. Jayaveera, G. V. Subba Reddy and C. Ramachandraiah, *Engineering Chemistry*, McGraw Hill Publishers, New Delhi.
3. Energy scenario beyond2100,by S.Muthu Krishna Iyer.

**Reference Book(s):**

1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5th edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.
3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

**Online Resources Web Resources:**

1. https://drive.google.com/file/d/0Bz82vSA0C1xlWC11WkpsTmlwQVk/view
2. https://www.cgaspirants.com/2017/08/engineering-chemistry-by-jain-jain.html
3. https://www.pdfdrive.com/concise-inorganic-chemistry-d33405948.html
4. https://chemistry.com.pk/books/skoog-principles-of-instrumental-analysis1/
2. https://www.thermalfluidscentral.org/e-books/book-intro.php?b=39
   file:///C:/Users/DELL/Downloads/HandbookOfInstrumentalTechniquesForAnalyticalChemistryPDFDrive.com.pdf
3. https://nptel.ac.in/courses/104/106/104106096/
4. https://youtu.be/KHh_IX1G6uA
5. https://www.youtube.com/watch?v=MfbxR9ZDs0s&feature=youtu.be
6. .https://nptel.ac.in/courses/113/105/113105028/
7. https://www.youtube.com/watch?v=15MY7abeCDk
8. https://www.youtube.com/watch?v=UeGJpwC1aiQ&feature=youtu.be

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1002 | BASIC ELECTRICAL CIRCUITS | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Fundamental of mathematics and physics**

**Course Objectives:**

1. To study the basics of circuit analysis.
2. To study the magnetic circuits.
3. The concepts of real power, reactive power, complex power, phase angle and phase difference.
4. To understand frequency response in electrical circuits.
5. To understand the concept of graphical solution to electrical network.
6. To impart knowledge on solving circuit equations using network theorems.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Apply the basics of circuit analysis.(BL-3) |
| **CO 2** | Analyze the behaviour of magnetic circuit.(BL-4) |
| **CO 3** | Explain the fundamentals of AC circuits.(BL-2) |
| **CO 4** | Analyze AC circuits along with resonance and locus diagrams.(BL-4) |
| **CO 5** | Analyze an electric network using graph theory and different network (BL-4) |
| **CO 6** | Analyze the electrical circuits using various network theorems.(BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 1 | | 1 | | | | | | | 3 | 3 | 1 |
| CO2 | 3 | 1 | | | | | | | | | | | 2 | |
| CO3 | 3 | 3 | 3 | 3 | | 1 | | | | | | | 3 | 3 |
| CO4 | 3 | 3 | 3 | 3 | | | | | | | | | 2 | 3 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | | |
| CO6 | 3 | 3 | 3 | | | | | | | | | | 2 | 2 |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

| MODULE – 1 | INTRODUCTION TO ELECTRICAL CIRCUITS | 8hrs |
|---|---|---|

Circuit Concept, R, L and C Parameters - Independent and Dependent Voltage and Current Sources -Source Transformation, Voltage - Current Relationship for Passive Elements (For Different Input Signals: Square, Ramp, Saw Tooth, Triangular). Kirchhoff's Laws, Network Reduction Techniques: Series, Parallel, Series Parallel, Star-to -Delta or Delta-to-Star Transformation. Examples

At the end of the Module 1, students will be able to:

1. Find the series and parallel connections in a circuit.(BL-2)
2. Apply various techniques to analyze an electric circuit. (BL-3)
3. Find the behaviour of an electrical circuit.(BL-2)

| MODULE -2 | INTRODUCTION TO MAGNETIC CIRCUITS | 7hrs |
|---|---|---|

Faraday's Laws of Electromagnetic Induction, Concept of Self and Mutual Inductance, Dot Convention, Coefficient of Coupling, Composite Magnetic Circuit-Analysis of Series and Parallel Magnetic Circuits, MMF Calculations.

At the end of the Module 2, students will be able to:

1. Explain the laws of electromagnetic induction. (BL-2)
2. Explain the dot convention technique.(BL-2)

3. Explain the self Inductance and mutual Inductance. (BL-2)

| MODULE -3 | SINGLE PHASE AC CIRCUITS | 9hrs |
|---|---|---|

R.M.S, Average Values and Form Factor for Different Periodic Wave Forms: Sinusoidal Alternating Quantities. Phase and Phase Difference, Complex and Polar Forms Of Representations, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) With Sinusoidal Excitation, Concept of Power Factor, Concept of Reactance, Impedance, Susceptance and Admittance-Real and Reactive Power and Complex Power. Examples.

At the end of the Module 3, students will be able to:

1. Understand the advantages of single phase AC system. (BL-2)
2. Explain the complex and polar forms representation.(BL-2)
3. Find the AC circuits in order to determine the voltage, current and power for the given problem. (BL-2)

| MODULE -4 | RESONANCE & LOCUS DIAGRAMS | 8hrs |
|---|---|---|

Resonance: Introduction, Definition of quality factor **Q** of inductor and capacitor, Series resonance, Bandwidth of the series resonant circuits, Parallel resonance (or anti-resonance), Conditions for maximum impedance, Currents in parallel resonance, , Bandwidth of parallel resonant circuits, General case of parallel resonance circuit. Locus diagrams of RL & RC circuits

At the end of the Module 4, students will be able to:

1. Explain AC circuits along with resonance and locus diagrams.(BL-2)
2. Understand the effect of resonance on series and parallel resonance circuits.(BL-2)
3. Explain the frequency response for a resonant circuits.(BL-2)

| MODULE -5 | ANALYSIS OF NETWORK TOPOLOGY | 8Hrs |
|---|---|---|

Definitions – Graph – Tree, Incidence Matrix, Basic Cutset and Tieset matrices for planar networks - Nodal Analysis, Mesh Analysis, Super Node Analysis and Super Mesh Analysis for Dependent and Independent Voltage and Current Sources and DC & AC Excitations - Duality and Dual Networks.

At the end of the Module 5, students will be able to:

1. Understand the overview of topology for a given network. (BL-2)
2. Find the graph for the given electrical network. (BL-2)
3. Apply graph theory to solve network equations. (BL-3)

| MODULE-6 | NETWORK THEOREMS | 8hrs |
|---|---|---|

Super position theorem, Compensation theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Tellegen's theorem, Millman's theorem, Reciprocity theorem; Application of network theorems in solving DC and AC circuits.

At the end of the Module 6, students will be able to:

1. Understand the way of approaching to solve for a given network. (BL-2)
2. Solve theorems for finding the solutions of network problem.(BL-3)
3. Explain the application of network theorems.(BL-2)

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Content beyond syllabus:**

1. Three Phase circuits and its Importance in Electrical Engineering.
2. Real time applications of network theorems.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | Reference |
|---|---|---|

| | | |
|---|---|---|
| 1 | Introduction to the electrical circuit | https://nptel.ac.in/courses/117/106/117106108/ |
| 2 | Introduction to the magnetic circuit | https://nptel.ac.in/courses/108/105/108105053/ |
| 3 | Single phase AC circuit | https://nptel.ac.in/courses/108/105/108105053/ |
| 4 | Locus diagram and resonance | https://nptel.ac.in/courses/108/105/108105112/ |
| 5 | Analysis of electrical circuit and Graph theory | https://nptel.ac.in/courses/108/105/108105159/ |
| 6 | Network theorem | https://nptel.ac.in/courses/117/106/117106108/ |

**Text Book(s):**

1. A Sudhakar and Shyam Mohan S P, "Circuits and Networks: Analysis and Synthesis", TMH, 5th Edition, New Delhi, 2015.
2. Ravish R., Network Analysis and Synthesis, 2/e, McGraw-Hill, 2015

**Reference Book(s):**

1. S.Sivanagaraju, G.Kishore & C.Srinivasa Rao, "Electrical Circuit Analysis", Cengage Learning, 1st Edition, 2010.
2. A. Chakrabarti : Circuit Theory (Analysis and Synthesis), Dhanpat Rai &Co
3. Joseph A. Edminister and Mahmood Nahvi, "Electric Circuits Schaum's Outline Series", 6th Edition, Tata McGraw-Hill, 2014, New Delhi.
4. Electric Circuits by N.Sreenivasulu, REEM Publications

**Online Resources / Web Reference:**

**1.** https://nptel.ac.in/courses/108/105/108105159/
**2.** https://nptel.ac.in/courses/108/102/108102042/
3. https://nptel.ac.in/content/storage2/courses/108105053/pdf/L-21(TB)(ET)%20((EE)NPTEL).pdf
4. https://en.wikibooks.org/wiki/Circuit_Theory
5.http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm
6.http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-andelectronics-spring-2007/video-lectures/lecture-2/
7. http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html
8. https://opencourses.emu.edu.tr/course/view.php?id=3

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1007 | **Introduction to Python Programming** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 2 | 0 | 0 | 32 | 2 | 40 | 60 | 100 |

**Pre-requisite:** **K**nowledge of Mathematics and Basic Programming Language

**Course Objectives:**

1. To learn the fundamentals of python.
2. To implement python programs for conditional loops and functions.
3. To handle the compound data using python lists, tuples, sets, dictionaries.
4. To learn the files, modules, packages concepts.
5. To introduce the concepts of class and exception handling using python.
6. To train in regular expression concepts.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Summarize the fundamental concepts of python programming. (BL - 2) |
| **CO 2** | Apply the basic elements and constructs the python to solve logical problems.(BL-3) |
| **CO 3** | Organize data using different data structures of python . (BL - 3) |
| **CO 4** | Implement the files modules and packages in programming. (BL - 3) |
| **CO 5** | Apply object oriented &exception handling concepts to build simple applications.( BL-3) |
| **CO 6** | Implement the concepts ofTurtle Graphics. ( BL - 3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | 2 | | | | | | | | | | | 1 | |
| **CO2** | 2 | 3 | 1 | 2 | | | | | | | | | 1 | 1 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | | | | | | | 2 | 2 | |
| **CO4** | 2 | 2 | 2 | 1 | 1 | | | | | | | 1 | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 1 | | | | | | | | 1 | 2 | 2 |
| **CO6** | 2 | 1 | 2 | 1 | | | | | | | | 1 | 2 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Introduction to Python** | **5H** |
|---|---|---|

**Introduction:** History of Python, Features of Python Programming, Applications of Python Programming, Running Python Scripts, Comments, Typed Language, Identifiers, Variables, Keywords, Input/output, Indentation, Data types, Type Checking, range( ), format( ), Math module.

At the end of the Module 1, students will be able to:

1. Learn the basics of python. (BL - 1)
2. Write the python programs. (BL - 1)
3. Understand concept of type checking. (BL - 2)

| **MODULE -2** | **Operators Expressions and Functions** | **5 H** |
|---|---|---|

**Operators and Expressions:** Arithmetic, Assignment, Relational, Logical, Boolean, Bitwise, Membership, Identity, Expressions and Order of Evaluations, Control Statements.

**Functions:** Introduction, Defining Functions, Calling Functions, Anonymous Function,

Fruitful Functions and Void Functions, Parameters and Arguments, Passing Arguments, Types of Arguments, Scope of variables, Recursive Functions.

At the end of the Module 2, students will be able to:

1. Solve the problems using operators, conditional and looping. (BL - 3)
2. Solve the problems using the functions. (BL -3)
3. Apply the principle of recursion to solve the problems. (BL-3)

| **MODULE-3** | **Strings, Lists, Tuples, and Dictionaries** | **6H** |
|---|---|---|

**Strings, Lists, Tuples, and Dictionaries:** Strings-Operations, Slicing, Methods, List-Operations, slicing, Methods, Tuple- Operations, Methods, Dictionaries- Operations, Methods, Mutable Vs Immutable, Arrays Vs Lists, Map, Reduce, Filter, Comprehensions.

At the end of the Module 3, students will be able to:

1. Write programs for manipulating the strings. (BL - 1)
2. Understand the knowledge of data structures like Tuples, Lists, and Dictionaries.(BL - 2)
3. Select appropriate data structure of Python for solving a problem.(BL -3)

| **MODULE-4** | **Files, Modules and Packages** | **6H** |
|---|---|---|

**Files, Modules and Packages:** Files- Persistent, Text Files, Reading and Writing Files, Format Operator, Filename and Paths, Command Line Arguments, File methods, Modules- Creating Modules, Import Statement, Form.Import Statement, name spacing, Packages- Introduction to PIP, Installing Packages via PIP( Numpy).

At the end of the Module 4, students will be able to:

1. Understand the concepts of files. (BL - 2)
2. Implement the modules and packages. ( BL - 3)
3. Organize data in the form of files.( BL - 3)

| **MODULE-5** | **Object Oriented Programming, Errors and Exceptions** | **5H** |
|---|---|---|

**OOP in Python:** Object Oriented Features, Classes, self variable, Methods, Constructors, Destructors, Inheritance, Overriding Methods, Data hiding, Polymorphism.
**Error and Exceptions:** Difference between an error and Exception, Handling Exception, try except block, Raising Exceptions.

At the end of the Module 5, students will be able to:

1. Apply object orientation concepts.(BL -3)
2. Apply the exception handling concepts. (BL -3)
3. Implement OOPs using Python for solving real-world problems.(BL -3)

| **MODULE-6** | **Turtle Graphics** | **5H** |
|---|---|---|

**Turtle Graphics:** Move and Draw, Turtle Operations, Turtle object, Simple Graphics, The Vagrant, The Beautiful Patterns, Drawing with Colors.

At the end of the Module 6, students will be able to:

1. Understand the concepts of Turtle Graphics. (BL -2)
2. Develop GUI applications using Python. (BL -3)

| | |
|---|---|
| **Total hours:** | **48Hours** |

**Content Beyond Syllabus:** Testing, GUI Programming, Matplotlib, Databases.

**Self-Study:**
Contents to promote self-Learning:

| SNo | Module | Reference |
|---|---|---|
| 1 | Introduction to Python | https://www.youtube.com/watch?v=WvhQhj4n6b8 |
| | | https://www.youtube.com/results?search_query=History+of+Python%2C+Features+of+Python+Programming%2C+Applications+of+Python+Programming%2C+Running+Python+Scripts%2C+Comments+in+edureka |

| | | |
|---|---|---|
| | | https://www.youtube.com/watch?v=9F6zAuYtuFw |
| | | https://www.youtube.com/watch?v=yHFcNNh-SsA |
| | | https://www.youtube.com/watch?v=FuPHs7GLxq8 |
| | | https://www.youtube.com/watch?v=6yrsX752CWk |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| | | https://www.youtube.com/watch?v=0Hp7AThTZhQ |
| | | https://www.youtube.com/watch?v=fy10ci10R_g |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| **2** | Operators, Expressions and Functions | https://www.youtube.com/watch?v=Pm9FOpOwhlA&t=143s |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| | | https://www.youtube.com/watch?v=oSPMmeaiQ68&t=51s |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| **3** | Strings, Lists,Tuples,and Dictionaries | https://nptel.ac.in/courses/106/106/106106145/ |
| | | https://nptel.ac.in/courses/106/106/106106145/ |
| | | https://www.youtube.com/watch?v=MEPlLAjPvXY |
| **4** | Files, Modules and Packages | https://nptel.ac.in/courses/106/106/106106145/ |
| **5** | Object Oriented Programming, Errors and Exceptions | https://nptel.ac.in/courses/106/106/106106145/ |
| **6** | Turtle Graphics | https://www.youtube.com/watch?v=WQlKPdKVXfw |
| | | https://www.youtube.com/playlist?list=PLzgPDYo_3xumT2sfELR4_YV3aojaxkUC9 |

**Text Book(s):**


1. VamsiKurama, Python Programming: A Modern Approach, Pearson, 2017.
2. Allen Downey, Think Python, 2ndEdition,Green Tea Press


**Reference Books :**


1. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019.
2. Allen B. Downey, “Think Python”, 2ndEdition, SPD/O’Reilly, 2016.
3. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
4. Mark Lutz, Learning Python, 5th Edition, Orielly, 2013.
5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007
6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015


**Online Resources / Web Resources:**

1. https://www.datacamp.com/learn-python-with-anaconda/
2. https://www.codecademy.com/learn/paths/data-science?
3. https://www.coursera.org/courses?query=python
4. https://www.edx.org/learn/python
5. https://training.crbtech.in/neo/online-it-training-programme.php?
6. https://www.tutorialspoint.com/python/index.htm
7. https://www.w3schools.com/python/
8. https://www.javatpoint.com/python-tutorial
9. https://www.learnpython.org/
10. https://docs.python.org/3/
11. Python - Simplilearn: https://www.youtube.com/playlist?list=PLEiEAq2VkUUKoW1o-A-VEmkoGKSC26i_I
12. Python - edureka: https://www.youtube.com/playlist?list=PL9ooVrP1hQOHY-BeYrKHDrHKphsJOyRyu
13. Python Notes for Professionals book : https://books.goalkicker.com/PythonBook/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20CH1501 | CHEMISTRY LAB (COMMON TO ECE,EEE&CSE ) | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 3 | 48 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:** The objective of the laboratory sessions is to enable the learners to get hands-on experience on the principles discussed in theory sessions and to understand the applications of these concepts in engineering.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Determine the cell constant and conductance of solutions |
| **CO 2** | Perform quantitative analysis using instrumental methods |
| **CO 3** | utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification\ and Spectroscopy |
| **CO 4** | analyze and gain experimental skill. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | | | | | | | | | | | | 1 | |
| CO2 | 3 | | | | | | | | | | | | 1 | |
| CO3 | 3 | | | | | | | | | | | | 1 | |
| CO4 | 3 | | | | | | | | | | | | 1 | |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task-1 :** Conductometrictitration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base | |
| **Objective**<br>1. perform a conductometric titration of a mixture of strong acid and weak acid with a strong base,<br>2. determine the equivalence point of the titration by plotting titration curve using conductance values and amount of the base added during titration,<br>3. state the advantages conductometric titrations, | CO2 |
| **Task-2 :** Determination of cell constant and conductance of solutions | |
| **Objective:**<br>1. To determine conductivity of the given water sample. by using conductivity meter<br>2. To understand the specific conductance. | CO 1 |

| | |
|---|---|
| **Task-3-** Verify Lambert-Beer's law | |
| **Objective:** 1.To use spectroscopy to relate the absorbance of a colored solution to its concentration.<br>2.Toprepare a Beer's Law Plot to determine the concentration of an unknown. | CO 2 |
| **Task-4:** pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base | |
| **Objective:**<br>1. To perform a potentiometric titration of an acidic solution of known molarity.<br>2. To graph the volume of base added vs the pH and to determine the equivalence point<br>3. To calculate the molarity of the basic solution | CO 2 |
| **Task-5:** Estimation of Ferrous Iron by Dichrometry. | |
| **Objective:**<br>1. determine the percentage of ferrous iron in an unknown sample by redox titration with potassium dichromate solution .<br>**2.** The student will pre-treat the sample to obtain the iron in the reduced(+2 oxidation) state**.**<br>3.The student will use a solution of primary standard as the titrant | CO 3 |
| **Task-6 :** Potentiometry - determination of redox potentials and emfs | |
| **Objective:**<br>1. Determine the concentration of an unknown iron(II) solution. By using potentiometer<br>2. Discuss how the potential changes with relative concentration of oxidised/reduced from,<br>3. perform a redox titration of ammonium iron (II) sulphate using potassium dichromate as oxidizing agent,<br>4. determine the equivalence point of the redox titration by plotting titration curve using potential change values and amount of oxidizing agent added during titration, | CO 3 |
| **Task-7 :** Preparation of a polymer | |
| **Objective:** To prepare phenol formaldehyde resin. (Bakelite)<br>1. Understand the differences between linear and cross linked polymers.<br>2. Compare and contrast the recycling properties of linear and cross linked polymers.<br>3. Compare the combustion properties of various types of material.<br>4. Define the following terms: polymer, monomer, repeat unit, cross linking, biopolymer | CO 4 |
| **Task-8:** Thin layer chromatography | |
| **Objective:** | CO 2 |

| | |
|---|---|
| 1. To separate spinach pigments using thin layer chromate graphy<br>2. To describe the method of chromatography and its applications | |
| **Task-9:** Identification of simple organic compounds by IR | |
| **Objective:**<br>1. To learn various function groups encountered in organic chemistry<br>2. To learn important roll of IR spectroscopy in the study of structure of organic compounds<br>3. To develop skill in the recognition of characteristic absorption bands<br>4.to identify compound by an investigation of its IR spectrum | CO 3 |
| **Task-10 :** Determination of Strength of an acid in Pb-Acid battery | |
| **Objective:**<br>1. To determine the half –reactions involved in spontaneous oxidation –reduction reactions.<br>2. Explain the function of the lead storage and dry cell batteries …electrolysis involving two lead strips immersed in sulfuric acid. | CO 4 |

| | |
|---|---|
| **Additional Experiments:** | |
| **Task-11 :** Measurement of 10Dq by spectro photometric method | |
| **Objective**<br>**1.** The purpose of the experiment is three-fold. First, the student verifies that the spectrochemical series<br>**2.** based on this model are generally in poor agreement with experimental values obtained from visible spectra (3). However, because of the octahedral symmetry it is true that the splitting of the d levels predicted by crystal field theory is qualitatively correct. | CO 4 |
| **Task-12 :** Models of potential energy surfaces | |
| **Objective:**<br>1. Distinguish between potential energies and potential energy surfaces ( PESs ).<br>2. Identify the saddle point, the reactant and product valleys and plateaus on the contour diagram of PESs<br>3. Distinguish between attractive and repulsive potential energy surfaces. | CO4 |
| **Virtual Labs:**<br>1. http://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1<br>2. http://vlab.amrita.edu/?sub=2&brch=190&sim=339&cnt=1 | |

3. http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Estimation of Ferrous Iron by Dichrometry. | CO 1 | https://www.youtube.com/watch?v=LxgZsMhuyNM |
| 2 | Paper chromatography | CO 1 | https://www.youtube.com/watch?v=NsI9vJMphKk |
| | Preparation of polymer | CO 4 | https://www.youtube.com/watch?v=PSSK5VGcC_0 |

**Text Book(s):**


1. A Textbook of Quantitative Analysis, Arthur J. Vogel.

2. Jain & Jain. Engineering Chemistry: Dhanapathrai Publications., 2015.

3.S.S.Dara, Experiments and Calculations in Engineering Chemistry: S-Chand Publications, Revised edition, 2008.


**Reference Book(s):**


1. S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.

2Sunitha Rattan, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition.


**Web References:**

1. https://nptel.ac.in/courses/122101001/23
2. https://nptel.ac.in/courses/104103071/39

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1507 | BASIC ELECTRICAL CIRCUIT LAB | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 2 | 32 | 1 | 40 | 60 | 100 |

**Pre-requisite: Network Analysis**

**Course Objectives:**

1. Fundamentals of Ohm's law, Kirchhoff's current and voltage laws and its practical implementation.
2. Measurement of voltage, current, power and impedance of any circuit.
3. Analysis of a given circuit depending on types of elements.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Apply Practical implications of the fundamentals of Kirchhoff's current and voltage Laws |
| **CO 2** | Familiar with basic electrical measurement instruments and know how to use them to make different types of measurements. |
| **CO 3** | Practically determine band width, Q-factor and verify with theoretical values. |
| **CO 4** | Apply suitable theorems for circuit analysis and verify the results theoretically. |
| **CO 5** | Analyze the behavior of AC circuts |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 2 | 2 | | 1 | | 1 | 2 | | 1 | | 2 | 2 | 2 |
| CO2 | 2 | 2 | 2 | | 1 | | 1 | 2 | | 1 | | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | | 1 | | 1 | 2 | | 1 | | 2 | 2 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | 1 | | 2 | 2 | 2 |
| CO5 | 2 | 2 | 2 | 1 | 1 | | 1 | 2 | | 1 | | 2 | 2 | 2 |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task 1 - Verification of Kirchoff's laws** | |
| **Objective:** To verify the KCL and KVL for a given circuit | CO 1 |
| **TASK-2 Determination of Self, Mutual Inductances and Coefficient of Coupling** | |
| **Objective:** To determine the self and mutual inductances and coefficient of coupling for two inductive coils. | CO 2 |
| **TASK-3 Locus Diagrams of RL and RC Series Circuits** | |
| **Objective:** To Plot the current locus diagrams for RL and RC circuits. | CO 3 |
| **TASK-4 Frequency response of series resonance circuit with analysis and design** | |
| **Objective:** To determine resonant frequency, band width and Q-factor for series RLC circuits | CO 3 |
| **TASK-5 Frequency response of parallel resonance circuit with analysis and design.** | |

| | |
|---|---|
| **Objective:**<br>To determine resonant frequency, band width and Q-factor for parallel RLC circuits | CO 3 |
| **TASK-6 Verification of Thevenin's and Nortons theorems** | |
| **Objective:**<br>To verify the Thevinis and Nortons Theorem | CO 4 |
| **TASK-7 Verification of Reciprocity and Millman's Theorems** | |
| **Objective:**<br>To verify the reciprocity and Millman's Theorems | CO 4 |
| **TASK-8 Verification of Superposition Theorem** | |
| **Objective:**<br>To verify the superposition theorem | CO 4 |
| **TASK-9 Verification of Maximum Power Transfer Theorem** | |
| **Objective:**<br>To verify the Maximum power transfer theorem | CO 4 |
| **TASK-10 Verification of compensation Theorem** | |
| **Objective:**<br>To verify the compensation theorem | CO 4 |
| **TASK-11 Measurement of current in various branches of RLC series and parallel circuits. And draw the phasor diagram.** | |
| **Objective:** To verify the series and parallel RLC circuits | CO 4 |
| **Task – 12 Measurement of Reactive Power for Star and Delta Connected Balanced Loads** | |
| **Objective:**<br>Measurement of reactive power of an 3- Φ balanced inductance load using one 1- Φ Wattmeter | CO 5 |

| | |
|---|---|
| **Additional Experiments:** | |
| **TASK-13 Measurement of 3-Phase Reactive Power by using one Wattmeter Method** | |
| **Objective:**<br>To measure the reactive power consumed by a 3 phase load using one wattmeter method | CO 5 |
| **TASK-14 Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads** | |
| **Objective:**<br>To measure the reactive power consumed by a 3 phase load, using 2 wattmeter method. | CO 5 |
| **Virtual Labs:**<br>1. Parallel RC Circuits<br>2. Parallel LC Circuits<br>3. Thevenin's theorem<br>4. Series RL Circuits<br>5. Norton's Theorem<br>6. Series LCR Circuit | |

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Thevinins and nortons | CO1 | **https://www.youtube.com/watch?v=7JfoDFk61o8** |
| 2 | Series Resonance in RLC Circuit | CO2 | **https://www.youtube.com/watch?v=YLGrugmDvc0** |
| 3 | Phasor Diagram of RL, RC and RLC Circuits | CO3 | **https://www.youtube.com/watch?v=HaFrY0qQ-NU** |

**Text Book(s):**

1. A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010.
2. A Sudhakar, Shyammohan S Palli, "Circuits & Networks", Tata McGraw- Hill, 4th Edition, 2010

**Reference Book(s):**

1. Willam Hayt.jr, Jack E.kemmerly,Steven M.Durbin, "Engineering Circuit analysis" Tata McGraw- Hill, 8th Edition2012
2. Rudrapratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1 st Edition, 1999.

**Web References:**

1. https://www.ee.iitkgp.ac.in/
2. http://www.vlab.co.in/lab_ready_for_use.php
3. http://vlab.amrita.edu/?sub=1&brch=75

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1504 | ENGINEERING GRAPHICS LAB | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credits | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 1 | 4 | 80 | 3 | 40 | 60 | 100 |

**Pre-Requisite:** Basic Mathematics (Geometry)

**Course Objectives:**

1. To impart skills on using drawing instruments
2. To convey exact and complete information of any physical object.
3. To Construct Engineering Curves.
4. To Learn and practice basic AutoCAD commands.
5. To Instruct the utility of drafting & modeling packages in orthographic and isometric drawings
6. To understand the applications of AUTOCAD for modeling physical objects

**Course Outcomes**: At the end of the course, student will be able to:

| | |
|---|---|
| **CO 1** | Define the qualities of precision and accuracy in engineering drawing. (BL-1) |
| **CO 2** | Draw engineering curves with different methods(BL-3). |
| **CO 3** | Develop the orthographic projection of points and straight lines(BL-3) |
| **CO 4** | Construct the planes and simple solids.(BL-3). |
| **CO 5** | Understand and practice basic AUTOCAD commands (BL-2) |
| **CO 6** | Construct Isometric views using AUTOCAD (BL-3). |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | | | | 1 | | | | | | | 1 | 1 | 1 |
| CO2 | 2 | 1 | | | 1 | | | | | | | 1 | 1 | 2 |
| CO3 | 2 | 2 | | | 1 | | | | | | | 2 | 2 | 2 |
| CO4 | 2 | 2 | | | 2 | 1 | | | | | | 2 | 2 | 2 |
| CO5 | 1 | 1 | 1 | | 1 | | | | | | | 1 | 1 | 1 |
| CO6 | 2 | 2 | 2 | | 2 | | | | | | | 1 | 2 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**Part-A Manual Drawing**

| **TASK– 1** | **Introduction and Conic sections** | 10 H |
|---|---|---|

**Introduction to Engineering graphics**:

Principles of Engineering Graphics and their significance; various instruments used, drawing sheet sizes and title block, lettering, BIS conventions, types of lines and dimensioning methods.

Geometrical constructions: simple constructions, construction of Pentagon, Hexagon by general method only.

**Conic Sections:**. Types of conics: Ellipse, Parabola and Hyperbola (Eccentricity method only),

At the end of the **TASK** -1, students will be able to:

1. Understand of Geometrical Constructions. (BL-2)
2. Draw Conic Sections by using eccentricity method . (BL-3)

| **TASK–-2** | **Orthographic Projections** | 10 H |
|---|---|---|

**Objectives and Principle of projection,**

Methods of projections, Comparison between first angle and third angle projection.

**Projections of points:** Projection of points placed in different quadrants,

**Projection of straight lines: F**undamental concepts**,** Line parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only,

**Projections of planes:** Projection of planes (Triangle, Square, Pentagon, Circle) parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only

At the end of the **TASK-** 2, students will be able to:

1. Understand Orthographic Projection of points. (BL-2)
2. Draw Projection of lines inclined to one and two reference planes. (BL-3)
3. construct the Projection of planes inclined to one and two reference planes.(BL-3)

| **TASK–3** | **Projections of Solids** | 12 H |
|---|---|---|

**Types of solids** ; Polyhedra, Solids of revolution,

**Projections of regular solids**(Prisms, Pyramids, Cylinders and Cone),with its axis perpendicular to one plane and parallel to other plane, Axis inclined to one plane and parallel to other plane.

At the end of the **TASK** - 3, students will be able to:

1. Understand Projections of regular Solids. (BL-2)
2. Draw projections of Prisms, Pyramids, Cylinders And Cones(BL-3)

| **TASK–4** | **Isometric and Orthographic views** | 10H |
|---|---|---|

**Isometric Projections** : Principles, Isometric scale, Isometric views ,Conventions, Isometric views of lines, planes, simple solids (Cube, Cylinder, Cone), Conversion of Isometric views to Orthographic views.

At the end of the **TASK** - 4, students will be able to:

1.Understand Principles of Isometric Projections and Isometric scale. . (BL-2)

2.Draw isometric views of simple solids (BL-2)

3.Apply the principles in Conversion of Isometric views in to Orthographic views. (BL-3)

**Part B Computer Aided Drafting**

| **TASK–5** | **Introduction to AutoCAD** | 15 H |
|---|---|---|

Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations.

At the end of the **TASK-** 5, students will be able to:

1. Understand the Basic AutoCAD commands. (BL-2)
2. Draw the templates of simple physical objects. (BL-3)
3. Apply the utility of drafting & modelling packages in orthographic and isometric drawings

| **TASK–6** | **Orthographic and Isometric Projections** | 18 H |
|---|---|---|

**Transformation of Isometric Projections into orthographic projections such as** simple solids such as cylinder, cone, square prism, pentagonal pyramid

Draw 3D model of mechanical components such as Stepped block, Bush bearing,

At the end of the **TASK** -6, students will be able to:

1. Develop the usage of 2D and 3D modelling. (BL-3)
2. Create the various views of machines components. (BL-3)

| | |
|---|---|
| **Total H:** | **75 H** |

**Content beyond syllabus:**

1. Development of surfaces, Section of solids

**Self-Study:**

Contents to promote self-Learning:

| **SNO** | **Topic** | **Reference** |
|---|---|---|
| 1 | **Introduction to Basic Engineering Scales** | https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf |
| 2 | **Engineeringcurves** | www.nptel.ac.in/courses/112104019/ |
| 3 | **Orthographic Projections** | www.nptel.ac.in/courses/112104019/ |
| 4 | **Projections of Solids** | www.nptel.ac.in/courses/105104148/ |
| 5 | **AutoCAD** | https://www.autodesk.in/campaigns/education/fusion-360?mktvar002=3510851\|SEM\|APAC_GGL_0025&gclid=EAIaIQobChMI25i62KuD6wIVj3wrCh1V1AUJEAAYASAAEgLpmfD_BwE |
| 6 | **Isometric and Orthographic Projections** | https://www.youtube.com/watch?v=iXgCzZFrYlg |

**Text Book(s):**

1. Bhatt N.D. "Elementary Engineering Drawing", CharotarPublishers,2014.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
3. K.L.Narayana&P.Kannaiah,EngineeringDrawing,3/e,ScitechPublishers,Chenna i, 2012.
4. Engineering Drawing by Dr AVS Sridhar Kumar, Dr Krishnaiah , T P Vara Prasad. ,Spectrum education, Sun techno Publications,2019

**Reference Book(s):**

1. Engineering Drawing and Graphic Technology -International Edition, Thomas E.French, Charles J. Vierck, Robert J. Foster, McGraw-Hill, 2014
2. Venugopal.K "Engineering Drawing and Graphics", New Age International (P) Ltd., New Delhi, 2010.

**Online Resources:**

1. www.nptel.ac.in/courses/112104019/
2. www.nptel.ac.in/courses/105104148/
3. www.vlab.co.in

**Web Resources:**

**1.** https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf
**2.**http://cbseacademic.nic.in/web_material/CurriculumMain21/SrSecondary/Engineering_Graphics_Sr.Sec_2020- 21.pdf
**3.**http://cbseacademic.nic.in/web_material/Curriculum19/Main-/11_Engineering_Graphics.pdf

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20ES1510 | **Introduction to Python Programming LAB** | | | | | | | R2020 |
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 2 | 32 | 1 | 40 | 60 | 100 |

**Pre-requisite:** Programming Knowledge

**Course Objectives:**

1. To gain knowledge on python programs basics
2. To prepare students for solving the programs on functions, data structures, Files
3. To prepare students for solving the programs on Classes, Exception Handiling, Regular Expressions and Multi threading

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO1** | Understanding and use of python- Basic Concepts(BL -2) |
| **CO2** | Solve the concepts of python functions and data structures(BL -3) |
| **CO3** | Understand the concepts of files, modules, multithreading and regular expressions (BL -2) |
| **CO4** | Solve the concepts of class and exception handling (BL -3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | 1 | 2 | | | | | | | | | | 1 | |
| **CO2** | 2 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| **CO3** | 2 | 2 | 3 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 1 | 1 | | | | | | | | 3 | 2 |

1-Low, 2-Medium, 3- High

| **COURSE CONTENT** | **CO** |
|---|---|
| **Task-1 - Python Basics (4H)** | |
| 1. Running instructions in Interactive interpreter and a Python Script<br>2. Write a program to purposefully raise Indentation Error and Correct it<br>3. Write a program to compute distance between two points taking input from the user (Pythagorean Theorem)<br>4. Write a program to convert a Binary number to Decimal number and verify if it is a Perfect number. | CO 1 |
| **Task-2 - Conditional Statements (2 H)** | |
| 1. Write a program to determine if a given string is a Palindrome or not<br>2. Write a program for Fibonacci sequence is generated by adding the previous two terms by starting with 1 and 2, the first 10 terms will be: 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, ... | CO 1 |
| **Task-3 - Functions (2 H)** | |
| 1. Write a function ball_collide that takes two balls as parameters and computes if they are colliding. Your function should return a Boolean representing whether or not the balls are colliding.<br>Hint: Represent a ball on a plane as a tuple of (x, y, r), r being the radius. If (distance | CO 2 |

| | |
|---|---|
| between two balls centers) <= (sum of their radii) then (they are colliding) | |
| **TASK-4 - Functions Continued (2 H)** | |
| 1. Write a function that draws a Pyramid with # symbols<br><br>2. Choose any five built-in string functions of C language. Implement them on your own in Python. You should not use string related Python built-in functions. | CO 2 |
| **TASK-5 - Strings(4 H)** | |
| 1. Write a program to use split and join methods in the string and trace a birthday with<br>Diction b array data structure.<br>2. Write a program using map, filter and reduce functions | CO 2 |
| **TASK-6 - Lists (4 H)** | |
| 1. Write program which performs the following operations on list's. Don't use built-in<br>functions<br>a) Updating elements of a list<br>b) Concatenation of list's<br>c) Check for member in the list<br>d) Insert into the list<br>e) Sum the elements of the list<br>f) Push and pop element of list<br>g) Sorting of list<br>h) Finding biggest and smallest elements in the list<br>i) Finding common elements in the list | CO 2 |
| **TASK-7 - Files (2 H)** | |
| 1. Write a program to print each line of a file and count the number of characters, words and lines in a file.<br>2. Write a program that allows you to replace words, insert words and delete words from the file. | CO 3 |
| **TASK-8 - Modules and Packages (2 H)** | |
| 1. Write a program for creating a module and import a module<br>2. Write a program to perform any two operations using Numpy | CO 3 |
| **TASK-9-Class and Objects (4 H)** | |
| 1. Write a program for Class variables and instance variable and illustration of the self variable<br>i) Robot<br>ii) ATM Machine | CO 4 |
| **TASK-10 - Exception Handiling (2 H)** | |
| 1. Write a program of exception handling to open a file while do not have write permissions | CO 4 |

| | |
|---|---|
| 2. Write a Programto handle multiple errors with one except statement. | |
| **TASK-11- Regular Expressions(2 H)** | |
| 1. Write a Python program to remove the parenthesis area in a string.<br>Sample data : ["example (.com)", "w3resource", "github (.com)", "stackoverflow (.com)"]<br>2. Write a program to match the name phone , emails, passwords and phone numbers using pattern matching | CO 3 |
| **TASK-12-Turtle (2 H)** | |
| 1. Write a turtle program to construct a clock dial<br>2. Write a turtle program to produce a flower in different colours | CO 3 |

| | |
|---|---|
| **Additional Experiments:** | |
| **TASK-1** | |
| 1. Write a python program to find the resolution of an image<br>2. Write a python program to count the number of vowels and consonants<br>3. Write a python program to print the ASCII value of acharacter | |

| | |
|---|---|
| **Virtual Labs:** | |
| Python Lab (IIT Bombay) : http://vlabs.iitb.ac.in/vlabs-dev/labs/python-basics/experimentlist.html | |
| **List of Experiments** | |
| 1. Arithmetic Operations<br>2. Built-in Functions<br>3. Loops<br>4. Data Types<br>5. Strings | 6. Classes and Objects<br>7. Built-in Modules<br>8. Constructors and Inheritance<br>9. File Operators |

**Text Book(s):**


1. VamsiKurama, Python Programming: A Modern Approach, Pearson, 2017.
2. Allen Downey, Think Python, 2ndEdition,Green Tea Press


**Reference Books :**


1. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019.
2. Allen B. Downey, “Think Python”, 2ndEdition, SPD/O’Reilly, 2016.
3. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018.
4. Mark Lutz, Learning Python, 5th Edition, Orielly, 2013.
5. Wesley J Chun, Core Python Programming, 2nd Edition, Pearson, 2007
6. Kenneth A. Lambert, Fundamentals of Python, 1st Edition, Cengage Learning, 2015

**Web References:**

1. https://www.tutorialspoint.com/python/index.htm
2. https://www.w3schools.com/python/
3. https://www.javatpoint.com/python-tutorial
4. https://www.geeksforgeeks.org/python-programming-language/

# NARAYANA ENGINEERING COLLEGE:GUDUR

| 20EN1502 | **ORAL COMMUNICATION SKILLS LAB** | | | | | | R2020 |
|---|---|---|---|---|---|---|---|
| I-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 2 | 32 | 1 | 40 | 60 | 100 |

**Pre-requisite:Nil**

**Course Objectives:**

1. Understand the role of communication in personal & professional success and develop awareness of appropriate communicationstrategies.
2. Understand and learn to distinguish informal speech from formal speech through role plays and can handle a concern or complaint, with empathy andunderstanding.
3. Improves speaking ability in English both in terms of fluency andcomprehensibility.
4. Understand the essential points in preparing an oralpresentation
5. To improve the mass communication and provide an opportunity to exercise their rights to express them effectively
6. To equip students with knowledge and techniques to effectively tackle the interviewprocess

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | To develop knowledge, skills, and judgment around human communication that facilitates their ability to work collaboratively with others. |
| **CO 2** | Use listening skills to create more effective, less confrontational, more productive professional & personal relationships and understand techniques required for excellent telephone etiquette. |
| **CO 3** | Develop their public speaking abilities to speak both formally and informally. |
| **CO 4** | Learn the skills necessary to deliver effective presentation with clarity and impact. |
| **CO 5** | Understand the nuances of English language and skills required for effective participation in group activities. |
| **CO 6** | Learn to face different types of interviews with confidence and understand the procedure & preparation required for attending an interview. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO | PO | | | | | | | | | | | | PSO | |
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 1 | | | | | | | | | 3 | | 2 | 1 | |
| CO2 | 1 | | | | | | | | | 2 | | 3 | 1 | |
| CO3 | 1 | | | | | | | | | 3 | | 2 | 1 | |
| CO4 | 1 | | | | | | | | | 3 | | 3 | 1 | |
| CO5 | 1 | | | | | | | | | 3 | | 2 | 1 | |
| CO6 | 1 | | | | | | | | | 2 | | 3 | 1 | |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| COURSE CONTENT | CO |
|---|---|
| **Module - 1** | |
| Ice - Breaking Activity – Introducing Oneself and Others – Greetings – Taking Leave - Introduction to Communication Skills – Verbal & Non Verbal Communication - Barriers to effective communication - Kinesics - Proxemics – Chronemics - Haptics- Paralanguage. | CO1 |
| **Module - 2** | |
| Situational Dialogues and Role play – Expressions in various Situations - Greetings – Apologies – Requests – Giving directions -Social and Professional etiquettes – TelephoneEtiquettes | CO2 |
| **Module - 3** | |
| Just a Minute (JAM) - Asking for Information and Giving Directions–Description (Oral): Pictures, Photographs, Products, and Process | CO3 |
| **Module – 4** | |
| Presentation Skills – Oral presentations (individual and group) through Seminars / PPTs - Fluency & accuracy in speech – Improving self- expression– Tonal variations – Listener oriented speaking - Developing persuasive speakingskills. | CO4 |
| **Module - 5** | |
| Debate : concepts, types, do's and don'ts - intensive practice- Group Discussion and Group Discussion : Dynamics of group discussion,intervention, summarizing, modulationof voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation. | CO5 |
| **Module - 6** | |
| Interview Skills: Concept and process, pre-interview planning, opening strategies,answering strategies, interview through Tele - Conference & video - conference and Mock Interviews. | CO6 |

**Reference Book(s):**


- *Rizvi,Ashraf.M.,EffectiveTechnicalCommunication,McGrawHill,NewDelhi.2005*
- *Raman, Meenakshi &Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi.2011.*
- *Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition,2018.*
- *English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill2009*
- *CommunicationSkillsbyLeenaSen,PHILearningPvtLtd.,NewDelhi,2009*


**Web Resources:**

- *Grammar/Listening/Writing1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/Grammar/Vocabulary*
- *English Language LearningOnline*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary GameReading*
- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/ Listening*
- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.htmlSpeaking*
- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciationtips*
- *Merriam-Webster – Perfect pronunciation Exercises AllSkills*
- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

*Online Dictionaries*

- *Cambridge dictionary online :https://dictionary.cambridge.org/*
- *MacMillan dictionary :https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries :https://www.oxfordlearnersdictionaries.com/*

# SEMESTER III

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20MA1006 | BS | Probability Statistics and Numerical Methods | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20ES1011 | ES | Data Structures | 2 | 0 | 2 | 4 | 3 | 40 | 60 | 100 |
| 20ES1013 | ES | Electronic Devices and Circuits | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2001 | PC | Electrical Circuit Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2002 | PC | DC Machines and Transformers | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20ES1516 | ES | Electronic Devices and Circuits Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2501 | PC | DC Machines and Transformers Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2502 | PC | Electrical Circuits and Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6001 | SC | Career competency Development I | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6001 | SC | Value added course/Certificate course I | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| 20MC8002 -12 | MC | Mandatory course II | 2 | 0 | 0 | 2 | 0 | | | |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 16 | 1 | 16 | 33 | 21.5 | 400 | 600 | 1000 |

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20MA1006 | PROBABILITY, STATISTICS AND NUMERICAL METHODS | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite**: inter mathematics

**Course Objectives:**

1. To study different coordinate systems, Physical significance of Divergence, Curl and Gradient.
2. To acquire knowledge on electric and magnetic fields in both static and dynamic domains.
3. To understand wave concept with the help of Maxwell's equations.
4. To Analyze reflection and refraction of EM waves and Electromagnetic wave propagation in different media.
5. To introduce concepts of polarization and fundamental theory of electromagnetic waves in transmission lines and their practical applications.

**Course Outcomes**: After successful completion of the course, the student will able to:

| | |
|---|---|
| **CO 1** | Use the concept of discrete and continuous probability distributions in life testing, expected failures for various engineering applications. (L-3) |
| **CO 2** | Test the Large samples data by applying inferential techniques. (L-4) |
| **CO 3** | Test the small samples data by applying inferential techniques. (L- 4) |
| **CO 4** | Apply the knowledge how to solve algebraic and transcendental equations using numerical methods and interpolating the polynomials. (L- 3) |
| **CO 5** | Utilize the numerical differentiation and integration techniques to solve engineering problems. (L- 3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | | 2 | | | | | | | | | 2 | |
| CO2 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | |
| CO3 | 3 | 3 | | 2 | | | | | | | | | 2 | |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | |
| CO5 | 3 | 3 | | 2 | | | | | | | | | 2 | |

1- Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Probability Distributions | Hours:10 |
|---|---|---|

Introduction of Random variables, Probability mass function and Probability density function concepts. Introduction to Binomial distribution (B.D), Mean, variances(without derivations), properties, application Problems on B.D, fitting of Binomial distribution, Poisson distribution (P.D), Mean, variances (without derivations), properties, some application Problems on P.D, Normal distribution (N.D) and properties, Mean, variances, mode (without derivations derivation), some application Problems on normal distribution, Exponential distribution, its properties and applications

At the end of the Module 1, students will be able to:

1. Apply the mathematical expectation techniques to find the expected value and variance. (L-3)
2. Acquire the knowledge about classification of the variables (characteristics), through. (L-3)
3. Apply an appropriate probability distribution to analysis the data. (L-3)
4. find expected mean life time of the product by using normal distribution. (L-1)

| MODULE -2 | Large Sample Tests | Hours:10 |
|---|---|---|

Population, sample, statistic, Introduction to Sampling distribution and standard error .Introduction to Hypothesis, critical region, type-I, type-II errors, level of the significance, one-tailed and two-tailed tests, test procedure, one sample mean-test, confidence intervals for one sample mean, two-mean test, confidence intervals for two sample mean, one-sample proportion test, confidence intervals for one

At the end of the Module 2, students will be able to:

1. Apply the testing of hypothesis techniques, decide the product is good or bad. (L-3)
2. How much of sample size is required for testing (L-1)
3. Determine the control limits of the product. (L-3)
4. Select appropriate test statistic to analysis the data. (L-3)

| **MODULE-3** | **Small Sample Tests** | **Hours:8** |
|---|---|---|

One sample mean-test, confidence intervals for one sample mean, two-mean test, confidence intervals for two sample mean, paired t-test, some application problems on t-test, Chi-square tests are one sample variance test, goodness of fit and test for independence of attributes. Some application problems on Chi-square –test. F-tests and some application problems on F-test

At the end of the Module 3, students will be able to:

4. Determine the product came from same company or not. (L-3)
5. Applying t-test techniques, to determine the experimentation useful or not (L-3)
6. Use the chi-square test techniques to select the appropriate distribution (L-3)
7. Applying the chi-square test to test whether the attributes are independent or not (L-3)

| **MODULE-4** | **Solution of Algebraic, Transcendental Equations & Interpolation** | **Hours:10** |
|---|---|---|

Algebraic and Transcendental Equations: Introduction, Transcendental equation Definition, Bisection Method - explanation, problem, The Method of False Position- Explanation, problem, Newton-Raphson Method- Explanation, problem. Interpolation: Introduction, Finite differences, Forward & Backward differences, Newton's Forward Difference interpolation- Formula without proof, problems, Newton's Backward Difference interpolation- Formula without proof, problems, Lagrange's Interpolation- Formula without proof, problems..

At the end of the Module 4, students will be able to:

1. Solve an algebraic or transcendental equation using an appropriate numerical method. (L-3)
2. Understand the use of different operators in interpolation. (L-2)
3. Estimate the value for the given data through interpolation polynomials. (L-5)
4. Understand the theoretical and practical aspects of the use of numerical methods. (L-2)
5. Proficient in implementing numerical methods for a variety of multidisciplinary applications. (L-2)

| **MODULE-5** | **Numerical Differentiation & Integration** | **Hours:10** |
|---|---|---|

Numerical Differentiation: Introduction, Numerical Differentiation formula using Newton's forward & backward Differences (without proof), problems. Numerical Integration: Introduction, Trapezoidal rule-formula (without proof), problems, Simpson's 1/3 Rule- Formula (without proof), problems, Simpson's 3/8 Rule- Formula (without proof), problems.

At the end of the Module 6, students will be able to:

1. Understand the different methods of numerical solution of ordinary differential equations. (L-2)
2. Acquire the knowledge how to solve ordinary differential equations through the numerical method. (L-3)
3. Apply Runge-kutta method in engineering problems (L-3)
4. Workout numerically on the ordinary differential equations using Taylor's series methods. (L-1)

| | |
|---|---|
| **Total hours** | **48** |

**Content beyond syllabus:**

1. Analysis variance.
2. lognormal distribution.
3. regression analysis .

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| **1** | Probability distribution | **CO1** | https://www.youtube.com/watch?v=6x1pL9Yov1k |
| **2** | Large sample tests | **CO2** | https://www.youtube.com/watch?v=80YzzIm8NK8 |
| **3** | Small sample tests | **CO3** | https://www.youtube.com/watch?v=c5YTyGWpcmw |
| **4** | Solution of Algebraic and Transcendental Equations | **CO4** | https://www.youtube.com/watch?v=apuEXUAntJo |
| **5** | Numerical Differentiation & Integration | **CO5** | https://www.youtube.com/watch?v=0rtaUUonwkU |
| **6** | Numerical solution of Ordinary differential equations | **CO6** | https://www.youtube.com/watch?v=QugqSa3Gl-w |

**Text Book(s):**


1. Iyengar T.K.V., Krishna Gandhi B. & Others., (2013), Numerical Methods, Second Revised Edition, New Delhi, S.Chand & Co.Ltd.
2. Miller and Freunds, Probability and Statistics for Engineers, 9/e, Pearson, 2017.
3. S.S. SASTRY, Introductory Methods of Numerical Analysis, 5/e, PHI learning private limited, 2011.
4. B S Grewal, (2017), Higher Engineering Mathematics, 44th Edition, New Delhi, Khanna Publishers.


**erence Book(s):**


1. S. Ross, a First Course in Probability, Pearson Education India, 2002.
2. Fundamentals of Mathematical Statistics" is written by SC Gupta and VK Kapoor and ... Aug 19, 2016.
3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
4. G S S Bhishma Rao (2011), Probability and Statistics, Fifth Edition, Hyderabad, SciTech Publications Pvt.Ltd.


.

**Online Resources/ Web References:**

1. https://www.vfu.bg/en/e-Learning/Math_Soong_Fundamentals_of_probabilityand statistics for engineers.pdf
2. http://www.math.ust.hk/~machas/numerical-methods.pdf
3. https://www.khanacademy.org/math/statistics-probability
4. http://www.randomservices.org/random/dist/index.htm l
5. https://global.oup.com/uk/orc/biosciences/maths/reed/01student/numerical_tutorials/pdf

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|---|---|---|---|---|---|---|---|---|
| 20ES1011 | DATA STRUCTURES | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 2 | 0 | 2 | 62 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Knowledge of Mathematics, Computer Programming, Analytical & Logical Skills

**Course Objectives:**

1. To explain efficient storage mechanisms of data for an easy access.
2. To design and implementation of various basic and advanced data structures.
3. To introduce various techniques for representation of the data in the real world.
4. To develop applications using data structures.
5. To pertain knowledge on improving the efficiency of algorithm by using suitable data structure.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand basic concepts of data structures and algorithm analysis. (BL - 2) |
| **CO 2** | Develop the applications using stacks and queues. (BL - 3) |
| **CO 3** | Demonstrate the use of linked lists. (BL - 2) |
| **CO 4** | Apply tree, graph data structures for various applications. (BL - 3) |
| **CO 5** | Implement algorithms for sorting, searching, and hashing methods. (BL - 3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO 1 | 1 | 1 | 2 | | | | | | | | | | 1 | |
| CO 2 | 2 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| CO 3 | 2 | 2 | 3 | 2 | 2 | | | | | | | | 3 | 2 |
| CO 4 | 2 | 2 | 2 | 1 | 1 | | | | | | | 2 | 3 | 2 |
| CO 5 | 2 | 1 | 2 | 1 | | | | | | | | 1 | 2 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Introduction to Data Structures | 10H |
|---|---|---|

**Introduction:** Overview of Data Structures, Implementation of Data Structures, Algorithm Specifications, Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off.
**Arrays:** One-Dimensional, Multi-Dimensional, Pointer Arrays.

At the end of the Module 1, students will be able to:

1. Understand the linear and non-linear data structures. (BL - 2)
2. Understand the time and space complexities of an algorithm. (BL - 2)
3. Illustrate representation of data using Arrays. (BL - 2)

| MODULE -2 | Stacks and Queues | 9H |
|---|---|---|

**Stacks:** Introduction, Representation of a Stack, Stack Operations, Applications of Stacks.
**Queues:** Introduction, Representation of a Queue, Queue Operations, Circular Queue, Applications of Queues.

At the end of the Module 2, students will be able to:

1. Explain stack ADT and its operations. (BL - 2)
2. Understand the expression evaluation using stacks. ( BL - 2)
3. Implement various queue structures. (BL - 3)

| **MODULE-3** | **Linked Lists** | **9H** |
|---|---|---|

Introduction, Singly linked lists, Doubly Linked Lists, Circular Linked Lists, Linked Stacks and Queues, Applications of Linked Lists.

At the end of the Module 3, students will be able to:

1. Understand basics concepts of linked lists. (BL - 2)
2. Illustrate various structures of linked lists. (BL - 2)
3. Understand the concept of dynamic memory management. (BL - 2)

| **MODULE-4** | **Trees & Graphs** | **10H** |
|---|---|---|

Trees-Introduction, Basic Terminologies, Definition and concepts, Representation of Binary Tree, operations on a BinaryTree, Binary SearchTree, Height BalancedBinaryTree.Graph Terminologies, Representation of Graphs, Graph Operations, Shortest Paths – Warshall's, Floyd's and Dijkstra's algorithms, Topological Sorting.

At the end of the Module 4, students will be able to:

1. Understand the concept of trees. (BL - 2)
2. Compare different tree structures. (BL - 2)
3. Explain the importance of Graphs for solving problems. (BL - 2)
4. Understand graph traversal methods. (BL - 2)
5. Implement algorithms to identify shortest path. (BL - 3)

| **MODULE-5** | **Sorting, Searching and Hash Tables** | **10H** |
|---|---|---|

Sorting: Introduction, Bubble Sort, Selection Sort, Quick Sort.Searching: Introduction, Basic Terminology, Linear Search and Binary Search Techniques. Hash Table:Hashing Techniques, Collision Resolution Techniques, Closed Hashing, Open Hashing.

At the end of the Module 6, students will be able to:

1. Implement the sorting algorithms (BL - 3)
2. Select the appropriate sorting algorithm for a given application (BL - 3)
3. Understand the concept of Hash Table (BL - 2)
4. Explain searching techniques. (BL - 2)

| **Total hours:** | **48 hours** |
|---|---|

**Content beyond syllabus:**

1. Heap Sort, Insertion Sort, Merge Sort
2. Optimum Sorting Algorithms

**Text Book(s):**


1. D. Samanta, "Classic Data Structures", 2nd Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012.
2. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures in C", 2nd Edition, Universities Press , 2008.

**Reference Books:**


1. NarasimhaKarumanchi, Data Structures and Algorithms Made Easy, Careermonk Publications, 2016
2. Peter Bras, “Advanced Data Structures”, Cambridge University Press, 2014.
3. RS Salaria, Data Structures, 3rd Edition, Khanna Publishing House, 2017.
4. YashwantKanetkar, Data Structures through C,3rd Edition, BPB Publications, 2019.
5. RB Patel, Expert Data Structures with C, Khanna Publications, 2019.
6. Richard F. Gilberg, Behrouz A. Forouzan, Data Structures A Pseudo code Approach with C, Second Edition, Cengage Learning.
7. Ananda Rao Akepogu, Radhika Raju Palagiri,Data Structures and Alg. Using C++ ,

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|---|---|---|---|---|---|---|---|---|
| 20ES1013 | ELECTRONIC DEVICES AND CIRCUITS | | | | | | | R20 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Semiconductor Physics.

**Course Objectives:**

1. To study the operation and characteristics of PN junction diode and special semiconductor devices..
2. To familiarize the design and analysis of rectifiers with filters.
3. To describe the characteristics of BJT and its configurations.
4. To analyze the biasing circuits of BJT.
5. To study the characteristics of MOSFET.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Illustrate the V-I characteristics of P-N junction Diode and special semiconductor devices. (BL-2) |
| **CO 2** | Demonstrate the performance of rectifiers with and without filters. (BL-2) |
| **CO 3** | Compare the operating characteristics of BJT (BL-3) |
| **CO 4** | Analyze the BJT biasing techniques. (BL-4) |
| **CO 5** | Interpret the characteristics of MOSFET. (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 1 | | | | | | | | | | | 3 | |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | |
| CO3 | 3 | 2 | | | | | | | | | | | 3 | |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 2 | |
| CO5 | 3 | 1 | 1 | | | | | | | | | | 3 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | SEMICONDUCTOR DIODE&SPECIAL SEMICONDUCTOR DEVICES | 10 Hrs |
|---|---|---|

**Semiconductor Diode:** Principle and Structure of PN junction diode, Open circuited PN junction diode, Energy band diagram of PN diode, Diode current Equation, Volt-Ampere Characteristics, Temperature dependence of Volt-Ampere Characteristics, Diode capacitance.

**Special Semiconductor Devices:** Principle of operation and Characteristics of Varactor diode, Tunnel Diode, Photo diode, LED, SCR

At the end of the Module 1, student will be able to:

1.Define PN junction diode (BL-1)
2. Explain the operation of PN junction diode for both forward and reverse bias. (BL-2)
3.Explain the energy band diagram of PN junction diode (BL-2)
4. Interpret the effect of temperature on V-I characteristics of PN junction diode (BL-2)
5. Derive the expression for transition and diffusion capacitance (BL-2)
6. Explain V-I Characteristics of various special diodes. (BL-2)
7. Describe the principle of operation of thyristors. (BL-2)

| MODULE -2 | RECTIFIERS & FILTERS | 10 Hrs |
|---|---|---|

**Diode applications:** P-N junction diode as a rectifier - Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, rectifier parameters, Harmonic components in Rectifier Circuits. Clippers and Clampers (Qualitative Treatment only)

**Filters**: Inductor Filters, Capacitor Filters, L- section Filters, π- section Filters, bleeder resistor.

At the end of the Module 2, students will be able to:

1. Explain the operation of a bridge rectifier. (BL-2)
2. Analyze the performance of rectifiers with and without filters. (BL-4)
3. Design half wave and full wave rectifier circuits. (BL-4)
4. Differentiate various rectifier circuits in terms of their parameter metrics.(BL-2)
5. Explain the importance of bleeder resistor (BL-2)

| MODULE-3 | BIPOLAR JUNCTION TRANSISTOR | 9 Hrs |
|---|---|---|

**Bipolar junction Transistor :**Construction, Principle of Operation, transistor current components , transistor configurations, Transistor h-parameter model, calculation of h-parameters from characteristics, transistor as a switch, transistor as an amplifier.

At the end of the Module 3, students will be able to:

1. Discuss the current components and their relationships in BJT (BL-2)
2. Explain principle, operation and applications of BJT (BL-2)
3. Describe input and output Characteristics of BJT (BL-2)
4. Differentiate BJT configurations (CB,CC,CE) (BL-2)

| MODULE-4 | TRANSISTOR BIASING | 10 Hrs |
|---|---|---|

**Transistor Biasing:** Need for biasing, operating point, load line analysis, Stabilization against variations in $I_{CO}$, $V_{BE}$ and β, biasing and stabilization techniques: fixed bias, collector to base bias, voltage divider bias, bias compensation techniques, thermal runaway, heat sink and thermal stability.

At the end of the Module 4, students will be able to:

1. Explain principle, operation and applications of MOSFET (BL-2)
2. Describe the operation and characteristics of Depletion MOSFET. (BL-2)
3. Explain the operation and characteristics of Enhancement MOSFET. (BL-2)
4. Differentiate enhancement and depletion mode MOSFET. (BL-2)

| MODULE-5 | METAL OXIDE SEMICONDUCTOR FIELD-EFFECT TRANSISTOR | 9 Hrs |
|---|---|---|

**MOSFET:** Construction of depletion mode and enhancement mode of NMOS and PMOS, Drain characteristics of MOSFET, Transfer Characteristics of MOSFET, MOSFET as a Switch, CMOS Inverter and it's Characteristics.

At the end of the Module 5, students will be able to:

1.Define biasing and stabilization (BL-1)
2.Explain the importance of thermal stability (BL-2)
3.Analyze the stabilization techniques.(BL-4)
4. Differentiate compensation techniques. (BL-2)

| | |
|---|---|
| **Total hours:** | **48 Hours** |

**Content beyond syllabus:**

1. Multi vibrators-Mono stable, Bi stable & Astable multi vibrators,
2. signal conditioning circuits-input signal determination, amplification, filtering.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Module | Reference |
|---|---|---|
| 1 | Semiconductor | https://www.electronics-tutorials.ws/diode/diode_3.html |

| | | | | |
|---|---|---|---|---|
| | | diode & Special semiconductor devices | https://www.electrical4u.com/tunnel-diode | |
| | 2 | Rectifiers and filters. | https://www.electricaltechnology.org/2019/01/what-is-rectifier-types-of-rectifiers-their-operation.html | |
| | 3 | Bipolar junction Transistor | https://www.electronics-tutorials.ws/transistor/tran_2.html | |
| | 4 | Transistor Biasing | https://www.tutorialspoint.com/amplifiers/methods_of_transistor_biasing.htm | |
| | 5 | Field effect transistors | https://www.electronics-tutorials.ws/transistor/tran_5.html. | |

**Text Book(s):**

1. 1. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.
2. L. Boylestad and Louis Nashelsky (2006), Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall
3. Electronic Devices and Circuits by Lal Kishore, BS Publications.

**Reference Book(s):**

1. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.
2. S. Salivahanan, N. Suresh Kumar, A. Vallavaraj (2008), Electronic Devices and Circuits, 2nd edition, Tata McGraw Hill, New Delhi.
3. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd edition, McGraw-Hill (India), 2010.

**Online Resources /Web References:**

1.http://www.acadmix.com/eBooks_Download
2.https://www.freebookcentre.net/Electronics/Electronic-Circuits-Books.html
3. https://nptel.iitm.ac.in/courses/108/108/108108122/
4.https://www.classcentral.com/course/swayam-microelectronics-devices-to-circuits-14198
5.https://www.khanacademy.org/science/electrical-engineering
6.http://afrotechmods.com/tutorials
7.http://www.tutorialspoint.com/electronic devices

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|---|---|---|---|---|---|---|---|---|
| 20EE2001 | **Electrical Circuit Analysis** | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total | Credit | Max Marks 100 | | |
| | L | T | P | hrs | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To know the analysis of three phase balanced and unbalanced circuits and to measure active and reactive powers in three phase circuits.
2. Knowing how to determine the transient response of R-L, R-C, R-L-C series circuits for D.C and A.C excitations.
3. To introduce the various two-port networks parameters for a given circuit.
4. To evaluation of poles and zeros of a given transfer function.
5. To study the different types of filters

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the analysis of three phase balanced and unbalanced circuits. |
| **CO 2** | Solve the problems in DC transient response for the given circuit. |
| **CO 3** | Solve the problems in AC transient response for the given circuit. |
| **CO 4** | Analyze the given network using different two port network parameters. |
| **CO 5** | Explain about the fundamental and types of filters. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | 3 | 2 | | | | | | | | | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 2 | | | | | | | | | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 2 | | | | | | | | | 3 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | | | | | | | | | 1 | 2 |
| **CO5** | 2 | 2 | 3 | 2 | | | | | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**Balanced Three phase circuits**

Three phase circuits: Phase sequence- Star and delta connection-Relation between line and phase voltages and currents in balanced systems-Analysis of balanced three phase circuits-Measurement of Active and Reactive power in balanced Three phase systems.

**Unbalanced Three phase circuits**

Analysis of Three Phase unbalanced circuits-Loop Method- Application of Millman's Theorem-Star Delta Transformation Technique – Two Wattmeter Method of measurement of three phase power, Advantages of Three Phase System.

At the end of the Module 1, students will be able to:

1. Explain about advantages of 3-φ circuits over 1-φ circuits

2. Distinguish between balanced and unbalanced circuits
3. Explain the phasor relationships of voltage, current, power in star and delta connected.
4. Measure the active, reactive powers in balanced circuits
5. Understand the analysis of unbalanced circuits and power calculations

**MODULE-2**

**Transient Analysis**

Transient Analysis in DC and AC circuits Transient response of R-L, R-C, R-L-C circuits for DC excitations, Solution using differential equations and Laplace transforms.

At the end of the Module 2, students will be able to:

1. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in DC excitations
2. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in sinusoidal excitations

**MODULE-3**

Transient Analysis in DC and AC circuits Transient response of R-L, R-C, R-L-C circuits for AC excitations, Solution using differential equations and Laplace transforms.

At the end of the Module 3, students will be able to:

1. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in AC excitations
2. Distinguish between classical method and Laplace transform approach in analysing transient phenomenon in sinusoidal excitations

**MODULE-4**

Two Port Network Parameters: Impedance, Admittance, Transmission and Hybrid Parameters and their relations, reciprocity and symmetry conditions, concept of transformed network, Two Port Network parameters using Transformed Variables

At the end of the Module 4, students will be able to:

1. Understand the concept of two port network theory
2. Find the transmission line networks for designing the transmission lines.

**MODULE-5**

**Filters**

Filters – Low Pass – High Pass and Band Pass – RC, RL filters– derived filters and composite filters design – Attenuators – Network functions for one port and two port networks, pole-zeros of network functions and network stability.

At the end of the Module 5, students will be able to:

1. Understand about Filter, Classification, where they can be used, etc.
2. Understand about attenuators and equalizers used in electronic high frequency circuits
3. Understand the basic of network synthesis.
4. Understand the properties of network function.

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Must be submit at least two assignments.

**Content beyond syllabus:**

1.Locus diagram and Electro magnetism

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Analysis of Three Phase balanced circuits | CO1 | https://www.youtube.com/watch?v=xaeob9lTXS0 |
| 2 | Analysis of Three Phase unbalanced circuits | CO2 | https://www.youtube.com/watch?v=xaeob9lTXS0 |
| 3 | Transient response for RL and RC circuits | CO3 | https://www.youtube.com/watch?v=2MaPC8Iw7nc |
| 4 | Fourier Theorem | CO4 | https://nptel.ac.in/courses/108/104/108104139/ |
| 5 | RC, RL filters | CO5 | https://www.youtube.com/watch?v=AGyjYG88LlE |
| 6 | basic synthesis procedure | CO6 | https://nptel.ac.in/courses/108/102/108102042/ |

**Text Book(s):**

1. William Hayt, Jack E. Kemmerly and Jamie Phillips, "Engineering Circuit Analysis", Mc Graw Hill, 9th Edition, 2019.
2. A. Chakrabarti, "Circuit Theory: Analysis & Synthesis", Dhanpat Rai & Sons, 2008.

**Reference Book(s):**

1. M.E. Van Valkenberg, "Network Analysis", 3rd Edition, Prentice Hall (India), 1980.
2. V. Del Toro, "Electrical Engineering Fundamentals", Prentice Hall International, 2009.
3. Charles K. Alexander and Matthew. N. O. Sadiku, "Fundamentals of Electric Circuits" Mc Graw Hill, 5th Edition, 2013.
4. Mahamood Nahvi and Joseph Edminister, "Electric Circuits" Schaum's Series, 6th Edition, 2013.
5. John Bird, Routledge, "Electrical Circuit Theory and Technology", Taylor & Francis, 5th Edition, 2014.
6. Sudhakar, A., Circuits and Networks, Tata McGraw
7. Suresh Kumar, K.S. Electrical circuits and Networks, Pearson Education.
8.Network Analysis and Synthesis – Umesh Sinha- Satya Prakashan Publications
9.A. Anand Kumar, Network Analysis and Synthesis, PHI publication

**Online Resources:**

1. http://www.acadmix.com/eBooks_Download
2. http://www.freetechbook.com/software-engineering-f15.html

**Web References:**

1)http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm
2)http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-andelectronics-spring-2007/video-lectures/lecture-2/
3) http://www.facstaff.bucknell.edu/mastascu/elessonsHTML/Circuit/Circuit1.html

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|---|---|---|---|---|---|---|---|---|
| 20EE2002 | DC MACHINES AND TRANSFORMERS | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To understand the constructional features of DC machines.
2. To understand the phenomena of armature reaction and commutation.
3. To understand the characteristics and parallel operation of dc machines.
4. To understand the methods for speed control of DC motors and applications of DC motors.
5. To understand the various types of losses that occurs in DC machines and how to calculate efficiency.
6. To understand the constructional features of a single phase transformer.
7. To understand the efficiency and voltage regulation of a transformer.
8. To understand the Autotransformers Construction & Comparison with two winding transformer.
9. To suggest a suitable three phase transformer connection for a particular operation.
10. To understand the tap changing of transformers.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Study construction, different phenomena like: armature reaction, commutation in DC machines. |
| **CO 2** | Understand about different types of dc generators and significance of OCC. |
| **CO 3** | Develop mathematical relations for torque developed by dc motor and learn about speed – torque characteristics of different types of DC motor. Gain knowledge of about different testing methods of dc machines. |
| **CO 4** | Identification of physical components of single phase transformer. |
| **CO 5** | Learn difference between two windings and auto transformers and identification of three phase transformers circuits. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 2 | 2 | 2 | | 2 | | | | 1 | 1 | 2 | 3 | 1 |
| CO2 | 2 | 2 | 2 | 2 | | 2 | | | | 1 | 1 | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | | 2 | | | | 1 | 1 | 2 | 3 | 1 |
| CO4 | 2 | 3 | 3 | 2 | | 2 | | | | 1 | 1 | 2 | 3 | 1 |
| CO5 | 3 | 3 | 3 | 3 | | | | | | 1 | 1 | 2 | 2 | 2 |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

### MODULE – 1

Principle of Electromechanical Energy Conversion, Energy balance equation, Introduction to DC Generator, principle of operation, Construction details, Design of Armature winding, E.M.F Equation- Numerical problems. Armature Reaction- Cross Magnetizing and De-Magnetizing AT/Pole, Compensating Winding, Commutation, Reactance Voltage, Methods of Improving

Commutation.

At the end of the Module 1, students will be able to:

- Able to understand the electromechanical energy conversion system
- Able to understand the construction, operation and armature windings of a DC generator
- Able to understand the Armature Reaction & Commutation

**MODULE -2**

Methods of Excitation – Separately Excited and Self Excited Generators, Build-Up of E.M.F - Critical Field Resistance and Critical Speed, Causes for Failure to Self Excite and Remedial Measures, Characteristics & Applications of Generators.
Parallel Operation of D.C shunt Generators, Series Generators-Use of Equalizer Bar and Cross Connection of Field Windings – Load Sharing.

At the end of the Module 2, students will be able to:

- Able to analyze the types of DC generators
- Able to analyze the characteristics of DC generators
- Able to understand the Parallel of operation of DC generators

**MODULE-3**

D.C Motor – Principle of Operation, Back Emf, Torque and power developed by armature, Types, Characteristics and Applications of dc Motors, speed control of DC motors(Armature control and Flux control methods), Necessity of starters, constructional details of 3-point and 4-point starters, Calculation of Starter Steps for D.C Shunt Motors.
Power stages in a dc machine, Losses – Constant & Variable Losses, Calculation of Efficiency, Condition for Maximum Efficiency & Numerical Problems. Methods of Testing - Brake Test, Swinburne's Test, Hopkinson's Test, Field's Test, Retardation Test.

At the end of the Module 3, students will be able to:

- Analyze the types of DC motors
- Analyze the characteristics & speed control of DC motors.
- Able to understand the calculation of starter resistance in steps.
- Analyze Power stages and types of losses in a DC machines.
- Able to understand the calculation of Efficiency in DC machines.
- Able to Analyze the testing of DC machines.

**MODULE-4**

Principle, construction and operation of single-phase transformers, EMF equation, equivalent circuit, phasor diagrams(no load and on load), losses and efficiency, voltage regulation, All Day Efficiency , Testing -open circuit, short circuit tests & Sumpner's test, separation of hysteresis and eddy current losses. Parallel operation of single-phase transformers.

At the end of the Module 5, students will be able to:

- Able to understand the construction & operation of transformer
- To predetermine the efficiency and voltage regulation of a transformer
- Able to understand the parallel operation of single phase transformers.

**MODULE-5**

Autotransformers-construction, principle, applications and comparison with two winding transformer. Three-phase transformer – construction, types of connection and their comparative features, Phase conversion - Scott connection, Tap-changing transformers - No-load and on-load tap changing of transformers.

At the end of the Module 6, students will be able to:

- Able to understand the Autotransformers
- Able to understand and analyze the phase conversions

| | |
|---|---|
| ▪ Analyze the tap changing of transformers | |
| **Total hours:** | **60 hours** |

**Term work:**

DC Machines- Lab & Transformers- Filed Work

**Content beyond syllabus:**

1. Advanced Speed control techniques for DC Motors.
2. Zigzag/star and V/V connections in a 3-Phase Transformers

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | DC Machines Introduction & Constructional features | CO1 | https://nptel.ac.in/courses/108/102/108102146/ |
| 2 | DC Generator Characteristics | CO2 | https://www.youtube.com/watch?v=TaZjv_sy_jo |
| 3 | DC Motor | CO3 | https://www.youtube.com/watch?v=GQatiB-JHdI |
| 4 | Testing of DC Machines | CO4 | https://www.youtube.com/watch?v=8WCbTZPjcTE |
| 5 | Transformers | CO5 | https://nptel.ac.in/courses/108/105/108105155/ |
| 6 | Auto Transformers | CO6 | https://www.youtube.com/watch?v=lltVwhoPvh0 |

**Text Book(s):**

1. Electrical Machinery, P.S. Bimbhra, Khanna Publishers, 7th Edition, 2011.
2. Electrical Machines, S K Bhattacharya, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2014, 3rd Reprint 2015.
3. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education,2010.

**Reference Book(s):**

1..Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
2.A. E. Fitzgerald and C. Kingsley, "Electric Machinery”, New York, McGraw Hill Education, 2013.
3. A. E. Clayton and N. N. Hancock, “Performance and design of DC machines”, CBS Publishers, 2004.

**Online Resources:**

1. http://175.101.102.82/moodle/
2. https://www.accessengineeringlibrary.com/
3. https://www.slideshare.net/
4. https://easyengineering.net/electrical-machinery-by-bimbhra/
5.https://books.google.co.in/books?id=dh_gDwAAQBAJ&lpg=PR1&dq=electrical%20machines%20by%20kothari%202020&pg=PR8#v=onepage&q&f=false

**Web Resources:**

1. https://electrical-engineering-portal.com/
2. https://www.electrical4u.com/
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html
4. https://www.engineering.com/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2501 | DC MACHINES AND TRANSFORMERS Lab | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To familiarize students about OCC and internal, external characteristics of dc shunt generator.
2. To know the performance characteristics and speed control method of dc shunt motor
3. To know how to predetermine the efficiency of dc shunt motor.
4. To find efficiency, losses and regulation of single phase transformer.
5. To know how to find motor and generator efficiency by connecting to dc shunt machines back to back
6. To familiarize students about characteristics of dc series motor

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Determine the magnetization and load characteristics of a DC shunt generator |
| **CO 2** | Describe the efficiency and performance characteristics of DC motors |
| **CO 3** | Predetermination of transformer with different loads |

**List of Experiments Prescribed and Conducted:**

**1.** Conduct an Experiment to obtain OCC Characteristics of dc Shunt generator.

**2.** Conduct Brake test on dc shunt motor to obtain performance characteristics.

**3.** Conduct speed control methods of dc shunt motor.

**4.** Conduct Swinburne's test on a DC Shunt machine.

**5.** Conduct OC and SC test on single phase transformer

**6.** Conduct Sumpner's test on two identical transformers

**7.** Conduct load test on single phase transformer

**8.** Conduct an Experiment to obtain internal and external characteristics of dc shunt generator.

**9.** Conduct an experiment from 3phase to 2 phase conversion by using Scott Connection

**10.** Conduct load test on dc series motor.

**Total hours: 30 hours**

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | | | | | | | 2 | 2 | | | 3 | 2 |
| **CO2** | 2 | 3 | | | | | | | 2 | 2 | | | 3 | 2 |
| **CO3** | 3 | 3 | | | | | | | 2 | 2 | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

# NARAYANA ENGINEERING COLLEGE:GUDUR

| 20EE2502 | **Electrical Circuits And Simulation Lab** | | | | | | | R2020 |
|---|---|---|---|---|---|---|---|---|
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 30 | 1.2 | 40 | 60 | 100 |

**Pre-requisite: Basic of Electrical circuit**

**Course Objectives:**

The objectives are to study:

1. To design electrical systems.
2. To analyze a given network by applying various Network Theorems.
3. To measure three phase Active and Reactive power.
4. To understand the locus diagrams

## List of Experiments

### PART A

1. Measurement of Active Power for Star Connected Balanced Loads
2. Measurement of Reactive Power for Star Connected Balanced Loads
3. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads
4. Measurement of Active Power for Delta Connected Balanced Loads 11. Measurement of Reactive Power for Delta Connected Balanced Loads
5. Locus Diagram of RL Series Circuits: a) Variable 'R' and Fixed 'L' b) Variable 'L' and Fixed 'R'
6. Locus Diagram of RC Series Circuits: a) Variable 'R' and Fixed 'C' b) Variable 'C' and Fixed 'R'
7. Constant K Low-Pass and High-Pass Filter.
8. Constant K Band-Pass and Band-Elimination Filters.
9. Study of Full Wave Rectifier with and without Filters

**PSPICE Simulation Experiments**:

1. Simulation of DC Circuits
2. Simulation of AC Circuits
3. DC Transient Response
4. Mesh Analysis
5. Nodal Analysis

**Course Outcomes**:

At the end of the course, students will be able to

1. The student will analyze the characteristics of Electrical circuits & P Spice Simulation.
2. To Perform Laboratory Experiments practically.
3. To carry out laboratory experiments on simulation & Networks.
4. To understand the fundamentals of electrical circuits & P Spice simulation

**Text Books**

1. David A. Bell, Fundamentals of Electric Circuits: Lab Manual OUP Canada, 7th Edition, 2009.

2. Muhammad H. Rashid, Introduction to PSPICE using OrCAD for Circuits and Electronics, Pearson Education, 3rd Edition, 2003.

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | | | 1 | | | | 2 | 2 | | | 3 | 2 |
| **CO2** | 2 | 3 | | | 1 | | | | 2 | 2 | | | 3 | 2 |
| **CO3** | 3 | 3 | | | 1 | | | | 2 | 2 | | | 3 | 2 |
| **CO4** | 2 | 2 | | | 1 | | | | 2 | 2 | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

# SEMESTER IV

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2003 | PC | Analog Electronic Circuits | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2004 | PC | Electro Magnetic Fields | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2005 | PC | Induction Motors and Synchronous Machines | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2006 | PC | Linear Control Systems | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2007 | PC | Power Generation & Transmission | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open elective I | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2503 | PC | Analog Electronics and Simulation Lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2504 | PC | Induction Motors and Synchronous Machines Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6002 | SC | Career competency Development II | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6002 | SC | Value added course/Certificate course II | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 10 | 28 | 21.5 | 400 | 600 | 1000 |

# NARAYANA ENGINEERING COLLEGE:GUDUR

| 20EE2003 | ANALOG ELECTRONIC CIRCUITS | | | | | | | R2020 |
|---|---|---|---|---|---|---|---|---|
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 2 | 0 | 0 | 36 | 2 | 40 | 60 | 100 |

**Pre-requisite: Basic knowledge on concepts of electronic devices.**

**Course Objectives:**

- To introduce linear and non linear wave shaping circuits.
- To explain the effect of negative feedback on amplifier characteristics RC & LC oscillator circuits
- To analyze single and multi stage amplifiers
- To introduce different types of large signal amplifiers
- To discuss op-ampcharacteristics and applications.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Demonstrate the concept of linear and non linear wave shaping circuits. (BL-02) |
| **CO 2** | Illustrate the concept of different types of feedback amplifiersandOscillators.(BL-02) |
| **CO 3** | Analyze various configurations of single stage and multistage amplifiers.(BL-04) |
| **CO 4** | Analyze the operation and characteristics of Power Amplifiers.(BL-02) |
| **CO 5** | Interpret the characteristics and applications Operational Amplifier.(BL-02) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 |
| CO1 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO2 | 3 | 2 | 2 | | | | | | | | | | 3 | |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 2 | |
| CO4 | 3 | 3 | | | | | | | | | | | 2 | |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 3 | |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

| MODULE – 1 | Wave Shaping Circuits | Hours: 10 |
|---|---|---|

**Linear Wave Shaping**: High pass and low pass RC circuits and their response for Sinusoidal, Step, Pulse, Square & Ramp inputs, High pass RC network as Differentiator, Low pass RC circuit as an Integrator.

**Non-Linear Wave Shaping**: Diode clippers, Transistor clippers, Clipping at two independent levels. Clamping Operation, Clamping circuit by considering Source and Diode resistances

At the end of the Module 1, students will be able to:

1. Understand the concept of high pass and low pass RC circuits. (BL-02)
2. Observe the response of Sinusoidal, step, pulse, square & ramp inputs.(BL-01)
3. Understand the working principle of Clippers and Clampers. (BL-02)

| MODULE – 2 | Feedback Amplifiers and Oscillators | Hours: 10 |
|---|---|---|

**FEEDBACK AMPLIFIERS:** Feedback principle and concept, types of feedback, feedback topologies, Characteristics of negative feedback amplifiers, Determination of input & output impedance of voltage series, voltage shunt, current series & current shunt configurations

**OSCILLATORS:** Oscillator principle, condition for oscillations, types of oscillators, Hartley oscillator, Colpitt's oscillator, RC-phase shift oscillator, Wein bridge oscillator,

At the end of the Module 2, students will be able to:

1. Understand the concept of feedback connection to an amplifier. (BL-02)
2. Identify different types of feedback topologies.(BL-01)
3. Summarize input and output impedance of various feedback configurations.(BL-02)
4. Compare characteristics of various types of feedback configurations.(BL-02)
5. Understand the working principle of oscillator. (BL-02)
6. Explain various LC oscillators by calculating frequency of oscillations and condition for oscillations.(BL-02)
7. Explain various RC oscillators by calculating frequency of oscillations and condition for oscillations.(BL-02)

| **MODULE – 3** | **Single Stage &Multistage Amplifiers** | **Hours: 09** |
|---|---|---|

**Single Stage Amplifiers:** Transistor hybrid model, determination of h-parameters, generalized analysis of transistor amplifier model using h-parameters, analysis of CB, CE and CC amplifiers.

**Multi Stage Amplifiers:** Classification of amplifiers, Different coupling techniques, Cascaded amplifier, Cascode amplifier.

At the end of the Module 4, students will be able to:

1. Understand the concept of hybrid model for analysis of transistor amplifier circuit. (BL-02)
2. Understand the role of different coupling schemes in cascading. (BL-02)
3. Analyze various multistage amplifiers.(BL-04)
4. Study two stage transistor amplifier circuits viz., Cascade amplifiers &Cascode amplifiers. (BL-02)

| **MODULE – 4** | **Power Amplifiers** | **Hours: 09** |
|---|---|---|

Classification, Series fed Class A large signal Amplifier, Transformer Coupled Class A large signal amplifier, Amplifier Distortion, Push- pull Class B Amplifier, Complementary Symmetry Class B Amplifier, Push- pull Class AB Amplifier, Complementary Symmetry Class AB Amplifier, class D amplifier, Heat sink and Thermal stability.

At the end of the Module 5, students will be able to:

1. Understand the role of power amplifier in multistage amplifiers. (BL-02)
2. Classify power amplifiers based on conduction angle. (BL-02)
3. Understand various distortions in amplifiers.(BL-02)
4. Demonstrate complementary symmetry topologies. (BL-02)
5. Find conversion efficiency of various topologies.(BL-01)

| **MODULE – 5** | **Op-Amp Characteristics** | **Hours: 10** |
|---|---|---|

Introduction, ideal and practical Op-amp, Op-amp characteristics - DC and AC characteristics, 741 Op-amp and its features, modes of operation-inverting, non-inverting, differential. Basic applications of Op-amp, instrumentation amplifier, , sample & Hold circuits, Differentiator and Integrator, Comparators, Schmitt trigger, Multivibrators, Introduction to voltage regulators

At the end of the Module 6, students will be able to:

1. Understand the concept of operational amplifier. (BL-02)
2. compare various modes of op-amp operation. (BL-02)
3. list the applications of operational amplifer.(BL-01)
4. Understand the concept of Multivibrators. (BL-02)

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

1. Model a single stage amplifier on PCB.

2. Model a multistage amplifier on PCB.
3. Model a Hartley oscillator on PCB
4. Survey and Submit a report on audio power amplifiers available in market.
5. Survey and Submit a report on oscillators available in market.
6. Survey and Submit a report on various op-amps available in market.

**Content beyond syllabus:**

3. Design of two stage RC coupled amplifier using FET-small signal analysis
4. Differential amplifier-CMRR, Common mode gain, Differential gain, Modes of operation.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Module | Reference |
|---|---|---|
| 1 | **Wave Shaping Circuits** | https://www.tutorialspoint.com/electronic_circuits/electronic_circuits_nonlinear_wave_shapping.htm |
| 2 | **Feedback Amplifiers** | https://www.tutorialspoint.com/amplifiers/amplifiers_feedback.htm |
| 3 | **Oscillators** | https://www.tutorialspoint.com/sinusoidal_oscillators/sinusoidal_oscillators_introduction.htm |
| 4 | **Single Stage &Multistage Amplifiers** | https://www.tutorialspoint.com/amplifiers/multi_stage_transistor_amplifier.htm |
| 5 | **Power Amplifiers** | https://www.tutorialspoint.com/amplifiers/classification_of_power_amplifiers.htm |
| 6 | **Op-Amp Characteristics** | https://www.electronicstutorials.ws/opamp/opamp_8.html |

**Text Book(s):**

1. Millman‟s Pulse, Digital and Switching Waveforms –J. Millman, H. Taub and Mothiki S. PrakashRao, 2 Ed., 2008, TMH.

2. Donald A. Neaman, “Electronic Circuit Analysis and Design”, McGraw Hill.

3. Op-Amps & Linear ICs – Ramakanth A. Gayakwad, PHI, 2003.

**Reference Book(s):**

1. Robert T. Paynter, “Introductory Electronic Devices and Circuits”, Pearson Education, 7th Edition

2. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuits Theory” Pearson/Prentice Hall, 9th Edition, 2006.

3. Sedra A.S. and K.C. Smith, “Micro Electronic Circuits”, Oxford University Press, 5th Edition.

4. Integrated Electronics, Jacob Millman, Christos C Halkias, TMH

5. Electronic Devices and Circuits, David A. Bell – 5thEdition, Oxford.

6. Electronic Circuit Analysis 4th Edition – by K. Lal Kishore , BS Publications.

**Online Resources/Web references:**

1.https://www.academia.edu/28016003/EDC_by_Lal_kishore
2.https://www.academia.edu/9984476/Electronic_devices_and_circuit_theory_robert_boylestad_1_

3. Donald A. Neaman, “Electronic Circuit Analysis and Design”, McGraw Hill.
4.https://nptel.ac.in/courses/122/106/122106025/
5. https://www.tutorialspoint.com/semiconductor_devices/index.htm
6. https://www.allaboutcircuits.com/textbook/semiconductors/
7.http://www.satishkashyap.com/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2004 | ELECTROMAGNETIC FIELDS | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To review the fundamentals of the different coordinate systems, vector algebra and calculus
2. To teach the basic laws of electromagnetism
3. To learn to compute and visualize the electrostatic and magnetostatic fields for simple configurations
4. To analyse the time varying electric and magnetic fields and to understand Maxwell's equations
5. To understand the propagation of electromagnetic waves through different media

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Ability to identify appropriate coordinate systems and visualize and understand the practical significance of vector calculus |
| **CO 2** | Understanding of the basic laws of electrostatics, Ability to compute, visualize electrostatic fields along with practical applications |
| **CO 3** | Understanding of the basic laws of magnetostatics |
| **CO 4** | Ability to compute, visualize magneto static fields along with practical applications |
| **CO 5** | Understanding of Maxwell's equations in different forms and medium |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| CO3 | 3 | 3 | 1 | 1 | | | | | | | | | 2 | 1 |
| CO4 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| CO5 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**ELECTROSTATICS -I**

Vector algebra , Coordinate systems, Vector calculus- Gradient, Divergence and Curl theorems and applications, Sources and effects of electromagnetic fields, Coulomb's Law – Electric field intensity – Field due to discrete and continuous charges – Gauss's law and its applications.

At the end of the Module 1, students will be able to:

1. Recollect the basic concepts Vectors
2. Understand the applications of Electrostatics

| |
|---|
| 3. Illustrate the basic laws of Electrostatics |
| **MODULE -2** |
| **ELECTROSTATICS -II**<br>Electric potential – Electric field and equipotential plots– Electric field in free space, conductors, dielectric -Dielectric polarization – Dielectric strength - Electric fields in multiple dielectrics – Boundary conditions, capacitance, Energy density, Poisson's and Laplace's equations. |
| At the end of the Module 2, students will be able to:<br>1. understand the concept of Electric potential<br>2. Differentiate between conductor and dielectric in electric field |
| **MODULE-3** |
| **MAGNETOSTATICS-I**<br>Magnetic field intensity (H) – Biot– Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – Magnetic force, Lorentz force, force between two conductors,- Boundary conditions. |
| At the end of the Module 3, students will be able to:<br>1. Understand the basic laws of Magnetostatics<br>2. Analyze the concept of magnetic force |
| **MODULE-4** |
| **MAGNETOSTATICS-II**<br>Scalar and vector potential, Poisson's Equation, Torque, Inductances and mutual inductances, Neumann's formula, Energy density, Numerical problems. |
| At the end of the Module 4, students will be able to:<br>1. Apply the poisson's & Laplace's equations to different problems<br>2. Analyze the inductance of different coil combinations |
| **MODULE-5** |
| **ELECTRODYNAMIC FIELDS**<br>Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Time varying potential – Relation between field theory and circuit theory , Applications. |
| At the end of the Module 5, students will be able to:<br>1. Understand the Faraday's law of electromagnetic induction<br>2. Analyze the Maxwell's equations for static and time varying fields |
| **Total hours: 48 hours** |

| |
|---|
| **Term work:** |
| **Content beyond syllabus:**<br>1. Electric power transmission |
| **Self-Study:**<br>Contents to promote self-Learning: |

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Gauss's law and its applications | CO1 | https://www.youtube.com/watch?v=M0GInI0vNh8 |
| 2 | Poisson's and Laplace's equations | CO2 | https://www.youtube.com/watch?v=I-lKnLnnbY4 |
| 3 | Biot– Savart's Law | CO3 | https://www.youtube.com/watch?v=X9mYh8aG2AQ |
| 4 | Neumann's formula | CO4 | https://www.youtube.com/watch?v=iVANETIf3cM |
| 5 | Displacement current | CO5 | https://www.youtube.com/watch?v=77PZPBXMl1w |
| 6 | Wave parameters; velocity, intrinsic impedance, propagation constant | CO6 | https://www.youtube.com/watch?v=z_L58oLkWc |

**Text Book(s):**

1. Mathew N. O. Sadiku, S.V.Kulkarni, 'Principles of Electromagnetics', 6th Edition, Oxford University Press, 2015, Asian Edition
2. William H. Hayt and John A. Buck, 'Engineering Electromagnetics', Tata McGraw Hill ,8th Revised edition, 2014
3. Joseph. A.Edminister, 'Schaum's Outline of Electromagnetics, Third Edition (Schaum's Outline Series), Tata McGraw Hill, 2010

**Reference Book(s):**

1. Bhag Singh Guru and Huseyin R. Hiziroglu "Electromagnetic field theory fundamentals",Cambridge University Press; Second Revised Edition, 2009.
2. . Ashutosh Pramanik, 'Electromagnetism – Theory and Applications', PHI Learning Private Limited, New Delhi, Second Edition-2009

**Online Resources:**

1. http://alumni.media.mit.edu/~aggelos/papers/EM_Hayt_6th.pdf
2. https://nptel.ac.in/courses/108/106/108106073/

**Web Resources:**

1. https://www.youtube.com/watch?v=pGdr9WLto4A&list=PLl6m4jcR_DbOx6s2toprJQx1MORqPa9rG
2. https://www.youtube.com/watch?v=G5P6dInMTFg&list=PLuv3GM6-gsE3-hVNaw-YEb7EeY5XVPZdz

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2005 | INDUCTION MOTORS AND SYNCHRONOUS MACHINES | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | hrs | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To understand the Constructional details, principle of operation and the importance of slip in Induction motor operation
2. To understand the slip-torque characteristics and torque calculations of Induction motor
3. To understand the methods of starting and speed control of Induction motor
4. To understand the construction and principle of working of synchronous machines
5. To understand the different methods of predetermining the regulation of alternators
6. To understand the concepts and computation of load sharing among alternators in parallel.
7. To understand the performance characteristics of synchronous motors and their use as synchronous condensers for power factor improvement.
8. To understand the different types of single phase motors and special motors used in house hold appliances and control systems.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | To acquire the basic knowledge of construction, working and operation of induction motor. |
| **CO 2** | Identify different speed controlling techniques of Induction motor for the given application. |
| **CO 3** | To impart knowledge on Construction and performance of salient and non – salient type synchronous generators and determine how several alternators running in parallel share the load on the system. |
| **CO 4** | Analyze the performance characteristics of synchronous motors. |
| **CO 5** | To impart knowledge on Construction, principle of operation and performance of single phase induction motors and special machines. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 1 | | | | | | | | | | 2 | 2 |
| **CO2** | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| **CO3** | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| **CO4** | 3 | 2 | 1 | | | | | | | | | | 2 | 2 |
| **CO5** | 3 | 2 | 1 | | | | | | | | | | 2 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

## COURSE CONTENT

### MODULE – 1

Polyphase Induction Motors-Constructional Details of Cage and Wound Rotor Machines, Production of Rotating Magnetic Field, Principle of Operation, Slip, Rotor Emf and Rotor Frequency, Rotor Reactance, Rotor Current and Power factor at Standstill and under running

| |
|---|
| conditions, Rotor Power Input, Rotor Copper Loss and Mechanical Power Developed and Their Inter Relationship. |
| At the end of the Module 1, students will be able to:<br>▪ Able to Analyze Production of Rotating Magnetic Field.<br>▪ Able to understand Cage and Wound Rotor Machines. |
| **MODULE -2** |
| Torque Equation, Expressions for Maximum Torque and Starting Torque, Torque Slip Characteristic, Load characteristics, Equivalent Circuit, Phasor Diagram, Crawling and Cogging, Circle Diagram, No Load and Blocked Rotor Tests-Predetermination of Performance.<br>Starting Methods and Starting Current and Torque Calculations, Speed Control-Change of Frequency; Pole Changing and Methods of Consequent Poles; Cascade Connection. Injection of an Emf. |
| At the end of the Module 2, students will be able to:<br>▪ Able to Analyze Torque Slip Characteristics<br>▪ Able to understand Starting Methods of Induction Motors |
| **MODULE-3** |
| Principle and Constructional Features of Salient Pole and Round Rotor Machines – Armature Windings, E.M.F Equation- Armature reaction – Voltage Regulation Methods, Power Flow Equation in Alternators – Synchronizing Power and Torque – Parallel Operation and Load Sharing – Effect of Change of Excitation and Mechanical Power Input – Determination of Sub-Transient, Transient and Steady State Reactances. |
| At the end of the Module 3, students will be able to:<br>▪ Able to understand the construction and principle of operation of synchronous generators.<br>▪ Able to understand the Voltage Regulation Methods.<br>▪ Able to understand the parallel operation of synchronous generators.<br>▪ Able to understand the Sub-Transient, Transient and Steady State Reactances. |
| **MODULE-4** |
| Synchronous Motors Operation – Phasor Diagram – Power Flow Equations in Synchronous Motors- Variation of Current and Power Factor with Excitation – V and Inverted V Curves – Synchronous Condensers – Hunting, and Methods to Eliminate Hunting – Starting Methods of Synchronous Motor. |
| At the end of the Module 4, students will be able to:<br>▪ Able to understand the operation of synchronous motors.<br>▪ Able to understand the Starting Methods of Synchronous Motor. |
| **MODULE-5** |
| Single Phase Induction Motors - Constructional Features – Double Revolving Field Theory-Elementary Idea of Cross Field Theory – Split Phase Motors – Capacitor Start and Run Motors – Shaded Pole Motor. Principle and Performance of A.C Series Motor - Universal Motor – Single Phase Synchronous Motors – Reluctance Motor – Hysteresis Motor – Stepper Motor. |
| At the end of the Module 5, students will be able to:<br>▪ Able to understand the operation of Single Phase Induction Motors.<br>▪ Able to understand the special Electrical Machines. |
| **Total hours: 48 hours** |

**Term work:**

Synchronous machines & Induction machines- Power plants & Industrial visits.

**Content beyond syllabus:**

1. Advanced Speed Control methods for Poly phase Induction Motors.
2. Two Reaction Theory –Determination of Xd and $X_q$ (Slip Test).
3. Principle of operation and control of Brushless DC motor.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | 3-phase Induction Motors | CO1 | https://nptel.ac.in/courses/108/102/108102146/ |
| 2 | Circle Diagram | CO2 | https://nptel.ac.in/courses/108/105/108105131/ |
| 3 | Synchronous Generator | CO3 | https://www.youtube.com/watch?v=b24jORRoxEc |
| 4 | Parallel operation of Alternators | CO4 | https://www.youtube.com/watch?v=aZR7JsH9QnM |
| 5 | Synchronous motor | CO5 | https://www.youtube.com/watch?v=fdMIuEqh48M&list=PLPpCFgQP7QKHSJQnSwaigL89gshecycXs |
| 6 | Single Phase Induction motors | CO6 | https://nptel.ac.in/courses/108/102/108102146/ |

**Text Book(s):**


1. Electrical Machinery, P.S. Bimbhra, Khanna Publishers, 7th Edition, 2011.
2. Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
3. Electrical Machines, S K Bhattacharya, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2014, 3rd Reprint 2015.


**Reference Book(s):**


1..Electric Machines 4th edition, D.P.Kothari and I.J. Nagrath, Mc Graw Hill Education (India) Pvt. Ltd., 4th Edition, 2010, 16th Reprint 2015.
2.A. E. Fitzgerald and C. Kingsley, "Electric Machinery", New York, McGraw Hill Education, 2013.
3. A. E. Clayton and N. N. Hancock, "Performance and design of DC machines", CBS Publishers, 2004.


**Online Resources:**

1. http://175.101.102.82/moodle/
2. https://www.accessengineeringlibrary.com/
3. https://www.slideshare.net/
4. https://easyengineering.net/electrical-machinery-by-bimbhra/
5.https://books.google.co.in/books?id=dh_gDwAAQBAJ&lpg=PR1&dq=electrical%20machines%20by%20kothari%202020&pg=PR8#v=onepage&q&f=false

**Web Resources:**

1. https://electrical-engineering-portal.com/
2. https://www.electrical4u.com/
3. http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Sadhya/experimentlist.html
4. https://www.engineering.com/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2006 | LINEAR CONTROL SYSTEMS | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | CS | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Basics concepts of Electrical Circuits & Basics of Laplace transform

**Course Objectives:**

1. To understand the merits and demerits of open and closed loop control systems
2. To understand the mathematical modeling of Electrical and mechanical control systems
3. To understand the step response of second order control systems
4. To plot Root locus for the given system transfer function
5. To understand the stability analysis from Bode plot, polar plots
6. To understand the state space analysis

**Course Outcomes**: After successful completion of the course, the student will be able to:

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|---|---|
| **CO 1** | Determine the transfer function for the given electrical or mechanical systems and also determine the transfer function of a system using block diagram reduction techniques and Mason's gain formula |
| **CO 2** | Analyze the system behaviour in time domain and step response to various dampings. |
| **CO 3** | Determine the stability of given system by applying Routh's stability criteria. |
| **CO 4** | Analyze the stability of given system by means of Bode plot and polar plot |
| **CO 5** | Determine the state model and assessment of controllability & observability from the given transfer function. |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO2** | 2 | 1 | | | | | | | | | | | 3 | 2 |
| **CO3** | 2 | 1 | | | | | | | | | | | 3 | 2 |
| **CO4** | 2 | 1 | 1 | | | | | | | | | | 3 | 2 |
| **CO5** | 2 | 1 | 1 | | | | | | | | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

**COURSE CONTENT**

**MODULE – 1**

Examples & Classification of control systems, merits and demerits of Open Loop and closed loop control systems, Effects of positive and negative feedback**.** (3H)

Mathematical modelling and transfer function of Electrical and Mechanical systems, Analogous systems, modelling of DC motor(4h)

Block diagrams: Block diagram representation of control systems, Block Diagram Reduction Rules .(4h)

Signal flow graph: Definitions, Reduction using Mason's gain formula.(3h)

Control System Components: DC Servo motor, AC Servo motor , Synchro Transmitter & Receiver (2h)

At the end of the Module 1, students will be able to:

1. Identify the difference between open loop and closed loop systems
2. Understand the effect of feedback on system performance

| |
|---|
| 3. Model the given electrical or mechanical control system<br>4. Apply the block diagram reduction to simplify the given system<br>5. Apply the Signal flow graph reduction to simplify the given system<br>6. Derive the transfer function of Ac and DC servo motor |
| **MODULE-2** |
| Time Response Analysis: Standard test signals, Time response of first order and second order un damped, under damped, critically damped and over damped systems, Time domain specifications. (5h)<br>Error Analysis**:** Steady state Error**,** static error coefficient of type 0,1, 2 systems (2h) |
| At the end of the Module 2, students will be able to:<br>1. Identify the importance of basic test signals<br>2. Analyze the Time response of second order system with different dampings<br>3. compute steady state error for the given system for any input signal. |
| **MODULE-3** |
| Stability: The concept of stability, Routh's stability criterion, limitations of Routh's stability.(4h)<br>Root locus plot: The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci. (5h) |
| At the end of the Module 3, students will be able to:<br>1. Understand various stability issues<br>2. Apply Routh's stability criteria to given system for stability assessment<br>3. Draw Root locus plot for the given system |
| **MODULE-4** |
| Frequency Response Analysis :Introduction, Frequency domain specifications, Bode plot, polar plot, Transfer function from the Bode Diagram, Stability Analysis from Bode Plots. Polar Plots, Nyquist Plots. (6h)<br>Compensation Techniques: Lag, Lead, Lag-Lead Compensators.(3h) |
| At the end of the Module 4, students will be able to:<br>1. Understand various frequency domain specifications.<br>2. Draw the Bode plot for the given system.<br>3. Determine the stability of given system from Bode plot and polar plot |
| **MODULE-5** |
| State Space Analysis<br>Introduction: Concepts of state, state variables and state model, derivation of state models from differential equations, Diagonalization. (5h)<br>Solution of state equation: Solving the Time invariant state Equations, State Transition Matrix and it's Properties. (2h)<br>The concepts of controllability and observability. (2h) |
| At the end of the Module 5, students will be able to:<br>1. Understand the importance of state space analysis<br>2. Find the state model for the given transfer function through various techniques.<br>3. Determine the controllability and observability of given state model. |
| **Total hours: 48 hours** |

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|---|
| **Term work:** Tutorials & quizzes |
| **Content beyond syllabus:**<br>**1.** Introduction to P,PI,PID controllers. |

**2.** State space representation of Armature and Field controlled DC motor.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Open Loop and closed loop control systems | CO1 | https://www.tutorialspoint.com/control_systems/control_systems_introduction.htm |
| 2 | Block diagram rules | CO2 | https://www.tutorialspoint.com/control_systems/control_systems_block_diagram_algebra.htm |
| 3 | Time response of second order system | CO3 | https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm |
| 4 | Routh's stability criteria | CO4 | https://www.tutorialspoint.com/control_systems/control_systems_stability_analysis.htm |
| 5 | Frequency domain specifications | CO5 | https://www.tutorialspoint.com/control_systems/control_systems_frequency_response_analysis.htm |
| 6 | Controllability and observability | CO6 | https://www.tutorialspoint.com/control_systems/control_systems_state_space_analysis.htm |

**Text Book(s):**

1. " Control Systems Engineering, I. J. Nagrath and M. Gopal, New Age International Publishers, 5th edition, 2007, Reprint 2012.
2. Control Systems by A. Anand Kumar, PHI Learning pvt. Ltd., second edition

**Reference Book(s):**

1. Norman S. Nise, "Control Systems Engineering", John Wiley & Sons PTE Ltd, 2013
2. 3. Modern Control Engineering, Katsuhiko Ogata, PEARSON, 1st Impression 2015.

**Online Resources:**

1. http://www.aoengr.com/SampleBook.pdf
2. http://www.ent.mrt.ac.lk/~rohan/teaching/EN5001/Reading/DORFCH1.pdf

**Web Resources:**

1. https://nptel.ac.in/courses/107/106/107106081/
2. https://www.tutorialspoint.com/control_systems/index.htm
3. https://www.youtube.com/watch?v=XYbrgwKP_6k

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2007 | **POWER GENERATION & TRANSMISSION** | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Basic concepts of electrical circuits and theorems

**Course Objectives:**

1. To understand the Structure, essential components and their layout in thermal power station
2. To study various aspects and issues involved in Nuclear power generation
3. To understand the electrical power generation from renewable energy sources as sun, wind and ocean
4. To understand the Calculation of different transmission line parameters and their use.
5. To understand the various effects in transmission system and Modeling of transmission line
6.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the working principle and operation of thermal power plant.(BL=2) |
| **CO 2** | Understand the working principle and operation of hydro & Nuclear power plant.(BL=2) |
| **CO 3** | Understand the working principle and operation of various Renewable energy sources.(BL=2) |
| **CO 4** | Analyze and compute the transmission line parameters.(BL=3) |
| **CO 5** | Analyze the performance of transmission Lines(BL=3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | 2 | 2 | | | | | | | | | | 2 | 2 |
| **CO2** | 2 | 2 | 1 | | | | | | | | | | 1 | 2 |
| **CO3** | 2 | 3 | | | | | | | | | | | 3 | 2 |
| **CO4** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO5** | 2 | 3 | 1 | | 1 | | | | | | | | 1 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **THERMAL POWER GENERATING SYSTEMS** | **8 hrs** |
|---|---|---|

Importance of electrical power generation-Sources of energy-Conventional and non-conventional sources-Block Diagram of Thermal Power Station (TPS) - Brief Description of TPS Components: Economizers, Boilers, Super Heaters, Turbines, Condensers, Chimney and Cooling Towers-Environmental Impact of Thermal power plants.

At the end of the Module 1, students will be able to:

1. illustrate, the operation of thermal power plant (BL=2)
2. understand the concept and layout of thermal power plant (BL=2)
3. Explain the operation of each component in thermal power plant (BL=2)

| MODULE -2 | HYDRO & NUCLEAR POWER GENERATING SYSTEMS | 8 hrs |
|---|---|---|

**Hydro Power:** Merits and demerits of hydroelectric power plants, Selection of site. General arrangement of hydel plant, Classification of the plants based on water flow regulation, water head and type of load the plant has to supply. Water turbines – Pelton wheel, Francis, Kaplan and propeller turbines. Underground, small hydro and pumped storage plants.

**Nuclear Power Plants**: Introduction, Merits and demerits, selection of site, Nuclear reaction, Nuclear fuels, Nuclear plant and layout, Nuclear reactor and its control, Effects of nuclear plants, Disposal of nuclear waste and effluent, shielding.

At the end of the Module 2, students will be able to:

1. Understand the concept of layout and design aspects of hydro &nuclear power plant. (BL=2)
2. Explain the required flow of river water, cost of generation and number of units generated in hydel power generation (BL=2)
3. Illustrate, the operation of nuclear power plant (BL=2)

| MODULE-3 | RENEWABLE POWER GENERATING SYSTEMS | 10 hrs |
|---|---|---|

**Solar Power Generation**: Introduction, Solar Cell Fundamentals, Solar Cell Characteristics, Solar Cell Classification, Maximizing the Solar PV Output and Load Matching. Maximum Power Point Tracker, Solar PV Systems, Solar PV Applications.

**Wind Power Generation**: Introduction – Basic principles of wind energy conversion power in the wind-Forces on blades and thrust on turbines

**Bio Energy:** Introduction – Biomass conversion technologies – Bio gas generation – Factors affecting bio digestion or generation of gas.

At the end of the Module 3, students will be able to:

1. Explain the working principle of PV cell and applications of solar energy. (BL=2)
2. Understand the electric power generation from renewable energy sources like Biomass,Ocean,Geothermal(BL=2)
3. select best renewable energy power generating system (BL=2)

| MODULE-4 | TRANSMISSION LINE PARAMETERS | 10 hrs |
|---|---|---|

Types of Conductors, Resistance For Solid Conductors – Skin Effect- Calculation of Inductance for Single Phase and Three Phase, Concept of GMR & GMD, Symmetrical and Asymmetrical Conductor Configuration with and without Transposition, Numerical Problems, Capacitance Calculations for Symmetrical and Asymmetrical Single and Three Phase, Effect of Ground on Capacitance, Numerical Problems.

At the end of the Module 4, students will be able to:

1. Explain Inductance & Capacitance for given transmission system(BL=2)
2. Understand GMR & GMD for given transmission system(BL=2)
3. Identify the importance of transposition of asymmetrical transmission lines(BL=4)

| MODULE-5 | PERFORMANCE OF TRANSMISSION LINE | 12 hrs |
|---|---|---|

**Insulators:** Types of Insulators, String Efficiency and Methods for Improvement, and numerical problem.

**Corona:** Corona Phenomenon, Factors Affecting Corona, Critical Voltages and Power Loss, Radio Interference and numerical problem..

| |
|---|
| **Sag and Tension Calculations:** Sag and Tension Calculations with Equal and Unequal Heights of Towers, Effect of Wind and Ice on Weight of Conductor, Stringing Chart, Sag Template and numerical Problems. Classification of Transmission Lines - Short, Medium and Long Lines and Their Exact Equivalent Circuits- Nominal-T, Nominal-π. Mathematical Solutions to Estimate Regulation and Efficiency of All Types of Lines. Long Transmission Line-Rigorous Solution, Evaluation of A,B,C,D Constants, Interpretation of the Long Line Equations |
| At the end of the Module 5, students will be able to:<br>1. Understand various factors in transmission system(BL=2)<br>2. Illustrate the factors affecting corona(BL=2)<br>3.Illustrate types of Insulators (BL=2) |

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Content beyond syllabus:**

1. Betz criterion, wind energy Applications.
2. Underground Cables

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | Reference |
|---|---|---|
| 1 | Thermal power plant | https://swayam.gov.in/nd1_noc19_me63/preview |
| 2 | Hydro power plant | https://nptel.ac.in/content/storage2/courses/105105110/pdf/m5l01.pdf |
| 3 | Renewable energy sources | https://nptel.ac.in/content/storage2/courses/113104058/mme_pdf/Lecture1.pdf |
| 4 | Transmission Line Parameters | https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49<br>https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=9 |
| 5 | Performance Of Transmission Line | https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=51<br>https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=6<br>https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=13<br>https://www.youtube.com/watch?v=_iz8ZkjD7z8 |
| 6 | Modeling of | https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=50 |

| | | |
|---|---|---|
| | Transmission Lines | https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=12<br>https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=14<br>https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49 |

**Text Book(s):**

1. Power System Engineering by M.L.Soni, P.V.Gupta, U.S.Bhatnagar and A.Chakraborti, Dhanpat Rai & Co. Pvt. Ltd., 1999
2. Non Conventional Energy Sources by G.D. Rai, Khanna Publishers, 2000.

**Reference Book(s):**

1. Principles of power systems by V.K.Mehta,Rohith Mehta S.Chand(P), 4th Edition
2. "Generation of Electrical Energy"- by B.R Gupta-S.Chand Publications,6th Edition(Reprint 2014)
3. Electrical Power Systems for Industrial Plants, Kamalesh Das, JAICO Publishing House, 2008.
4. Electrical power systems, C.L.Wadhwa, New Age International (P) Limited, 6th Edition, 2010, Reprint 2014.

**Online Resources/ Web References:**

1. https://b-ok.asia/book/3429304/c1e86f
2. https://b-ok.asia/book/2729267/f90c96
3. http://www.acadmix.com/eBooks_Download
4. file:///C:/Users/DELL/Downloads/Electric%20Power%20Generation,%20Transmission,%20and%20Distribution%20%20(%20PDFDrive.com%20).pdf
5. http://nptel.ac.in/course
6. https://freevideolectures.com/course/2342/energy-resources-and-technology
7. https://nptel.ac.in/courses/108/102/108102047/
8. https://nptel.ac.in/courses/108/107/108107112/

# NARAYANA ENGINEERING COLLEGE:GUDUR

| 20EE2503 | **ANALOG ELECTRONIC CIRCUITS AND SIMULATION LAB** | | | | | | | R2020 |
|---|---|---|---|---|---|---|---|---|
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 2 | 32 | 1 | 40 | 60 | 100 |

**Pre-requisite: Basic knowledge on amplifiers and oscillators.**

**Course Objectives:**

1. Analyze amplifiers for frequency response
2. Analyze feedback circuits, amplifier circuits and oscillator circuits
3. Design and construct simple electronic circuits to accomplish a specific function, e.g., designing amplifiers

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Measure various parameters of analog circuits and compare experimental results in the laboratory with theoretical analysis. **(BL-3)** |
| **CO 2** | Analyze negative feedback amplifier circuits, oscillators, Power amplifiers, Tuned amplifiers.**(BL-4)** |
| **CO 3** | Design analog electronic circuits using discrete components **(BL-3)** |
| **CO 4** | Design RC and LC oscillators, Feedback amplifier for specified gain and multistage amplifiers for Low, Mid and high frequencies. **(BL-3)** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | | | | | | | | | | 1 | | | | |
| CO2 | 2 | 2 | | | 2 | | | | | 1 | 1 | | | 1 |
| CO3 | 2 | 2 | 2 | 1 | 2 | | | | | 1 | 1 | | 1 | 1 |
| CO4 | | | 2 | | 2 | | | | | 1 | 1 | | 1 | 1 |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task-1 : COMMON EMITTER AMPLIFIER** | |
| **Objective:** Design voltage divider based Common Emitter amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response. | CO1 |
| **Task-2 : COMMON COLLECTOR AMPLIFIER** | |
| **Objective:** Design voltage divider based Common collector amplifier with discrete components and calculate the bandwidth of amplifier from its frequency response. | CO 1 |
| **Task-3: RC COUPLED AMPLIFIER** | |
| **Objective:** Design two stage RC coupled amplifier for given specifications. Determine Gain and Bandwidth from its frequency response curve. | CO 1 |
| **Task-4: CE-CB CASCODE AMPLIFIER** | |
| **Objective:** Design CE – CB Cascode amplifier. Determine Gain and Bandwidth from its frequency response curve. | CO 2 |
| **Task-5 : VOLTAGE SERIES FEEDBACK AMPLIFIER** | |
| **Objective:** Design voltage series feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier. | CO 2 |
| **Task-6 : VOLTAGE SHUNT FEEDBACK AMPLIFIER** | |
| **Objective:** Design voltage shunt feedback amplifier for the given specifications. Determine the effect of feedback on the frequency response of a voltage series feedback amplifier | CO 2 |
| **Task-7: CURRENT SHUNT FEEDBACK AMPLIFIER** | |
| **Objective:** Design and simulate current shunt feedback amplifier for the given specifications using PSPICE /Multisim. Determine the effect of feedback on the frequency response of a current shunt feedback amplifier. | CO 2 |

| | |
|---|---|
| **Task-8: CURRENT SERIES FEEDBACK AMPLIFIER** | |
| **Objective:** Design and simulate current Series feedback for the given specifications using PSPICE /Multisim. Determine the effect of feedback on the frequency response of a current series feedback amplifier. | CO 2 |
| **Task-9: RC PHASE SHIFT OSCILLATOR** | |
| **Objective:** Design and simulate RC Phase shift oscillator for the given specification using PSPICE /Multisim. Determine the frequency of oscillation using simulation tool. | CO 4 |
| **Task-10 : HARTLEY AND COLPITTS OSCILLATORS** | |
| **Objective:** Design and simulate Hartley and Colpitts oscillators for the given specifications using PSPICE /Multisim. Determine the frequency of oscillation using simulation tool. | CO 4 |
| **Task-11: CLASS-A POWER AMPLIFIER** | |
| **Objective:** Design and simulate class A power amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms. | CO 2 |
| **Task-12: CLASS-B PUSH PULL AMPLIFIER** | |
| **Objective:** Design and simulate class B push-pull amplifier using PSPICE /Multisim, find out the efficiency and Plot the output waveforms. | CO 2 |

| | |
|---|---|
| **Additional Experiments:** | |
| **Task-13: WEIN BRIDGE OSCILLATOR** | |
| **Objective:** Design Wien bridge oscillator for the given specification. Determine the frequency of oscillation. | CO 3 |
| **Task-14 : MONO STABLE MULTIVIBRATOR** | |
| **Objective:** Design and simulate Mono Stable Multivibrator for the given specifications using PSPICE /Multisim. | CO 3 |
| **Virtual Labs:**<br>1. http://vlabs.iitkgp.ac.in/tcad/exp10/index.html#<br>2. http://vlab.amrita.edu/index.php?sub=1&brch=201 | |

**Text Book(s):**

1. Introduction to PSPICE Using OrCAD for Circuits and Electronics by Rashid Muhammad H
2. PSPICE and MATLAB for electronics: An integrated approach by John o. Attia
3. Fundamentals of Electronic Circuit Design, Getting Started: MultiSim Textbook Edition byDavid J. Comer, Donald T. Comer.

**Reference Book(s):**

1. A Guide to Circuit Simulation and Analysis Using PSPICE by Paul W. Tuinenga
2. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits Theory" Pearson/Prentice Hall, 9th Edition, 2006.
3. Sedra A.S. and K.C. Smith, "Micro Electronic Circuits", Oxford University Press, 5th Edition.

**Web References:**

1. https://nptel.ac.in/courses/122/106/122106025/
2. https://www.tutorialspoint.com/semiconductor_devices/index.htm
3. https://www.allaboutcircuits.com/textbook/semiconductors/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2504 | **INDUCTION MACHINES AND SYNCHRONOUS MACHINES Lab** | | | | | | | R2020 |
| II-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To find the performance of induction motor by calculating the efficiency.
2. To find direct and quadrature axis reactances of synchronous motor.
3. To find voltage regulation by using various methods on synchronous machine
4. To determine 'v' and 'inverted v' curves of synchronous motor.
5. To find the efficiency and power factor from circle diagram byconducting no load and blocked rotor test on 3-phase induction motor.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Find the performance characteristics of the 3-phase induction motor. |
| **CO 2** | Draw the direct and quadrature axis reactance and regulation of synchronous machine. |
| **CO 3** | To Know the Equivalent Circuit Parameters of a Single Phase Induction Motor |

| Course | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | 3 | 3 | 3 | 2 | 2 | | | | 2 | 2 | | 3 | 3 | 3 |
| **CO 2** | 3 | 3 | 3 | 2 | 2 | | | | 2 | 2 | | 3 | 3 | 3 |
| **CO 3** | 3 | 2 | 3 | 2 | 2 | | | | 2 | 2 | | 3 | 3 | 3 |

**List of Experiments Prescribed and Conducted:**

1. Conduct Brake test on 3-phase induction motor.
2. Determination of Xd and Xq of a Salient Pole Synchronous Machine
3. Equivalent Circuit of a Single Phase Induction Motor
4. Conduct no load and blocked rotor test on 3-phase squirrel cage induction motor
5. Regulation of a Three –Phase Alternator by using Synchronous Impedance Method.
6. Regulation of a Three –Phase Alternator by using M.M.F.Method.
7. Regulation of a Three –Phase Alternator by using ZPF.Method.
8. Regulation of a Three –Phase Alternator by using ASA.Method.
9. Conduct an experiment to draw V and Λ curves of synchronous motor at no load and load conditions.
10. Separation of Core Losses of a Single Phase Transformer.

**Total hours: 30 hours**

# SEMESTER V

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2008 | PC | Digital Electronics and logic design | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2009 | PC | Power Distribution & Distributed Generation | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2010 | PC | Power Electronics | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open elective II | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4001 -05 | PE | Professional Elective I | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2505 | PC | Control Systems and Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20EE2506 | PC | Power Electronics & Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6003 | SC | Career competency Development III | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6003 | SC | Value added course/Certificate Course III | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| 20EE7501 | PR | Internship/skill development Training I | 0 | 0 | 0 | 0 | 1.5 | 00 | 100 | 100 |
| 20MC800 2-12 | MC | Mandatory course III | 2 | 0 | 0 | 2 | 0 | 00 | 00 | 00 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 11 | 29 | 21.5 | 360 | 640 | 1000 |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2008 | **Digital Electronics & Logic Design** | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Basic knowledge on number system and algebra.

**Course Objectives:**

To study the basic concepts of number systems and binary codes.

To minimize Boolean expressions using map and Q-M method.

To design combinational and sequential circuits.

To familiarize Registers &counters using Flip-Flops.

To understand the concept of memory organization

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Use number systems, binary codes and Boolean algebra to implement digital circuits. (BL-3) |
| **CO 2** | Apply minimization techniques on Boolean expressions. (BL-3) |
| **CO 3** | Design combinational circuits using logic gates. (BL-3) |
| **CO 4** | Analyze synchronous sequential circuits. (BL-4) |
| **CO 5** | Classify the memories & programmable logic devices. (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 1 | | | | | | | | | | 2 | |
| **CO2** | 3 | 3 | 3 | 1 | | | | | | | | | 2 | |
| **CO3** | 3 | 3 | 3 | 1 | | | | | | | | | 2 | |
| **CO4** | 3 | 1 | 2 | | | | | | | | | | 3 | |
| **CO5** | 2 | 2 | | | | | | | | | | | 2 | |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **NUMBER SYSTEMS & BOOLEAN ALGEBRA** | **10 h** |
|---|---|---|

Number Systems: Introduction, Number Systems, Number base conversions, 1's and 2's Complements, BCD code, Excess -3 codes, Gray code, ASCII code, Error Detection and Correction Codes. Boolean Algebra: Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, Logic gates, implementation of Boolean functions using logic gates

At the end of the Module 1, students will be able to:

1. List number systems. (BL-1)
2. Illustrate different code conversions. (BL-2)
3. List Theorem's and properties of Boolean algebra (BL-1)
4. Explain the functionality of logic gates(BL-2)

| **MODULE -2** | **SIMPLIFICATION OF BOOLEAN FUNCTIONS** | **10 h** |
|---|---|---|

Introduction, Karnaugh map simplification, Don't care conditions, Prime Implicants, Quine-McCluskey method Simplification, NAND & NOR Implementations, Two Level Implementations.

At the end of the Module 2, students will be able to:

1. Apply basic laws and De Morgan's theorems to simplify Boolean expressions(BL-3)
2. Explain map and Q-M method to minimize Boolean expressions. (BL-2)
3. Implement Boolean expression using universal gates. (BL-3)
4. Implement Boolean expression using two level methods. (BL-3)

| MODULE-3 | COMBINATIONAL CIRCUITS | 9 h |
|---|---|---|
| Introduction, Design Procedure, Adders, Sub tractor, Binary Adder-Sub tractor, BCD Adder, Binary Multiplier, Magnitude Comparator, Multiplexers, De-multiplexers, Decoders, Encoders and Code Converters. | | |
| At the end of the Module 3, students will be able to:<br>1. Design combinational logic circuits. (BL-3)<br>2. Implement Boolean expression using multiplexer. (BL-3)<br>3. Implement higher order MUX using lower order MUX.(BL-3)<br>4. Design code converters using gates. (BL-3) | | |
| **MODULE-4** | **SEQUENTIAL CIRCUITS** | **10 h** |
| Introduction, Latches, Flip-flops, Master-slave flip flops, Edge-triggered flip-flops, Flip-Flop conversions, Design of Synchronous Sequential Circuits: State Equations, State Table, State reduction, State assignment, State diagram , Mealy and Moore machine models, Registers, Shift Registers, Counters: Synchronous counters, Asynchronous counters & other counters. | | |
| At the end of the Module 4, students will be able to:<br>2. Describe behavior of latches & flip flops. (BL-2)<br>3. Analyze the flip-flop conversions(BL-3)<br>4. Analyze synchronous sequential circuits. (BL-3)<br>5. Explain the design procedure of sequential circuits(BL-2)<br>6. Design synchronous sequential circuits using state reduction & assignment process. (BL-3) | | |
| **MODULE-5** | **MEMORY &PROGRAMMABLE LOGIC DEVICES** | **9 h** |
| Introduction, Random Access Memory, Types of RAM, Memory decoding, Read Only Memory, Types of ROM, Flash memory, Programmable Logic Devices (PLDs): Basic concepts, Programmable Read Only Memory (PROM), Programmable Array Logic (PAL) and Programmable Logic Array(PLA). | | |
| At the end of the Module 6, students will be able to:<br>1. Explain PROM, PAL and PLA. (BL-2)<br>2. Compare digital logic families. (BL-2)<br>3. Illustrate the characteristics of digital IC's . (BL-2) | | |
| | **Total hours:** | **48 hours** |

**Content beyond syllabus:**

1. Representation of signed & unsigned binary numbers in digital computer
2. Binary subtraction operation using 1's and 2's complement methods in digital circuits

**Self-Study:**

Contents to promote self-Learning:

| SNO | Module | Reference |
|---|---|---|
| 1 | Number systems | https://www.geeksforgeeks.org/digital-electronics-logic-design-tutorials/ |
| 2 | Simplification of Boolean functions | https://www.electrical4u.com/simplifying-boolean-expression-using-k-map/<br>https://www.electronicshub.org/k-map-karnaugh-map |
| 3 | Combinational circuits | https://www.allaboutcircuits.com/textbook/digital/ |
| 4 | Sequential Circuits | https://www.electronics-tutorials.ws/sequential/seq_1.html<br>https://technobyte.org/counters-up-down-synchronous-asynchronous/ |
| 5 | Programmable logic devices | https://www.tutorialspoint.com/digital_circuits/digital_circuits_programmable_logic_devices.htm |

**Text Book(s):**


1. M. Morris Mano, M.D. Ciletti, "Digital Design", 5th edition, Pearson, 2018.
2. John F Wakely Digital Design Principles And Practices, Pearson Publication , Fourth edition
3. Anil K. Maini, "Digital Electronics: Principles, Devices and Applications", Willey, 2007

**Reference Book(s):**


1. Anand Kumar, Switching Theory and Logic Design, PHI,2008
2. John. M Yarbrough, “Digital Logic Applications and Design”, Thomson Learning, 2006.
3. R. P. Jain, "Modern Digital Electronics", 4th edition, McGraw Hill Education (India Private Limited), 2012.


**Online Resources / Web References:**

1. https://nptel.ac.in/courses/108/105/108105113/ (IIT- Kharagpur – digital Circuits)
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-004-computation-structures-spring-2017/c4/
3. https://nptel.ac.in/courses/106/105/106105185/(IIT- Kharagpur – Switching Circuits and Logic Design)
4. https://www.researchgate.net/publication/264005171_Digital_Electronics
5. https://www.academia.edu/37445384/Anil_K._Maini_Digital_Electronics_Principles_01.04.16.pdf
6. https://intuitionke.weebly.com/uploads/1/1/8/2/118271274/digital_principles_switching_theory.pdf
7. https://www.javatpoint.com/digital-electronics

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2009 | **POWER DISTRIBUTION & DISTRIBUTED GENERATION** | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | PD&DG | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To illustrate the Necessity of distributed generation
2. To Understand different renewable energy sources
3. To Understand the control aspects & Power quality issues of DG's
4. To understand the structure of Electrical distribution system and various factors
5. To understand the technical issues of substations such as location, ratings & Bus bar arrangements

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | **Compare the advantages & disadvantages** of various distributed generation**.** |
| **CO 2** | **Describe various Distributed Generation systems, Micro-grid** and storage devices |
| **CO 3** | **Illustrate the Economic and control aspects** of DGs |
| **CO 4** | **Analyze the different load characteristics, distribution factors & Modelling** of distribution system. |
| **CO 5** | **Design of Distribution Feeders, Voltage Drop and power loss** in D.C Distributors. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | 2 | | 2 | | | | | | | | 3 | 2 |
| CO2 | 2 | 3 | 2 | | 2 | | | | | | | | 3 | 2 |
| CO3 | 3 | 3 | 2 | 1 | 2 | | | | | | | | 3 | 2 |
| CO4 | 2 | 2 | 2 | 1 | 2 | | | | | | | | 3 | 2 |
| CO5 | 2 | 2 | 2 | 1 | 2 | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**Need for Distribution Generation**

Distributed generation, features and operations, advantages and disadvantages of DG, Comparison among the DG Technologies, Non conventional and renewable energy sources. Grid Interconnection-Standards of interconnection, Recent trends in power electronic DG interconnection.

At the end of the Module 1, students will be able to:

1. Understand the advantages & disadvantages of various DGs
2. Understand the Grid Interconnection
3. Identify the recent trends in power electronic DG interconnection

**MODULE -2**

**Distribution Generation Resources**

Introduction - Solar photovoltaic (PV) systems, Photovoltaic power characteristics – Wind energy conversion systems (WECS), power curve, power coefficient, wind energy distribution, Biomass Power, Fuel cells types, types of Tidal power generation schemes, mini and micro hydro power schemes - Storage devices: Batteries Storage, ultra-capacitors, flywheels Control of Micro grids.

At the end of the Module 2, students will be able to:

1. Understand the fundamentals of Various DG sources
2. Illustrate various types of storage devices related to DGs

**MODULE-3**

**Economic and control aspects of DGs**

Market facts, issues and challenges – Limitations of DGs – Voltage control techniques, Reactive power control, Harmonics, Power quality issues – Reliability of DG based systems – Steady state and Dynamic analysis.

At the end of the Module 3, students will be able to:

1. Understand various voltage & reactive power control techniques
2. Understand Power quality issues & Reliability of DG based systems

**MODULE-4**

**INTRODUCTION TO ELECTRICAL DISTRIBUTION SYSTEMS**

Introduction to Distribution Systems, Coincidence Factor, Contribution Factor, Relationship between the Load Factor and Loss Factor, Classification of Loads (Residential, Commercial, Agricultural and Industrial), Load Modeling and Characteristics

**POWER FACTOR IMPROVEMENT:** Causes of Low P.F -Methods of Improving P.F

At the end of the Module 4, students will be able to:

1. Understand the structure of Electrical Distribution System
2. Understand various factors associated with Distribution system
3. Understand the modeling of various types of Loads

**MODULE-5**

**CLASSIFICATION & DESIGN FEATURES OF DISTRIBUTION SYSTEM**

Classification of Distribution Systems - Comparison of DC & AC and Under-Ground & Over -Head Distribution Systems. Voltage Drop and power loss in D.C Distributors.

**SUBSTATIONS AND BUSBAR ARRANGEMENT**

Location of Substations, Classification of Substations, Single Bus Bar, Sectionalized Single Bus Bar, Main and Transfer Bus Bar, One and Half Breaker System.

At the end of the Module 5, students will be able to:

1. Compare DC vs AC and Under-Ground vs Over - Head Distribution Systems
2. Understand the benefits derived through Optimal Location of Substations
3. Understand Various Bus bar arrangements in Substations

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Field work to EHV Substation, Wind & Solar Power plants/ Tutorials/ Quiz's

**Content beyond syllabus:**

1. Distribution Automation

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Distributed Generation | CO1 | https://www.dg.history.vt.edu/ch1/introduction.html |
| 2 | Wind Energy Conversion system | CO2 | https://www.dg.history.vt.edu/ch2/conversion.html<br>https://www.dg.history.vt.edu/ch2/storage.html |
| 3 | Reliability of DG system | CO3 | https://b-ok.asia/book/2941113/af547e |
| 4 | Distribution Systems | CO4 | **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=9** |
| 5 | Classification & Design of DS | CO5 | **https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=51**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=6**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=13**<br>**https://www.youtube.com/watch?v=_iz8ZkjD7z8**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=50**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=12**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=7&lesson=14**<br>**https://onlinecourses.nptel.ac.in/noc18_ee15/unit?unit=5&lesson=49** |

**Text Book(s):**

1. H. Lee Willis, Walter G. Scott , 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. G. Masters, Renewable and Efficient Electric Power Systems, IEEE- John Wiley and Sons Ltd. Publishers, 2nd Edition, 2013.
3. Electric Power Distribution Engineering, Turan Gonen, CRC Press, 3rd Edition,2014.
4. Electric Power Distribution, A.S. Pabla, Tata Mc Graw Hill (India) Pvt. Ltd., 6th Edition, 2011.

**Reference Book(s):**

1. "Fundamentals of renewable energy systems "by D.Mukherjee, S.Chakrabarti, New Age International Publishers.
2. Electrical Power Distribution Systems, V. Kamaraju, Jain Book Depot. 2012.
3. Electrical Power Systems for Industrial Plants, Kamalesh Das, JAICO Publishing House, 2008.

**Online Resources:**

1. https://b-ok.asia/book/1117604/f01d10
2 https://b-ok.asia/book/2729267/f90c96

**Web Resources:**

1. https://nptel.ac.in/courses/108/102/108102047/
2.https://nptel.ac.in/courses/108/107/108107112/
3. https://www.youtube.com/watch?v=ptiaNGkuylY

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2010 | POWER ELECTRONICS | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To understand the various applications of Power electronic devices for conversion, control and conditioning of the electrical power and to get an overview of different types of power semiconductor devices and their dynamic characteristics.
2. To understand the operation, characteristics and performance parameters of controlled rectifiers
3. To study the operation, switching techniques and basics topologies of DC-DC switching regulators
4. To learn the different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | **Describe the operation** of power semiconductor devices |
| **CO 2** | **Illustrate the construction and operation** of silicon controlled rectifier |
| **CO 3** | **Analyze the various uncontrolled rectifiers and design suitable** filter circuits |
| **CO 4** | **Demonstrate** the operation of the DC-DC converters and inverters |
| **CO 5** | **Summarise the operation** of AC controllers. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 2 | 3 | | | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

### MODULE – 1

**Power Semiconductor Devices**

Concept of power electronics, application of power electronics, advantages and disadvantages of power electronics converters, power diodes, power transistors, power MOSFETS, IGBT and GTO, uncontrolled converters.

At the end of the Module 1, students will be able to:

1. Discuss the concept, applications, advantages and disadvantages of power electronics
2. understand the switching phenomenon of various power semiconductor devices

### MODULE -2

| |
|---|
| **Silicon Controlled Rectifier:**<br>Thyristors, brief description of members of Thyristor family with symbol, V-I characteristics and applications of SCR. Two transistor model of SCR, SCR turn on methods, switching characteristics, ratings, gate triggering circuits, different commutation techniques of SCR. |
| At the end of the Module 2, students will be able to:<br>1. understand the switching phenomenon of various members of thyristor family<br>2. Examine the characteristics, turn on & off methods, ratings & protection of SCR |
| **MODULE-3** |
| **Phase controlled converters:**<br>Principle of operation of single phase and three phase half wave, half controlled, full controlled converters with R, R-L and RLE loads, effects of freewheeling diodes and source inductance on the performance of converters. |
| At the end of the Module 3, students will be able to:<br>1. Understand the operation of single phase and three phase converters with all possible loads<br>1. Examine the behaviour of dual converter<br>3. Analyze the performance parameters of converters |
| **MODULE-4** |
| **DC-DC converters and Inverters**<br>Principle of operation, control strategies, step down & step up choppers, types of choppers circuits based on quadrant of operation & commutation technique, Definition, classification of inverters based on nature of input source, wave shape of output voltage, Principle of operation of single phase and three phase bridge inverter with R and R-L loads, |
| At the end of the Module 4, students will be able to:<br>1. Explain the control strategies and operation of different choppers<br>2. Describe the performance of all types choppers.<br>3. Analyze the performance parameters of inverters. |
| **MODULE-5** |
| **AC controllers:**<br>Principle of on-off and phase control, single phase and three phase AC Voltage controllers with R and R-L loads. Principle of operation of cycloconverters, single phase to single phase step up and step down cycloconverters. |
| At the end of the Module 6, students will be able to:<br>1. Differentiate between AC Voltage controllers and cycloconverters<br>2. Explain the operation of AC Voltage controllers and cycloconverters |
| **Total hours: 48 hours** |

| |
|---|
| **Term work:**<br>Development of Multi level Inverter and Rectifier |
| **Content beyond syllabus:**<br>1. Three phase cycloconverters |
| **Self-Study:**<br>Contents to promote self-Learning: |

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | IGBT | CO1 | https://www.youtube.com/watch?v=ekSbhm4l0Go |
| 2 | Commutation techniques of SCR | CO2 | https://www.youtube.com/watch?v=mf-97ZXrOz0<br>https://www.youtube.com/watch?v=h7cu27etdmg<br>https://www.youtube.com/watch?v=WX5G0RHozAs<br>https://www.youtube.com/watch?v=d4sbVc-r7I4 |
| 3 | Three phase converters | CO3 | https://www.youtube.com/watch?v=VYmd3KKfCQQ |
| 4 | Switching mode regulators | CO4 | https://www.youtube.com/watch?v=Q7cTuZIH8IA<br>https://www.youtube.com/watch?v=I0ZbC7uCe9A<br>https://www.youtube.com/watch?v=YiYQjdARZ7I |
| 5 | Resonant Pulse inverters | CO5 | https://www.youtube.com/watch?v=AISpcLLiOPA |

**Text Book(s):**

1. Power Electronics, M.D. Singh and K.B. Khanchandani, Tata Mc Graw Hill. 2007
2. Power Electronics, M.H. Rashid, PHI, 3rd Edition
4. Power Electronics, P.S. Bhimra, Khanna Publishers, 3rd Edition.

**Reference Book(s):**

1. Modern Power Electronics & AC drives, B.K. Bose, Prentice Hall
2. Power Electronics, V.R. Moorthi, Oxford, 2005
3. Power Electronics, Mohan,Undeland & Riobbins, Wiley India
4. Element of power Electronics, Phillip T Krein, Oxford, 2007

**Online Resources:**

1. https://books.google.co.in/books?id=0_D6gfUHjcEC&printsec=frontcover#v=onepage&q&f=false
2. https://nptel.ac.in/courses/108/105/108105066/

**Web Resources:**

1.https://www.youtube.com/watch?v=ZbvWe9xBu3Q&list=PLp6ek2hDcoND7i5-DAD9mPmYF1Wg6ROdO
2. https://www.youtube.com/watch?v=1Auay7ja2oY&list=PLA07ACBDE053A8229

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2505 | **Control systems & Simulation Lab** | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | CSS | TOTAL |
| I-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To provide practical knowledge for Time response of second order system
2. Determine of transfer functions of various systems and control of it by different Methodologies
3. The characteristics of Magnetic Amplifier, servo mechanisms which are helpful in automatic control systems
4. Determine the stability analysis of different system by using PSPICE and MATLAB
5. To study the closed loop performance for the given plant using P, PD, PI, PID Controllers.
6. The design of controllers/compensators to achieve desired specifications.

| | |
|---|---|
| **CO 1** | Determine the transfer functions of various system |
| **CO 2** | Analyse the knowledge about the effect of poles and zeros location on transient and steady state behaviour of second order systems and can implement them to practical systems |
| **CO 3** | Model the systems and able to design the controllers and compensators |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 2 | | | | | | 2 | 2 | | | 3 | 3 |
| **CO2** | 3 | 2 | 2 | | | | | | 2 | 2 | | | 3 | 2 |
| **CO3** | 1 | 2 | 1 | 2 | | | | | 2 | 2 | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

**List of Experiments**

**Any Ten of the following experiments are to be conducted:**

1. Time Response of Second Order System
2. Characteristics of Synchro pair
3. Characteristics of AC Servo Motor

4. Characteristics of DC Servo Motor
5. Transfer Function of DC Machine
6. Characteristics of Magnetic Amplifiers
7. Lag and Lead Compensation – Magnitude and Phase Plot
8. Effect of P, PD, PI, PID Controller on a Second Order System.
9. Temperature Controller Using PID
10. Programmable Logic Controller – Study and Verification of Truth Tables of Logic Gates, Simple Boolean Expressions and Application of Speed Control of Motor.
11. Characteristics of Magnetic Amplifier
12. Simulation of transfer functions using operational amplifier

**Any two simulation experiments are to be conducted:**

1. PSPICE Simulation of Op-Amp Based Integrator and Differentiator Circuits.
2. Linear System Analysis (Time Domain Analysis, Error Analysis) Using MATLAB.
3. Stability Analysis (Bode, Root Locus, Nyquist) of Linear Time Invariant System Using MATLAB
4. State Space Model for Classical Transfer Function Using MATLAB – Verification.

| | |
|---|---|
| **Total hours:** | **36hours** |

**Term work:**

Lab seminars

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Time response of second order system | CO1 | https://www.tutorialspoint.com/control_systems/control_systems_time_response_analysis.htm |
| 2 | Synchro Pair | CO2 | https://circuitglobe.com/synchro.html |
| 3 | AC & DC Servo Motor | CO3 | https://circuitglobe.com/servo-motor.html |
| 4 | Transfer function of DC Machine | CO4 | https://www.eeeguide.com/transfer-function-of-a-field-controlled-dc-motor/ |

| | | | |
|---|---|---|---|
| 5 | Magnetic amplifiers | CO5 | http://www.tubebooks.org/Books/mag_amp.pdf |

**Text Book(s):**

1 . Simulation of Electrical and electronics Circuits using PSPICE - by M.H Rashid, M/S PHI Publications.
2. PSPICE A/D user's manual --Microsim USA
3. MATLAB and its Tool Books yser's manual and - Mathworks, USA

**Reference Book(s):**

1.. PAPICE reference guide -Microsim, USA

**Online Resources:**

1.http://www.acadmix.com/eBooks_Download
2.

**Web Resources:**

1. https://webstor.srmist.edu.in/web_assets/srm_mainsite/files/2017/Control-lab-manual-final.pdf

# NARAYANA ENGINEERING COLLEGE:GUDUR

| 20EE2506 | **Power Electronics & Simulation Lab** | | | | | | | R2020 |
|---|---|---|---|---|---|---|---|---|
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Basic of Electrical circuit**

**Course Objectives:**

The objectives are to study:

1. The characteristics of power electronic devices with gate firing circuits
2. Various forced commutation techniques
3. The operation of single-phase voltage controller, converters and Inverters circuits with R and RL loads
4. Analyze the TPS7A4901, TPS7A8300 and TPS54160 buck regulators

**List of Experiments**

**PART A**

1. Single Phase AC Voltage Controller with R and RL Loads
2. DC Jones Chopper with R and RL Loads
3. Forced Commutation Circuits (Class A, Class B, Class C, Class D and Class E)
4. Buck Convertor
5. Single Phase Parallel Inverter with R and RL Loads
6. Single Phase Series Inverter with R and RL Loads
7. Single Phase Dual Converter with RL Loads
8. Illumination control / Fan control using TRIAC

**NI Multisim Simulation Experiments**:

1. Simulation of Single Phase Half Controlled Converter
2. Simulation of Single Phase Fully Controlled Converter
3. Simulation of PWM Inverter
4. Simulation of Single Phase AC Voltage Controller

**Course Outcomes**:

At the end of the course, students will be able to

1. The student will analyze the characteristics of power semiconductor devices & P Spice Simulation.
2. To Perform Laboratory Experiments practically.
3. To carry out laboratory experiments on simulation & Kits.

**Text Books**

1. Muhammad H. Rashid, Introduction to PSPICE using OrCAD for Circuits and Electronics, Pearson Education, 3rd Edition, 2003.
2. Simulation of Power Electronic Circuits by M. B. Patil , M. C. Chandorkar , V. Ramanarayanan , V.T. Ranganathan.

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO1 | PSO 2 |
| CO1 | 3 | 2 | | | 2 | | | | 2 | 2 | | | 3 | 2 |
| CO2 | 2 | 3 | | | 2 | | | | 2 | 2 | | | 3 | 2 |
| CO3 | 3 | 3 | | | 2 | | | | 2 | 2 | | | 3 | 2 |

1: Low, 2-Medium, 3- High

## SEMESTER VI

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE2011 | PC | Electrical Measurements & Instrumentation | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2012 | PC | Modern Power System Analysis | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2013 | PC | Switch Gear and Protection | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open Elective III | 3 | 0 | 3 | 3 | 3 | 40 | 60 | 100 |
| 20EE4006 -10 | PE | Professional Elective II | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4011 -15 | PE | Professional elective III | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2507 | PC | Measurements & Instrumentation Lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2508 | PC | Power Systems Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6004 | SC | Career competency Development IV | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6004 | SC | Value added course/Certificate course IV | 0 | 1 | 0 | 1 | 1 | 40 | 60 | 100 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 17 | 1 | 13 | 28 | 21.5 | 400 | 600 | 1000 |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2011 | **Electrical Measurements and Instrumentation** | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 2 | 0 | 0 | 32 | 2 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

**1.** The basic principles of different types of electrical instruments for the Measurement of voltage, current, power factor, power and energy.

**2.** The measurement of R, L, and C parameters using bridge circuits.

3.The principles of magnetic measurements.

4.The use of Current Transformers, Potential Transformers, andPotentiometers.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | **Describe** the concepts and principles of Measuring Instruments to measure voltage and current. |
| **CO 2** | **Analyze** the working principles of single and three phase wattmeters & energy meter to measure power and energy in circuits. |
| **CO 3** | **Demonstrate** the concepts and principles of AC and DC bridges to evaluate resistance, inductance and Capacitance for AC and DC Circuits. |
| **CO 4** | **Demonstrate** the operating principles of instrument transformers and potentiometer to measure unknown voltage, Current & Resistance in circuits. |
| **CO 5** | **Identify** the physical variables to describe operating principle of the transducers. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**Measurement of voltage & current**

General principles of measurements –essentials of indicating instruments - deflecting, damping, controlling torques-Ammeters and voltmeters - moving coil, moving iron, constructional details, operation, Expression for deflecting & controlling torques and errors compensations- principles shunts and multipliers – extension of range.

At the end of the Module 1, students will be able to:

1. Understand the basic principles of different types of electrical instruments for the Measurement of voltage, current
2. Use the MI & MC instruments
3. Extend the range of ammeters and voltmeters
4. Understand the working and applications of cathode ray oscilloscope.

**MODULE -2**

**Measurement of Power, Energy, Power factor**

***power meters*** :Dynamometer type wattmeter –1-phase and 3-phase - LPF and UPF- Double Element and Three Element wattmeter's.

***Energy meters*** : Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and Compensations. Three Phase Energy Meter-TOD meter

***P.F. Meters*** : Dynamometer and Moving Iron Type – 1-ph and 3-ph Meters.

At the end of the Module 2, students will be able to:

1. Illustrate the working principle of wattmeter, energy meter
2. Measure active power, reactive power, power factor, and energy in both 1-phase and 3-phase circuits
3. To have an adequate knowledge in the measurement techniques for power ,energy

**MODULE-3**

**Measurement of Resistance, Inductance and Capacitance**

***Measurement of Resistance***: Kelvin's double bridge -Whetstone's bridge, sensitivity, limitations- loss of charge method -Megger method.

***Measurement of Inductance and Capacitance****:* Maxwell's inductance and capacitance bridge-Hay's bridge-Anderson's bridge- Desauty's bridge -Schering bridge-weins bridge- Problems

At the end of the Module 3, students will be able to:

1. Measurement of R, L, and C parameters using bridge circuits
2. able to measure resistance ,inductance & capacitance using appropriate bridges

**MODULE-4**

**Extension of Instrument Ranges**

***Instrument transformers****:* Current Transformers and Potential Transformers – Ratio and Phase Angle Errors – Methods for Reduction of Errors-Design Considerations.

***Potentiometers:*** Principle and Operation of D.C. Crompton‟s Potentiometer – Standardization – Measurement of unknown Resistance, Current, Voltage -AC Potentiometers: Polar and Coordinate types-Standardization – Applications.

At the end of the Module 4, students will be able to:

1. Use CTs and PTs for measurement of very large currents and high voltages
2. Ability to measure current and voltage using potentiometric method.
3. Analyse the concept of extension of range of meters used in electrical measurements.

**MODULE-5**

**TRANSDUCERS**

Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature -LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors,thermocouple,

Need for instrumentation system, data acquisition system.

At the end of the Module 6, students will be able to:

1. Identify the transducers for physical variables and to describe operating principle
2. understand the various electrical measuring instruments

| | |
|---|---|
| **Total hours:** | **32 hours** |

**Term work:**

Term work shall consist of report on substation where various measuring instruments can be observed , ,seminars and practical session based on syllabus.

**Content beyond syllabus:**

1. Miscellaneous Measuring Instruments: Maximum demand indicators

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | PMMC INSTRUMENT | CO1 | https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_dc_voltmeters.htm |
| 2 | ENERGY METER | CO2 | https://circuitglobe.com/energy-meter.html |
| 3 | DC & AC BRIDGES | CO3 | https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_dc_bridges.htm |
| 4 | POTENTIOMETER | CO4 | https://www.youtube.com/watch?v=i05A2sfO7Xc&list=PL227ZNwByTlTGq1atJsFst_qnEptI870O&index=33 |
| 5 | TRANSDUCERS | CO5 | https://www.tutorialspoint.com/electronic_measuring_instruments/electronic_measuring_instruments_transducers.htm |

**Text Book(s):**

1. Electrical & Electronic Measurements and Instrumentation by AK Sawhney, Dhanpat Rai & Sons Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.
2. J. B. Gupta - A course in Electronic and Electrical measurements and Instrumentation, S. K. Kataria Publication
3. Electrical Measurements & Measuring Instruments by M.L.Anand (Author)

**Reference Book(s):**

1. E. W. Golding - Electrical & Electronic Measurements & Instrumentation
2. A. D. Helfrick and W.D. Cooper- Modern Electronic Instrumentation and Meas. Techniques

**Online Resources:**

1. https://b-ok.asia/book/2563619/2f98e0
2. https://civildatas.com/download/electronic-and-electrical-measuring-instruments-machines-by-bakshi
3. https://books.google.co.in/books?id=Q6uBCgAAQBAJ&pg=PA9&lpg=PA9&dq=measurements+for+today&source=bl&ots=oXNqMKSLxk&sig=ACfU3U2cEvMiC6pSV205CRFO3WM8vC1HMQ&hl=en&sa=X&ved=2ahUKEwjNq6Lsx4_qAhXlQ3wKHaM4DZ0Q6AEwD3oECAgQAQ#v=onepage&q=measurements%20for%20today&f=false

**Web Resources:**

1. https://nptel.ac.in/courses/108/105/108105153/
2. http://www.instrumentationtoday.com/
3. https://www.youtube.com/watch?v=n1MinLtvnPY&list=PL227ZNwByTlTGq1atJsFst_qnEptI870O&index=2

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2012 | MODERN POWER SYSTEM ANALYSIS | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | hrs | C | CIE | SEE | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. Discuss the power system network matrices, formation of $Y_{Bus}$ and $Z_{Bus}$
2. Calculation of power flow in a power system network using various techniques
3. Discuss the Short Circuit Analysis
4. Examine the Power system stability

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Discuss the Representation of power system matrices with formation of $Y_{BUS}$ . |
| **CO 2** | Describe the Representation of power system matrices with formation of $Z_{BUS}$ . |
| **CO 3** | Apply the concepts of algorithm for the given power system network. |
| **CO 4** | Analyse the symmetrical faults and unsymmetrical faults of a power system network. |
| **CO 5** | Develop the steady State, Dynamic and Transient Stabilities for a power system. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 3 |
| CO2 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 3 |
| CO3 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | 3 | | | | | | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

**COURSE CONTENT**

**MODULE – 1**

**P.U SYSTEM AND $Y_{bus}$ FORMATION**

Per-Unit representation of Power system elements - Per-Unit equivalent reactance network of a three phase Power System - Graph Theory: Definitions, Bus Incidence Matrix, YBus formation by Direct and Singular Transformation Methods, Numerical Problems.

At the end of the Module 1, students will be able to:

1. Discuss the Matrices, construction of primitive network element
2. Formation of $Y_{BUS}$ by using different methods
3. Discuss the Per Unit Quantities

**MODULE -2**

**Formation of $Z_{Bus}$**: Partial network, Algorithm for the Modification of $Z_{Bus}$ Matrix for addition element for the following cases: Addition of element from a new bus to reference, Addition of element from a new bus to an old bus, Addition of element between an old bus to reference and Addition of element between two old busses - Modification of $Z_{Bus}$for the changes in network ( Problems )

At the end of the Module 2, students will be able to:

1. Formation of $Z_{BUS}$ and Algorithm for the Modification of $Z_{BUS}$.
2. Explain the concept of Zbus.
3. Understand the Modification of $Z_{Bus}$for the changes in network

**MODULE-3**

**POWER FLOW ANALYSIS**

Static load flow equations – Load flow solutions using Gauss Seidel Method: Algorithm and Flowchart. Acceleration Factor, Load flow Solution for Simple Power Systems (Max. 3-Buses): Newton Raphson Method in Polar Co-Ordinates Form: Load Flow Solution- Jacobian Elements, Algorithm and Flowchart. Decoupled and Fast Decoupled Methods.- Comparison of Different Methods

At the end of the Module 3, students will be able to:

1. Describe the Load Flow studies by using different methods
2. Discuss the Comparison of Different Methods

**MODULE-4**

**SHORT CIRCUIT ANALYSIS**

Short Circuit Current and MVA Calculations, Fault levels, Application of Series Reactors. Symmetrical Component Theory: Positive, Negative and Zero sequence components, Positive, Negative and Zero sequence Networks. Symmetrical Fault Analysis: LLLG faults with and without fault impedance, Unsymmetrical Fault Analysis: LG, LL and LLG faults with and without fault impedance, Numerical Problems.

At the end of the Module 4, students will be able to:

1. Describe e the Equivalent Reactance Network of a Three Phase Power System.
2. Listen the Symmetrical fault Analysis and Unsymmetrical Fault Analysis.

**MODULE-5**

**STABILITY ANALYSIS**

Elementary concepts of Steady State, Dynamic and Transient Stabilities. Derivation of Swing Equation, Power Angle Curve and Determination of Steady State Stability. Determination of Transient Stability by Equal Area Criterion, Application of Equal Area Criterion, Critical Clearing Angle Calculation.
Numerical methods for solution of swing equation - Methods to improve Stability - Application of Auto Reclosing and Fast Operating Circuit Breakers.

At the end of the Module 5, students will be able to:

1. Describe the Power system stabilities
2. Examine the Swing Equation
3. Distinguish the Equal Area Criterion

| | |
|---|---|
| **Total hours:** | **48 hours** |

Term work:

Field work of load flow in power system

**Content beyond syllabus:**

**1.** knowledge of Multi machine stability in power system.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Representation of | CO1 | http://175.101.102.82/moodle/mod/folder/view.php?id=17046 |

| | | | | |
|---|---|---|---|---|
| | | power System Network Matrices | | |
| | 2 | Load Flow Studies | CO2 | http://175.101.102.82/moodle/mod/folder/view.php?id=17046 |
| | 3 | Newton Raphson Method | CO3 | http://175.101.102.82/moodle/mod/folder/view.php?id=17046 |
| | 4 | Short Circuit current and MVA Calculations | CO4 | http://175.101.102.82/moodle/mod/folder/view.php?id=17046 |
| | 5 | Power system Stabilities | CO5 | http://175.101.102.82/moodle/mod/folder/view.php?id=17046 |

**Text Book(s):**

1. Elements of power systems analysis by W D Stevenson Jr Fourth Edition TMH International students edition
2. Modern power system analysis by D.P.Kothari and I.J.Nagrath , TMH 3rd Edition
3. Electrical power systems by C.L. Wadhwa , New age International (P) Limited
4. Power system Analysis by TK Nagasarkar and Sukhija , Oxford press

**Reference Book(s):**

1. Power System Stability by Kimbark vol - I willey Publications, Inc
2. Power system Stability and control by P. Kundur , TMH
3. A.R. Bergen and V.vittal; "Power system Analysis", Pearsib Publication

**Online Resources:** http://175.101.102.82/moodle/course/view.php?id=693

1.http://www.acadmix.com/eBooks_Download
2. https://nptel.ac.in/courses/108105067/
3.https://nptel.ac.in/course.html

**Web Resources:** http://175.101.102.82/moodle/course/view.php?id=693

1. https://lecturenotes.in/subject/482/power-system-analysis-psa/note
2.https://www.youtube.com/watch?v=j44kQiphUB4&list=PL1XaeVNXKsvwkfUAGQiUuqWBswJ4VM3Ed
3.https://www.youtube.com/watch?v=-bX0k5Dlwek&list=PLgzsL8klq6DJv0G1l7ji4OI8BTXgEADfP
4.https://www.youtube.com/watch?v=tb3gCr9m0LU&list=PLtcRcIUOKppXWUMEVXGwwULXgzEBygOK-
5.https://www.youtube.com/watch?v=fBm1dr_gRBk&list=PL36A60B630E8C7B56
6. https://www.youtube.com/watch?v=NfnrupJ0BwY&list=PLfDaOYdi9aZyO2oYhr7G9DYMhoFmqS4A1

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2013 | **Switch Gear & Protection** | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | PSP | TOTAL |
| II-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |
| **Pre-requisite: Nil** | | | | | | | | |
| **Course Objectives:**<br>1. To Learn in detail about Switch gear Protective equipments<br>2. To Learn about the technical aspects involved in the operation of Circuit Breakers<br>3. To Learn about Basic Requirements of Protective Relays<br>4. To Learn different types Relays & Applications | | | | | | | | |
| **Course Outcomes**: After successful completion of the course, the student will be able to: | | | | | | | | |
| **CO 1** | **Demonstrate** the operation of different types of Circuit Breakers | | | | | | | |
| **CO 2** | **Describe** the operation & application of various types of protective relays. | | | | | | | |
| **CO 3** | **Compare** the different types of comparators. | | | | | | | |
| **CO 4** | **Analyze** the various protection schemes of various power system components like alternators, transformers and bus-bars. | | | | | | | |
| **CO 5** | **Illustrate** the various methods of over voltage protection in power systems | | | | | | | |

| CO-PO Mapping | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO2** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO3** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO4** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| **CO5** | 3 | 2 | | | | | | | | | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | |

| **COURSE CONTENT** |
|---|
| **MODULE – 1** |
| **CIRCUIT BREAKERS:** Circuit Breakers: Arc Phenomenon, Methods of Arc Interruption, Restriking and Recovery Voltage - Restriking Phenomenon, RRRV, Current Chopping and Resistance Switching. Constructional features & Principle operation of Minimum Oil Circuit Breakers, Air Blast Circuit Breakers, Vacuum and SF6 Circuit Breakers, Ratings of CB's, Auto Reclosure's. |
| At the end of the Module 1, students will be able to:<br>1. Understand the constructional features & principle of operation of various Circuit Breakers<br>2. Identify applications of various Circuit Breakers in real time.<br>3. Understand the concept of Auto Reclosing of Circuit Breakers |
| **MODULE-2** |
| **PROTECTIVE RELAYS:** Basic Requirements of Protective Relays-Primary and Backup Protection<br>**CLASSIFICATION OF RELAYS-I :** Types of Electromagnetic Relays, Over current Relays, Directional & Non Directional Relays |

At the end of the Module 2, students will be able to:

1. Understand the basic requirements of protective relay
2. Understand the applications of Electromagnetic, Over current Relays in real time
3. Identify the difference between Directional & Non Directional Relays

**MODULE-3**

**CLASSIFICATION OF RELAYS-II:** Differential Relays, Distance Relays, Static Relays-Advantages & Disadvantages, Microprocessor Based Relays-Advantages & Disadvantages, Universal Relay Torque equation.

**COMPARATORS:** Amplitude and Phase Comparators

At the end of the Module 3, students will be able to:

1. Understand the applications of Differential, Distance Relays in real time
2. Identify the difference between Static Relays, Microprocessor Based Relays
3. Explain the Universal Relay Torque equation

**MODULE-4**

**GENERATOR PROTECTION:** Protection of Generators against Stator Faults, Rotor Faults and Abnormal Conditions, Numerical Problems on percentage winding unprotected.

**TRANSFORMER PROTECTION:** Differential Protection, Buccholz Relay Protection, Numerical Problems on Design of CT Ratio.

**FEEDER PROTECTION:** Protection of Feeder (Radial & Ring Main) Using Over Current Relays, Protection of Transmission Line – Three Zone Protection Using Distance Relays.

At the end of the Module 4, students will be able to:

1. Understand various faults occurring in Generator, Transformer.
2. Explain the Protective schemes for Generator, Transformer & Feeder.
3. Compute the Percentage of winding unprotected.

**MODULE-5**

**NEUTRAL GROUNDING:** Advantages, Types of Neutral Grounding

OVER VOLTAGE PROTECTION: Causes of Over Voltages in Power Systems.-Phenomenon of Lightning, Protection against Lightning Over Voltages, Lightning Arresters –Rod Gap, Horn Gap, Valve Type and Zinc-Oxide Lighting Arresters.

At the end of the Module 5, students will be able to:

1. Understand the advantages of Neutral Grounding.
2. Understand the causes of over voltages in power systems.
3. Explain the phenomenon of Lightning.

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Field work to EHV Substation / Tutorials/ Quiz's

**Content beyond syllabus:**

1. Carrier current protection
2. Insulation Coordination, Basic Impulse Insulation Level

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Circuit Breakers | CO1 | https://www.electrical4u.com/electrical-circuit-breaker-operation-and-types-of-circuit-breaker/ |
| 2 | Protective relays | CO2 | https://circuitglobe.com/types-of-circuit-breaker.html |
| 3 | Electromagnetic Relays | CO3 | https://www.electrical4u.com/electromagnetic-relay-working-types-of-electromagnetic-relays/ |
| 4 | Generator protection | CO4 | https://circuitglobe.com/differential-protection-relay.html https://circuitglobe.com/impedance-type-distance-relay.html https://www.engineeringenotes.com/electrical-engineering/comparators/amplitude-comparators-and-its-types-devices-electrical-engineering/32806 |
| 5 | Neutral grounding | CO5 | https://circuitglobe.com/differential-protection-of-a-generator.html https://circuitglobe.com/differential-protection-of-a-transformer.html https://circuitglobe.com/feeder-protection.html#:~:text=Feeder%20Protection,the%20various%20type%20of%20fault. |

**Text Book(s):**

1. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications,2011.
2. Switchgear and Protection, Sunil S Rao, Khanna Publishers, 1992.

**Reference Book(s):**

1. Electrical Power Systems, C.L.Wadhwa, New Age international (P) Limited, Publishers, 2012.
2. Transmission network Protection, Y.G. Paithankar , Taylor and Francis,2009.
3. Power system protection and switch gear, Bhuvanesh Oza, TMH, 2010
4. Principles of power systems by V.K.Mehta,Rohith Mehta S.Chand(P), 4th Edition

**Online Resources:**

1. http://175.101.102.82/moodle/course/view.php?id=691
2. https://subjects.ee.unsw.edu.au/elec9712/ELEC9712%20-%20Lec8%20-%20Circuit%20breakers%20Notes.pdf
3. https://b-ok.asia/book/5482781/8e4867
4. https://b-ok.asia/book/5482780/4ec690

**Web Resources:**

1. https://nptel.ac.in/courses/108/101/108101039/
2. https://www.youtube.com/watch?v=GSh0f94JwaA&t=54s
3. https://www.youtube.com/watch?v=dPInm2zoirA&t=40s
4. https://www.youtube.com/watch?v=OH7-NJRdDyA
5. https://www.youtube.com/watch?v=Kd_73FnTueI
6. https://www.youtube.com/watch?v=OElOqRSN0FE
7. https://www.youtube.com/watch?v=Y5dAaeLPzzk
8. https://www.youtube.com/watch?v=ODj4sWxKm9o

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2507 | ELECTRICAL MEASUREMENT & INSTRUMENTATION LAB | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | hrs | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 2 | 30 | 1 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. Measurement of coefficient of coupling between two coupled coils.
2. Accurate determination of inductance and capacitance using D.C and A.C Bridges
3. Calibration of various electrical measuring instruments.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Accurately determine the values of inductance and capacitance using a a.c bridges |
| **CO 2** | Compute the coefficient of coupling between two coupled coils |
| **CO 3** | Calibrate various electrical measuring instruments |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 1 | 1 | 2 | 1 | | | | | 2 | 2 | | | | 1 |
| CO2 | 2 | 2 | 2 | 1 | | | | 1 | 2 | 2 | | | | 2 |
| CO3 | 2 | 2 | 1 | 1 | 1 | | | 1 | 2 | 2 | | | | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**List of Experiments**

**Any 12 of the following experiments are to be conducted:**

**1. Calibration and Testing of Single phase energy meter**

**2. Calibration of dynamometer wattmeter using phantom loading Test**

**3. Calibration of dynamometer power factor meter**

**4. Measurement of 3 -phase reactive power with single -phase wattmeter for balanced loading**

**5. Measurement of parameters of a choke coil using 3-Voltmeter and 3-Ammeter methods**

**6. Crompton D.C Potentiometer - Calibration of PMMC Ammeter and PMMC Voltmeter**

**7. Kelvin's Double Bridge - Measurement of low resistance - Determination of Tolerance**

**8. Capacitance Measurement using Schering Bridge**

**9. Inductance Measurement using Anderson Bridge.**

**10. LVDT and capacitance pickup - characteristics and calibration**

**11. Measurement of % Ratio Error and Phase angle Error of Given C.T by using Silsbee's Method.**

| | |
|---|---|
| **12. Measuremnt of 3-phase power by using Two Wattmeter method**<br>**13. Resistance strain gauge- Strain measurement and calibration** | |
| **Total hours:** | **36 hours** |

**Term work:**

Calibrate the Electrical & Electronics Instruments

**Content beyond syllabus:**

1. **Measurement of 3-phase power with single wattmeter and 2 No's CT**

**Online Resources:**

1.http://www.acadmix.com/eBooks_Download

**Web Resources:**

1. http://sreevahini.edu.in/pdf/electrical-measurements-lab.pdf
2. http://www.eee.griet.ac.in/wp-content/uploads/2014/12/EMI-Lab-Manual.pdf

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2508 | POWER SYSTEM LAB | | | | | | | R2020 |
| III-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| II-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |
| **Pre-requisite:** Must have the basic knowledge in Generation, Transmission & Distribution | | | | | | | | |
| **Course Objectives:**<br>1. To study the different methods of power system analysis.<br>2. To learn about the power system control.<br>3. To learn about the concepts of Power system stability. | | | | | | | | |
| **Course Outcomes**: After successful completion of the course, the student will be able to: | | | | | | | | |
| **CO 1** | Examine the power system analysis **(BL=4)** | | | | | | | |
| **CO 2** | Identify characteristics of various Relays**(BL=3)** | | | | | | | |
| **CO 3** | Understand various tests on Motors and Transformers **(BL=2)** | | | | | | | |

| CO-PO Mapping | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 2 | 2 | 1 | 1 | | | | 2 | 2 | | | 3 | 3 |
| **CO2** | 2 | 2 | 1 | 1 | 1 | | | | 2 | 2 | | | 3 | 3 |
| **CO3** | 2 | 2 | 1 | 1 | 1 | | | | 2 | 2 | | | 2 | 3 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| COURSE CONTENT | CO |
|---|---|
| **Task - 1 - Determination of Sub transient Reactance of Salient Pole Synchronous Machine.** | **CO 1** |
| **Objective:** To determine the sub transient direct axis reactance and Quadrature axis reactance of a salient pole synchronous machine. | |
| **Task -2 -Determination of Sequence Impedances of Cylindrical Rotor Synchronous Machine.** | **CO 1** |
| **Objective:** To determine experimentally Positive, Negative and Zero sequence reactance's of a cylindrical rotor synchronous machine. | |
| **Task -3 - LG -Fault Analysis** | **CO 1** |
| **Objective:** To find the fault currents and fault voltages when a single line to ground (L-G) fault occurred on unloaded alternator. | |
| **TASK -4 - LLG -Fault Analysis** | **CO 1** |
| **Objective:** To find the fault currents and fault voltages when a double line to ground (LLG) fault occurred on unloaded alternator. | |
| **TASK -5 -Equivalent Circuit of a Three Winding Transformer.** | **CO 3** |
| **Objective:** To determine the equivalent circuit parameters of a 3-Ø three winding transformer. | |
| **TASK-6 - Separation of No-Load Losses of Three-Phase Squirrel Cage Induction Motor.** | **CO 3** |

| | |
|---|---|
| **Objective:**To separate the No-Load losses(Iron losses and Mechanical losses) of a three phase squirrel cage induction motor. | |
| **Task -7 - LL -Fault Analysis** | **CO 1** |
| **Objective:**To find the fault currents and fault voltages when a line to line (L-L) faults occurred on unloaded alternator. | |
| **TASK -8 - LLLG -Fault Analysis** | **CO 1** |
| **Objective:**To find the fault currents and fault voltages when a Triple line to ground (LLLG) faults occurred on unloaded alternator. | |
| **TASK -9 -Characteristics of IDMT Over Current Relay -Electromagnetic Type.** | **CO 2** |
| **Objective:**To determine the Time-Current characteristics of IDMT Over Current Relay | |
| **TASK -10 - Characteristics of Over Voltage Relay -Electromagnetic Type.** | **CO 2** |
| **Objective: :**To determine the operating characteristics of Over Voltage Relay | |
| **TASK -11 - Characteristics of Over Voltage Relay- Microprocessor Type.** | **CO 2** |
| **Objective:**To determine the operating characteristics of the numerical Over Voltage Relay | |
| **TASK -12 - Characteristics of Percentage Biased Differential Relay-Electromagnetic Type** | **CO 2** |
| **Objective:** To determine the operating characteristics of Percentage Biased Differential Relay | |

| | |
|---|---|
| **Additional Experiments:** | |
| **TASK -13 – Performance of Digital Distance Relay** | **CO 2** |
| **Objective:**To verify the performance of Numerical Distance Relay | |
| **TASK -14 - Characteristics of Percentage Biased Differential Relay- Static Type** | **CO 2** |
| **Objective:** To determine the operating characteristics of Percentage Biased Differential Relay | |
| **TASK - 15 – Ferranti Effect in Transmission Lines** | **CO 1** |
| **Objective:**To study the Ferranti Effect of transmission line/cable | |
| **TASK - 16 - Buchholz relay for Transformer protection** | **CO 1** |
| **Objective:** To Study the abnormal conditions in a oil filled transformer by gas actuated Buchholz relay | |
| **TASK - 16 - ABCD parameters of transmission line** | |
| **Objective:** To study the performance of a transmission line. Also compute its ABCD parameters | |
| | |

**Virtual Labs:**

1. http://www.ee.iitkgp.ac.in/faci_ps.php
2. https://vp-dei.vlabs.ac.in/Dreamweaver/list.html

**Self-Study:**

Contents to promote self-Learning:

| SNO | CO | Reference |
|---|---|---|
| 1 | **CO 1** | https://nptel.ac.in/courses/108/105/108105067/ |
| 2 | **CO 2** | https://nptel.ac.in/content/storage2/courses/108101039/download/Lecture-15.pdf |
| 3 | **CO 3** | https://nptel.ac.in/courses/108/105/108105017/ |

**Text Book(s):**

1. POWER SYSTEM ANALYSIS – by – HADI SAADAT - Tata McGraw-Hill Education, 01-Aug-2002.
2. Power System Protection and Switchgear, Badri Ram, D.N Viswakarma, TMH Publications, 2011.

**Reference Book(s):**

1. Power Systems Analysis, Grainger and Stevenson, Tata Mc Graw-hill, 2005.
2. Modern Power system Analysis 2nd edition, I.J.Nagrath&D.P.Kothari: Tata McGraw- Hill Publishing Company, 2003.
3. Kundur, P., "Power System Stability and Control", Mc. Graw Hill inc. 1994.
4. Jim Arlow, Ila Neustadt, "UML 2 and the Unified Process: Practical Object-Oriented Analysis and Design", 2nd Edition, Pearson, (2005).

**Web Resources:**

1. http://www.academia.edu/Documents/in/Power-System-Analysis-by-Hadi-Saadat-Electrical-Engineering
2. https://nptel.ac.in/courses/108/101/108101040/
3. https://nptel.ac.in/courses/108/104/108104052/
4. https://nptel.ac.in/courses/108/105/108105067/
5. https://nptel.ac.in/courses/108/101/108101039/

## SEMESTER VII

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20HS5001-8 | HE | Humanities and Social Science Elective | 2 | 0 | 0 | 2 | 2 | 40 | 60 | 100 |
| 20EE2014 | PC | Solid State Electric Drives | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2015 | PC | Power System Operation and Control | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| - | OE | Open Elective IV | 2 | 0 | 2 | 4 | 3 | 40 | 60 | 100 |
| 20EE4016-20 | PE | Professional elective IV | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE4021-25 | PE | Professional elective V | 3 | 0 | 0 | 3 | 3 | 40 | 60 | 100 |
| 20EE2509 | PC | Electronic systems design lab | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE2510 | PC | Power Systems Simulation Lab | 0 | 0 | 3 | 3 | 1.5 | 40 | 60 | 100 |
| 20CD6005 | SC | Career competency Development V | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20CC6501 | SC | Skill development Training | 0 | 0 | 2 | 2 | 1 | 40 | 60 | 100 |
| 20EE7502 | PR | Internship II/on job training/Com Ser | 0 | 0 | 3 | 3 | 1.5 | 00 | 100 | 100 |
| 20MC8002-12 | MC | Mandatory course IV | 2 | 0 | 0 | 2 | 0 | 00 | 00 | 00 |
| | | Counseling/Mentoring | 0 | 0 | 1 | 1 | 0 | -- | -- | -- |
| | | Sports/Hobby Clubs/Activities | 0 | 0 | 2 | 2 | 0 | -- | -- | -- |
| | | Activity Point Programme | During the Semester | | | | | 20 Points | | |
| | | Total | 18 | 0 | 17 | 35 | 23 | 400 | 700 | 1100 |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2014 | **Solid State Electrical Drives** | | | | | | | R2020 |
| IV-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |
| **Pre-requisite: Nil** | | | | | | | | |

**Course Objectives:**

1. To understand steady state operation and transient dynamics of a motor load system.
2. To study and analyze the operation of the converter fed dc drive, both qualitatively and quantitatively.
3. To study and analyze the operation of the chopper fed dc drive, both qualitatively and quantitatively.
4. To study and understand the operation and performance of AC Induction motor drives.
5. To study and understand the operation and performance of AC Synchronous motor drives.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Describe the basic requirements of motor selection for different load profiles. |
| **CO 2** | Analyze the operation of the converter fed dc drive |
| **CO 3** | Demonstrate the operation of the chopper fed dc drive |
| **CO 4** | Illustrate the operation and performance of AC Induction motor drives |
| **CO 5** | Analyze the induction motor drive using inverter |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO5** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

### MODULE – 1

**Electric Drive**

Classification of Electric Drives, Basic elements of Electric Drive, Dynamic Control of a Drive system, Stability analysis, Introduction to Thyristor Controlled Drives, Single Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited motor-Output Voltage and Current Waveforms – Speed and Torque Expressions -problems.

At the end of the Module 1, students will be able to:

1. Understand the basic requirements of motor selection
2. Analyze the converter fed DC drives

### MODULE -2

Three Phase Semi and Fully Controlled Converters Connected to D.C Separately Excited and D.C Series Motors – Continuous Current Operation – Output Voltage and Current Waveforms – Speed and Torque Expressions – Speed – Torque Characteristics- Problems. Introduction to Four Quadrant Operation – Motoring Operations, Electric Braking – Plugging, Dynamic and Regenerative Braking Operations. Four Quadrant Operation of D.C Motors by Dual Converters

At the end of the Module 2, students will be able to:

1. Analyze the three phase converter fed DC drives
2. Differentiate between braking methods of motors
3. Understand the four quadrant operation

**MODULE-3**

**DC motor drives:**

Single Quadrant, Two Quadrant and Four Quadrant Chopper Fed DC Separately Excited and Series Excited Motors – Continuous Current Operation – Output Voltage and Current Wave Forms – Speed Torque Expressions – Speed Torque Characteristics.

At the end of the Module 3, students will be able to:

1. Understand the chopper fed DC drives
2. Analyze the characteristics of chopper fed DC drives

**MODULE-4**

Induction Motor Stator Voltage Control and Characteristics. AC Voltage Controllers – Waveforms – Speed Torque Characteristics - Stator Frequency Control and Characteristics. Voltage Source and Current Source Inverter - PWM Control – Speed Torque Characteristics.

At the end of the Module 4, students will be able to:

1. Understand the stator side control of induction motor drives
2. Analyze the inverter fed Induction Motor Drives

**MODULE-5**

**Induction motor drives:**

Static Rotor Resistance Control – Slip Power Recovery – V/f control of Induction Motor – Their Performance and Speed Torque Characteristics – Advantages- Applications – Problems.

**Synchronous motor drives:**

Separate Control & Self Control of Synchronous Motors – Operation of Self Controlled Synchronous Motors by VSI and CSI

At the end of the Module 5, students will be able to:

1. Understand the rotor side control of induction motor drives
2. Analyze the performance of induction motor drives.
3 Understand the performance of synchronous motor drives

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Tutorials/Quizes

**Content beyond syllabus:**

1. Cycloconverter fed synchronous motor drives

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Thyristor Controlled Drives | CO1 | https://www.youtube.com/watch?v=-EC6q5_grM4 |
| 2 | Four Quadrant Operation | CO2 | https://www.youtube.com/watch?v=Tfrv9DJfVgs |
| 3 | Chopper Fed DC Motors | CO3 | https://www.youtube.com/watch?v=pdjVSWSQ83w |
| 4 | AC Voltage Controller fed AC drives | CO4 | https://www.youtube.com/watch?v=Pc7txXwvhBM |
| 5 | Slip Power Recovery scheme | CO5 | https://www.youtube.com/watch?v=9Z0Tn5iTYyE |

**Text Book(s):**

1. Power semiconductor controlled drives, G K Dubey, Prentice Hall, 1995.
2. Modern Power Electronics and AC Drives, B.K.Bose, PHI, 2002.

**Reference Book(s):**

1. Power Electronics, MD Singh and K B Khanchandani, Tata McGraw-Hill Publishing company, 2008.
2. Power Electronic Circuits, Devices and applications, M.H.Rashid, PHI, 2005.
3. Electric drives Concepts and Applications, Vedam Subramanyam, Tata McGraw Hill

**Online Resources:**

1. https://doku.pub/documents/electric-drives-by-gk-dubey-59qge6y3vm0n
2. https://nptel.ac.in/courses/108/104/108104140/

**Web Resources:**

1. https://www.youtube.com/watch?v=1AT1yuQ9awM&list=PLFW6lRTa1g83slfVY1p1xGqPGYUmXyahx
2. https://www.youtube.com/watch?v=WsDPqDqnpyw&list=PLuv3GM6-gsE3UGP1cSOl1KuEXscGFdKXB

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2015 | POWER SYSTEM OPERATION & CONTROL | | | | | | | R2020 |
| IV-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |
| **Pre-requisite: Nil** | | | | | | | | |

**Course Objectives:**

1. To understand the importance of optimal power flow and power system.
2. To Describe the hydrothermal scheduling, and its constraints.
3. To listen about single area and two area load frequency control , modeling of turbines
4. To understand the Deregulation, Restructuring models.

| **Course Outcomes**: After successful completion of the course, the student will be able to: | |
|---|---|
| **CO 1** | Enumerate the Heat rate curves, Economic operations of power systems |
| **CO 2** | Describe the Hydrothermal power stations Scheduling |
| **CO 3** | Discuss the single area load frequency control, modelling of turbines , speed governing systems. |
| **CO 4** | Illustrate two area load frequency control , tie line and economic dispatch control for load frequency control. |
| **CO 5** | Discuss the deregulation and conditions of deregulation in a power systems. |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 1 | 2 | 2 | | 2 | | | | | | | | 3 | 2 |
| **CO2** | 2 | 2 | 2 | | 2 | | | | | | | | 3 | 2 |
| **CO3** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 2 | | | | | | | | 3 | 2 |
| **CO5** | 2 | 2 | 2 | | 2 | | | | | | | | 3 | 2 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

## COURSE CONTENT

### MODULE – 1

**UNIT – ECONOMIC OPERATION OF THERMAL POWER STATION**

Over view of power system operation and Control, System Load variation, Formulation of Economic dispatch in Thermal Power station - Heat Rate Curve – Cost Curve –Incremental Fuel and Production Costs, Input-Output Characteristics , Constraints of power systems, Optimum Scheduling of Thermal power station

**Optimum Generation Allocation:**

Optimum Generation Allocation with Line Losses Neglected. Loss Coefficients, General line loss formula, Optimum Generation Allocation with Line Losses

At the end of the Module 1, students will be able to:

1. Discuss the Economic dispatch in Thermal power station
2. Determine the Optimum Generation Allocation without losses
3. Discuss the Optimum Generation Allocation with and without losses

### MODULE -2

**UNIT–II-HYDROTHERMAL SCHEDULING and Governing**

Optimal scheduling of Hydrothermal system: Scheduling problems, Optimal Scheduling of Hydrothermal System, short term Hydro thermal Scheduling(4h)

**MODELLING OF TURBINE AND SPEED GOVERNING SYSTEM**

Modeling of Turbine: First Order Turbine Model, Approximate Linear models, Modeling of Governor, Mathematical Modeling of Speed Governing System, Derivation of Small Signal Transfer Function – Block Diagram (4h)

At the end of the Module 2, students will be able to:

1. Listen the Hydro Electro Power Plant Models
2. Examine the constraints
3. Enumerate the Hydrothermal Scheduling problems

**MODULE-3**

**LOAD FREQUENCY SINGLE AREA CONTROL**

Necessity of Keeping Frequency Constant.–Definition of control Area, – Mathematical modeling of generator , loads, for LFC & corresponding block diagram representation, Block Diagram Representation of an Isolated Power System – Steady State Analysis – Dynamic Response – Uncontrolled Case. (8h)

At the end of the Module 3, students will be able to:

1. Discuss the Necessity of keeping frequency constant
2. Listen the Load Frequency Single Area Control
3. Describe the steady state Analysis

**MODULE-4**

**Load Frequency Control of 2-Area System: Load Frequency control of 2-Area system** and its Block diagram, Uncontrolled case and controlled case. Tie-Line Bias Control. Proportional Plus Integral Control of Single Area and Its Block Diagram Representation, Economic Dispatch Control.

At the end of the Module 4, students will be able to:

1. Discuss the Load Frequency Control of 2-Area system
2. Examine the Tie Line Bias Control
3. Describe the Economic Dispatch Control

**MODULE-5**

**Deregulation of Power system:**

Deregulation, Need and conditions for deregulation, Basics of public good economics, Components of Deregulation, Technical , economic & Regulatory issues involved in deregulation of power industry, Privatization, Competition in the electricity sector, conditions, barriers, benefits of Challenges, Reregulation.

At end of the Module 5 , students will be able to :

1. Describe the Deregulation and its conditions
2. Examine Technical, economic & Regulatory issues of deregulation of power industry
2. Discuss the Deregulation and benefits of deregulation

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Field work of power system operation & Deregulation in Thermal power plant

**Content beyond syllabus:**

1. **Knowledge of Voltage control in Power systems**

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Economic Operation of Thermal power station | CO1 | http://175.101.102.82/moodle/mod/folder/view.php?id=13928 |
| 2 | Hydro thermal scheduling | CO2 | http://175.101.102.82/moodle/mod/folder/view.php?id=13928 |
| 3 | Load frequency single area control | CO3 | http://175.101.102.82/moodle/mod/folder/view.php?id=13928 |
| 4 | Load frequency two area control | CO4 | http://175.101.102.82/moodle/mod/folder/view.php?id=13928 |
| 5 | Deregulation of Power system | CO5 | http://175.101.102.82/moodle/mod/folder/view.php?id=13928 |

**Text Book(s):**

1. Power Generation Operaton and control - Wood and Wollenerg, wiley Publishers
2. Power systems operation and Control - Chakravarthi, Halder
3. D.P.Kothari and I.J.Nagrath, " Modern Power System Analysis" Tata Mc Graw Hill publishing company Ltd., 2003.

**Reference Book(s):**

1. S Sivanagaraju and G Sreenivasan, " Power System Operation and Control ", Pearson"MeriPustak-Machwan Communication & Research publishing Company Ltd,2004
2 Geoffrey Rothwell, Tomas Gomez (Eds), " Electricity Economics Regulation and Deregulation", IEEE Press Power Engineering series , John Wiley & Sons, 2003
3. Loi Lei Lai, "Power System Restructuring and Deregulation", John Wiley & Sons Ltd, England, 2001
4. Mohammad Shahidehpour , Muwaffaq Alomoush, "Restructured Electric power Systems:Operation, Trading and Volatility", Marcel Dekker , Inc., 2001

**Online Resources:** http://175.101.102.82/moodle/course/view.php?id=610
1.http://www.acadmix.com/eBooks_Download

**Web Resources:** http://175.101.102.82/moodle/course/view.php?id=610
1.https://lecturenotes.in/notes/14667-note-for-power-system-operation-and-control-psoc-by-jntu-heroes?reading=true&continue=2
2.https://lecturenotes.in/notes/17488-note-for-power-system-operation-and-control-psoc-by-sucharita-das
3.http://www.crectirupati.com/sites/default/files/lecture_notes/PSOC%20-%20%20IV%20-%20EEE_0.pdf
4.http://www.tutorialspoint.com/

| NARAYANA ENGINEERING COLLEGE: GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE2510 | POWER SYSTEM SIMULATION LAB | | | | | | | R2020 |
| IV-B.Tech | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| I-Semester | 0 | 0 | 3 | 30 | 1.5 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To study the different methods of power system analysis.
2. To learn about the power system control.
3. To learn about the concepts Power system stability.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Examine the power system analysis- (BL-4) |
| **CO 2** | Construct the controllers of a power system. (BL-3) |
| **CO 3** | Analyze the various power system stabilities- (BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 2 | 2 | 1 | 3 | | | | 2 | 2 | | | 2 | 3 |
| CO2 | 2 | 2 | 1 | 1 | 3 | | | | 2 | 2 | | | 2 | 3 |
| CO3 | 2 | 2 | 1 | 1 | 2 | | | | 2 | 2 | | | 1 | 3 |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | CO |
|---|---|
| **Task - 1 - FORMATION OF BUS ADMITTANCE MATRIX($Y_{BUS}$)** | **CO 1** |
| **Objective:**To form Bus Admittance matrix by using Matlab and verify output with theoretical output. | |
| **Task -2 -POWER FLOW ANALYSIS USING GAUSS SEIDAL METHOD** | **CO 1** |
| **Objective:**To run the power flow of the given system using Gauss Seidal Method and verify the obtained results with theoretical calculations. | |
| **Task -3 - POWER FLOW ANALYSIS USING NEWTON RAPHSON METHOD** | **CO 1** |
| **Objective:** To run the power flow of the given system using Newton Raphson Method and verify the obtained results with theoretical calculations. | |
| **TASK -4 -LOAD FLOW ANALYSIS USING FAST DECOUPLED METHOD** | **CO 1** |
| **Objective:** To obtain PV & QV curves on IEEE 30-bus by applying Fast Decoupled Method. | |
| **TASK -5 -STEP RESPONSE OF TWO AREA SYSTEM WITH AND WITHOUT INTEGRAL CONTROL AND ESTIMATION OF FREQUENCY DEVIATION USING SIMULINK** | **CO 2** |
| **Objective:** To obtain the frequency deviation of the two-area power system with and without integral controller for a sudden change of load in any area. | |
| **TASK-6 STEP RESPONSE OF TWO AREA SYSTEM WITH INTEGRAL CONTROL AND ESTIMATION OF TIE-LINE POWER DEVIATION USING** | **CO 2** |

| SIMULINK | |
|---|---|
| **Objective:** To obtain the power deviation of the two-area power system with and without integral controller for a sudden change of load in any area. | |
| **TASK -7 - ANALYSIS OF STEADY STATE STABILITY OF A SINGLE MACHINE CONNECTED TO INFINITE BUS USING POINT BY POINT METHOD.** | **CO 2** |
| **Objective:** To develop a MATLAB program for the analysis of steady state stability in the case of single machine connected to infinite bus.<br>(OR)<br>To develop a MATLAB program to solve swing equation of the problem. | |
| **TASK -8 - DESIGN OF P-I-D CONTROLLER** | **CO 2** |
| **Objective:** To Design a P-I-D controller of a Transfer Function and to obtain the Proportional, Integral and derivative gains. | |
| **TASK -9 -DESIGN OF FUZZY LOGIC AIR CONDITIONER** | **CO 2** |
| **Objective:**To design a fuzzy air conditioner using MATLAB | |
| **TASK -10 - LOAD FLOW ANALYSIS USING NEURAL NETWORKS** | **CO 2** |
| **Objective:**To implement Neural Network on load flow analysis. | |
| **TASK -11 - PROGRAM FOR SWING CURVE WHEN THE FAULT IS CLEARED.** | **CO 3** |
| **Objective:**To determine the Swing curve when the fault is cleared i) At the beginning of the Line ii) At the middle of the line | |
| **TASK -12 - SWING CURVE FOR SUSTAINED FAULT AND CRITICAL CLEARING ANGLE & TIME.** | **CO 3** |
| **Objective:**To determine swing curve for sustained fault and critical clearing angle & time. | |

| **Additional Experiments:** | |
|---|---|
| **TASK -13 - DESIGN OF KALMAN FILTER** | **CO 3** |
| **Objective:**To design a time varying and a steady state "KALMAN FILTER" and to obtain its response, covariance error, values before and after filtering. | |
| **Task - 14- FORMATION OF BUS IMPEDANCE MATRIX($Z_{BUS}$)** | **CO 1** |
| **Objective:**To form Bus Impedance matrix by using MATLAB and verify output with theoretical output. | |
| **TASK - 15 - MATLAB PROGRAM TO FIND OPTIMUM LOADING OF GENERATORS NEGLECTING TRANSMISSION LOSSES** | **CO 2** |
| **Objective:**To find optimum loading of two units for the given load neglecting transmission losses and verify using MATLAB. | |
| **TASK - 16 - MATLAB PROGRAM TO FIND OPTIMUM LOADING OF** | **CO 2** |

| GENERATORS WITH PENALTY FACTORS | |
|---|---|
| **Objective:**To find optimum loading of two units for the given load with penalty factors and verify using MATLAB. | |
| | |

**Self-Study:**

Contents to promote self-Learning:

| SNO | CO | Reference |
|---|---|---|
| 1 | **CO 1** | https://nptel.ac.in/courses/108/105/108105067/ |
| 2 | **CO 2** | 1. https://nptel.ac.in/courses/108/101/108101040/<br>2. https://nptel.ac.in/courses/108/104/108104052/ |
| 3 | **CO 3** | 1. https://nptel.ac.in/courses/108/101/108101040/<br>2. https://nptel.ac.in/courses/108/104/108104052/ |

**Text Book(s):**

1. POWER SYSTEM ANALYSIS – by – HADI SAADAT - Tata McGraw-Hill Education, 01-Aug-2002.
2. MATLAB for Electrical Engineers and Technologists: MATLAB Tutorial with Practical Electrical Examples- Stephen P. Tubbs, 2010

**Reference Book(s):**

1. Power Systems Analysis, Grainger and Stevenson, Tata Mc Graw-hill, 2005.
2. Modern Power system Analysis 2nd edition, I.J.Nagrath & D.P.Kothari: Tata McGraw- Hill Publishing Company, 2003.
3. Kundur, P., “Power System Stability and Control”, Mc. Graw Hill inc. 1994.
2. Jim Arlow, Ila Neustadt, “UML 2 and the Unified Process: Practical Object-Oriented
3. Analysis and Design”, 2nd Edition, Pearson, (2005).

**Web Resources:**

1.http://www.academia.edu/Documents/in/Power-System-Analysis-by-Hadi-Saadat-Electrical-Engineering
2. https://nptel.ac.in/courses/108/101/108101040/
3. https://nptel.ac.in/courses/108/104/108104052/
4. https://nptel.ac.in/courses/108/105/108105067/

## SEMESTER VIII

| Subject Code | Category | Course Title | Contact Periods per week | | | | Credits | Scheme of Examination Max. Marks | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P | Total | | Int. Marks | Ext. Marks | Total Marks |
| 20EE7503 | PR | Project work, seminar and internship | 0 | 0 | 0 | 0 | 12 | 60 | 140 | 200 |
| | | Activity Point Programme | During the Semester | | | | | 20 points | | |
| | | | **0** | **0** | **0** | **0** | **12** | **60** | **140** | **200** |

# PROFESSIONAL ELECTIVES (PE)

| Elective Track/Group | Professional Elective-1 | Professional Elective-2 | Professional Elective-3 | Professional Elective-4 | Professional Elective-5 |
|---|---|---|---|---|---|
| Advanced Power systems | Industrial Electrical Systems (20EE4001) | Power System Planning (20EE4006) | Reactive Power Compensation and Management (20EE4011) | Power Quality (20EE4016) | Smart Grid Technologies (20EE4021) |
| Control Systems | System Modeling and Identification (20EE4002) | Advanced Control systems (20EE4007) | Digital Signal Processing (20EE4012) | Multivariable Control System (20EE4017) | Real Time Control System (20EE4022) |
| Electromechanical Systems | Machine Modeling and Analysis (20EE4003) | Electrical Machine Design (20EE4008) | Programmable Control Devices and Applications (20EE4013) | Hybrid Electrical Vehicles (20EE4018) | Automotive Electrical Engineering (20EE4023) |
| Energy Systems | Renewable Energy Conversion Systems (20EE4004) | Solar and Fuel Cell Energy Systems (20EE4009) | Wind and Biomass Energy Systems (20EE4014) | Utilization of Electrical Energy (20EE4019) | Energy Audit &Demand side Management (20EE4024) |
| Power Electronics | Advanced Power Electronics (20EE4005) | Advanced Electrical Drives (20EE4010) | HVDC & FACTS (20EE4015) | Advanced Power Converters (20EE4020) | Advanced Power Semiconductor Devices and Protection (20EE4025) |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4001 | INDUSTRIAL ELECTRICAL SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To make students understand the fundamental theory governing the photovoltaic devise and make them carry out preliminary system design.
2. To learn the fundamental knowledge about various fuel cell technologies.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the electrical wiring systems for residential, commercial and industrial consumers through symbols, drawings and SLD (BL-2) |
| **CO 2** | Justify the need of industrial electrical system components and industrial automation (BL-3) |
| **CO 3** | Analyze the size, rating and cost of electrical installations for residential and commercial applications (BL-4) |
| **CO 4** | Analyze the appropriate electrical system with protective equipments for industrial applications (BL-4) |
| **CO 5** | Understand the role of industrial automation (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | 2 | | | | | | | | | | 2 | 1 |
| CO2 | 3 | 2 | | | | | | | | | | | 3 | 2 |
| CO3 | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| CO4 | 3 | 2 | 2 | 2 | | | | | | | | | 3 | 3 |
| CO5 | 2 | 2 | | | 2 | | | | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Electrical System Components | 10 Hours |
|---|---|---|

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, Protection components- Fuse, MCB, MCCB, ELCB, Symbols for wiring components, Single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

At the end of the Module 1, students will be able to:

1. Understand the different types protecting devices (BL-2)
2. Discuss the various performance characteristics of protecting devices.(BL-2)

| MODULE -2 | Residential and Commercial Electrical Systems | 10 Hours |
|---|---|---|

Types of residential and commercial wiring systems, General rules and guidelines for installation, Load calculation and sizing of wire, Rating of main switch, distribution board and protection devices, Earthing system calculations, Requirements of commercial installation, Deciding lighting scheme and number of lamps, Earthing of commercial installation, Selection and sizing of components

At the end of the Module 2, students will be able to:

1. Discuss the different types of wiring systems (BL-3)
2. Discuss the concepts of Earthing system and its calculation (BL-3)

| MODULE-3 | Illumination Systems | 09 Hours |
|---|---|---|

| | | |
|---|---|---|
| Understanding various terms regarding light- lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, Various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, Energy saving in illumination systems, Design of a lighting scheme for a residential and commercial premises, Flood lighting | | |
| At the end of the Module 3, students will be able to:<br>1. Predict the performance of various lighting systems in industry. (BL-4) | | |
| **MODULE-4** | **Industrial Electrical Systems** | **10 Hours** |
| HT connection, Industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components<br>DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks | | |
| At the end of the Module 4, students will be able to:<br>1. Analyze the application of various equipments in industrial electrical system. (BL-4) | | |
| **MODULE-5** | **Industrial Electrical System Automation** | **09 Hours** |
| Study of basic PLC, Role of automation, Advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation | | |
| At the end of the Module 5, students will be able to:<br>1. Understand the performance of industrial automation for better operation of industry. (BL-2) | | |
| | **Total hours:** | **48 hours** |

**Term work:**

1. Field trip

**Content beyond syllabus:**

1. Introduction of hydrogen energy systems
2. Hydrogen production processes
3. Hydrogen storage and safety

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | Electric shock and Electrical safety practices | https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment |
| 2 | General rules and guidelines for installation | https://www.tutorhelpdesk.com/homeworkhelp/Engineering-/General-Rules-For-Wiring-Assignment-Help.html |
| 3 | Flood lighting | https://www.tutorialspoint.com/what-is-flood-lighting-definition-purpose-calculation-and-applications |
| 4 | Selection of UPS and Battery Banks | https://myelectrical.com/notes/entryid/164/ups-battery-sizing#:~:text=Example%20of%20UPS%20battery%20sizing,cells%20of%202%20V%20each). |
| 5 | Introduction to SCADA system for distribution automation | https://www.scadalink.com/support/knowledge-base/an-introduction-to-scada/#:~:text=The%20term%20SCADA%20stands%20for,for%20control%20or%20monitoring%20purposes. |

**Text Book(s):**

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.

2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.

**Reference Book(s):**

1. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008
2. 5. IS Standards : https://bis.gov.in

**Online Resources:**

1. https://electrical-engineering-portal.com/21-safety-rules-for-working-with-electrical-equipment
2. https://www.tutorhelpdesk.com/homeworkhelp/Engineering-/General-Rules-For-Wiring-Assignment-Help.html
3. https://www.tutorialspoint.com/what-is-flood-lighting-definition-purpose-calculation-and-applications
4. https://myelectrical.com/notes/entryid/164/ups-battery-sizing#:~:text=Example%20of%20UPS%20battery%20sizing,cells%20of%202%20V%20each).
5. https://www.scadalink.com/support/knowledge-base/an-introduction-to-scada/#:~:text=The%20term%20SCADA%20stands%20for,for%20control%20or%20monitoring%20purposes.

**Web References:**

1. https://nptel.ac.in/courses/108107112

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4006 | **POWER SYSTEM PLANNING** | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To make students understand the fundamental theory governing the power system planning and forecasting.
2. To make the students to understand the economics related to expansion of power system.
3. To learn the fundamental knowledge about transmission and distribution planning for future expansion.
4. To make the students to understand the reliability concept in power system to better operation of power system.
5. To make the students to make the planning with respect to electricity market based demand.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Discuss primary components of power system planning, planning methodology for optimum power system expansion and show knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools. (BL-2) |
| **CO 2** | Discuss methods to mobilize resources to meet the investment requirement for the power sector and understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions to power generation and planning for system energy in the country (BL-2) |
| **CO 3** | Analyze the operating states of transmission system, their associated contingencies and the stability of the system and discuss principles of distribution planning, supply rules, network development and the system studies. (BL-4) |
| **CO 4** | Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies (BL-2) |
| **CO 5** | Discuss planning and implementation of electric –utility activities, market principles and the norms framed by CERC for online trading and exchange in the interstate power market. (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 2 | 2 | 1 | 2 | | 2 | 2 | 2 | | 2 | 2 | 1 |
| **CO2** | 2 | 3 | 2 | 1 | 2 | 2 | | 2 | | | | 2 | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 2 | 2 | 2 | | 1 | 2 | 2 | | 2 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 2 | 1 | 2 | | 2 | | | | 2 | 3 | 3 |
| **CO5** | 3 | 2 | 2 | 2 | 2 | 2 | | 2 | 2 | 2 | | 2 | 2 | 1 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| COURSE CONTENT | | |
|---|---|---|
| **MODULE – 1** | Power System | **10 Hours** |

**Power System:**

Power Systems, Planning Principles, Planning Process, Project Planning, Power Development, Power Growth, National and Regional Planning, Enterprise Resources Planning, Structure of a Power System, Power Resources, Planning Tools, Power Planning Organisation, Regulation, Scenario Planning.

**Electricity Forecasting:**

Load Requirement, System Load, Electricity Forecasting, Forecasting Techniques, Forecasting Modelling, Spatial – Load Forecasting, Peak Load - Forecast, Reactive – Load Forecast, Unloading of a System.

At the end of the Module 1, students will be able to:

1. Discuss primary components of power system planning, planning methodology for optimum power system expansion, various types of generation, transmission and distribution.
2. Show knowledge of forecasting of future load requirements of both demand and energy by deterministic and statistical techniques using forecasting tools.

| **MODULE -2** | Power-System Economics | **10 Hours** |
|---|---|---|

**Power-System Economics:**

Financial Planning, Techno – Economic Viability, Private Participation, Financial Analysis, Economic Analysis, Economic Characteristics – Generation Units, Transmission, Rural Electrification Investment, Total System Analysis, Credit - Risk Assessment, Optimum Investment, Tariffs.

**Generation Expansion:**

Generation Capacity and Energy, Generation Mix, Conventional Generation Resources, Nuclear Energy, Clean Coal Technologies, Distributed Power Generation, Renovation and Modernization of Power Plants.

At the end of the Module 2, students will be able to:

- Discuss methods to mobilize resources to meet the investment requirement for the power sector
- Understand economic appraisal to allocate the resources efficiently and appreciate the investment decisions
- Discuss expansion of power generation and planning for system energy in the country

| **MODULE-3** | **Transmission & Distribution Planning:** | **08 Hours** |
|---|---|---|

**Transmission:**

Transmission Planning Criteria, Right – of – Way, Network Studies, High – Voltage Transmission, Conductors, Sub – Stations, Power Grid, Reactive Power Planning, Energy Storage.

**Distribution:**

Distribution Deregulation, Planning Principles, Electricity – Supply Rules, Criteria and Standards, Sub – Transmission, Basic Network, Low Voltage Direct Current Electricity,
Distribution(continued): Upgradation of Existing Lines and Sub – Stations, Network Development, System Studies, Urban Distribution, Rural Electrification, Villages Self – Sufficiency in Energy,

Community Power, Self – Generation.

At the end of the Module 3, students will be able to:

- Evaluation of operating states of transmission system, their associated contingencies and the stability of the system.
- Discuss principles of distribution planning, supply rules, network development and the system studies

| **MODULE-4** | **Reliability and Quality** | **10 Hours** |
|---|---|---|

Reliability Models, System Reliability, Reliability and Quality Planning, Functional Zones, Generation Reliability Planning Criteria, Transmission Reliability Criteria, Distribution Reliability, Reliability Evaluation, Grid Reliability, Reliability Target, Security Requirement, Disaster Management, Quality of Supply, Reliability and Quality Roadmap.

At the end of the Module 4, students will be able to:

- Discuss reliability criteria for generation, transmission, distribution and reliability evaluation and analysis, grid reliability, voltage disturbances and their remedies

| **MODULE-5** | Demand-Side Planning | **10 Hours** |
|---|---|---|

**Demand-Side Planning:**

Demand Response, Demand – Response Programmes, Demand– Response Technologies, Energy Efficiency, Energy - Economical Products, Efficient – Energy Users, Supply – Side Efficiency, Energy Audit.

**Electricity Market:**

Market Principles, Power Pool, Independent System Operator, Distribution System Operator, Power Balancing, Market Participants, Power Markets, Market Rules, Bidding, Trading, Settlement System, Locational Marginal Pricing, Transmission Charges, Merchant Power, Differential Electricity, Congestion Management, Ancillary Services, Hedging, Smart Power Market.

At the end of the Module 5, students will be able to:

- Discuss planning and implementation of electric –utility activities, market principles and the norms framed by CERC for online trading and exchange in the interstate power market.

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

1. Open book based exam

**Content beyond syllabus:**

1.

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | Power System Regulation, Scenario Planning | https://www.nrel.gov/docs/fy08osti/42297.pdf |
| 2 | Modernization of Power Plants | https://www.powermag.com/history-of-power-plant-renovation-and-modernization-in-india/#:~:text=The%20GoI%20initiated%20a%20new,the%20existing%20thermal%20power%20plants. |
| 3 | Reactive Power Planning | https://www.igi-global.com/dictionary/reactive-power-planning/63461 |
| 4 | Reliability and Quality Roadmap | https://www.slideshare.net/ASQwebinars/reliability-roadmap-using-quality-function-deployment |
| 5 | Smart Power Market | https://www.alliedmarketresearch.com/smart-energy-market-A09434 |

**Text Book(s):**

1. Electric Power Planning A. S. Pabla McGraw Hill, 2nd Edition, 2016

**Online Resources:**

1. https://www.nrel.gov/docs/fy08osti/42297.pdf
2. https://www.powermag.com/history-of-power-plant-renovation-and-modernization-in-india/#:~:text=The%20GoI%20initiated%20a%20new,the%20existing%20thermal%20power%20plants.
3. https://www.igi-global.com/dictionary/reactive-power-planning/63461
4. https://www.slideshare.net/ASQwebinars/reliability-roadmap-using-quality-function-deployment
5. https://www.alliedmarketresearch.com/smart-energy-market-A09434

**Web References:**

1. https://nptel.ac.in/courses/108101040

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4011 | **Reactive Power Compensation and Management** | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

- To identify the necessity of reactive power compensation
- To describe load compensation
- To select various types of reactive power compensation in transmission systems
- To contrast reactive power coordination system
- To characterize distribution side and utility side reactive power management.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads (BL-3) |
| **CO 2** | Observe various compensation methods in transmission lines (BL-2) |
| **CO 3** | Construct model for reactive power coordination (BL-3) |
| **CO 4** | Understand the demand side reactive power management (BL-2) |
| **CO 5** | Understand the user side reactive power management (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | 2 | 2 | | 2 | | | | | 2 | | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | | 2 | | | | | 2 | | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | | 2 | | | | | 2 | | 2 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | | 2 | | | | | 2 | | 3 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | | 2 | | | | | 2 | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Load Compensation** | **10 Hours** |
|---|---|---|

Objectives and specifications – reactive power characteristics – inductive and capacitive approximate biasing – Load compensator as a voltage regulator – phase balancing and power factor correction of unsymmetrical loads- examples.

At the end of the Module 1, students will be able to:

1. Distinguish the importance of load compensation in symmetrical as well as un symmetrical loads (BL-3)

| **MODULE -2** | **Steady – State Reactive Power Compensation in Transmission System** | **10 Hours** |
|---|---|---|

Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –examples Transient state reactive power compensation in transmission systems: Characteristic time periods – passive shunt compensation – static compensations- series capacitor compensation – compensation using synchronous condensers – examples

At the end of the Module 2, students will be able to:

1. Observe various compensation methods in transmission lines (BL-2)

| **MODULE-3** | **Reactive Power Coordination** | **09 Hours** |
|---|---|---|

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency –Harmonics, radio frequency and electromagnetic interferences

At the end of the Module 3, students will be able to:

1. Construct model for reactive power coordination (BL-3)

| **MODULE-4** | **Demand Side Management** | **10 Hours** |
|---|---|---|

Load patterns – basic methods load shaping – power tariffs- KVAR based tariffs penalties for voltage flickers and Harmonic voltage levels Distribution side Reactive power Management:: System losses –loss reduction methods – examples – Reactive power planning – objectives – Economics Planning capacitor placement – retrofitting of capacitor banks

At the end of the Module 4, students will be able to:

1. Understand the demand side reactive power management (BL-2)

| **MODULE-5** | **User Side Reactive Power Management** | **09 Hours** |
|---|---|---|

KVAR requirements for domestic appliances – Purpose of using capacitors – selection of capacitors – deciding factors – types of available capacitor, characteristics and Limitations Reactive power management in electric traction systems and are furnaces: Typical layout of traction systems – reactive power control requirements – distribution transformers- Electric arc furnaces – basic operations- furnaces transformer –filter requirements – remedial measures –power factor of an arc furnace

At the end of the Module 5, students will be able to:

1. Understand the user side reactive power management (BL-2)

| **Total hours:** | **48 hours** |
|---|---|

**Term work:**

1.

**Content beyond syllabus:**

1. Modern tool usage to analyze the reactive power in power system

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | power factor correction of unsymmetrical loads | http://ethesis.nitrkl.ac.in/6395/1/E-8.pdf |
| 2 | series capacitor compensation | https://circuitglobe.com/series-compensation.html |
| 3 | radio frequency and electromagnetic interferences | https://en.wikipedia.org/wiki/Electromagnetic_interference |
| 4 | retrofitting of capacitor banks | https://www.theelectricalguy.in/tutorials/5-types-of-power-factor-correction-capacitor-bank-locations/ |
| 5 | power factor of an arc furnace | https://www.ijert.org/research/power-quality-improvement-in-electric-arc-furnace-IJERTV4IS040198.pdf |

**Text Book(s):**

- Reactive power control in Electric power systems by T.J.E. Miller, John Wiley and sons, 1982.

- Reactive power Management by D. M. Tagare, Tata McGraw Hill, 2004.

**Reference Book(s):**

- Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "Reactive Power Compensation: A Practical Guide, April, 2012, Wiely publication.

**Online Resources:**

1. http://ethesis.nitrkl.ac.in/6395/1/E-8.pdf
2. https://circuitglobe.com/series-compensation.html
3. https://en.wikipedia.org/wiki/Electromagnetic_interference
4. https://www.theelectricalguy.in/tutorials/5-types-of-power-factor-correction-capacitor-bank-locations/
5. https://www.ijert.org/research/power-quality-improvement-in-electric-arc-furnace-IJERTV4IS040198.pdf

**Web References:**

1. https://www.youtube.com/watch?v=OR5Fdfh9Hbw

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4016 | POWER QUALITY | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. Power quality issues and standards.
2. The sources of power quality disturbances and power transients that occur in power systems.
3. The sources of harmonics, harmonic indices, Devices for controlling harmonic distortion.
4. The principle of operation of DVR and UPQC.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Address power quality issues to ensure meeting of standards (BL-2) |
| **CO 2** | Apply the concepts of compensation for sags and swells using voltage regulating devices (BL-3) |
| **CO 3** | Assess harmonic distortion and its mitigation. (BL-4) |
| **CO 4** | Understand the power measurement data according to standards (BL-2) |
| **CO 5** | Analyze the power quality improvement with custom power devices (BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | | | | | | | | | 3 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 2 |
| CO4 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | INTRODUCTION | 10 Hours |
|---|---|---|

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues- Magnitude Versus Duration Plot - Power Quality Standards - Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

At the end of the Module 1, students will be able to:

1. Address power quality issues to ensure meeting of standards (BL-2)

| MODULE -2 | TRANSIENTS, SHORT DURATION AND LONG DURATION VARIATIONS | 10 Hours |
|---|---|---|

Categories and Characteristics of Electromagnetic Phenomena in Power Systems- Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality
Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

At the end of the Module 2, students will be able to:

1. Apply the concepts of compensation for sags and swells using voltage regulating devices (BL-3)

| MODULE-3 | FUNDAMENTALS OF HARMONICS & APPLIED HARMONICS | 09 Hours |
|---|---|---|

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

At the end of the Module 3, students will be able to:

1. Assess harmonic distortion and its mitigation. (BL-4)

| **MODULE-4** | **POWER QUALITY MONITORING** | **10 Hours** |
|---|---|---|

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations-Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

At the end of the Module 4, students will be able to:

1. Understand the power measurement data according to standards (BL-2)

| **MODULE-5** | **POWER QUALITY ENHANCEMENT USING CUSTOM POWER DEVICES** | **09 Hours** |
|---|---|---|

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

At the end of the Module 5, students will be able to:

1. Analyze the power quality improvement with custom power devices (BL-4)

| **Total hours:** | **48 hours** |
|---|---|

**Term work:**

1.

**Content beyond syllabus:**

1. AI based power quality improvement methods.

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | Responsibilities of Suppliers and Users of Electric Power | https://pure.tue.nl/ws/files/2804575/712690.pdf |
| 2 | Conventional Devices for Voltage Regulation | https://www.electrical4u.com/voltage-regulator/ |
| 3 | Devices for Controlling Harmonic Distortion | https://www.brainkart.com/article/Devices-for-Controlling-Harmonic-Distortion_11725/ |
| 4 | Power Quality Monitoring Standards | https://www.engineeringenotes.com/electrical-engineering/power-quality/standards-for-monitoring-power-quality-electricity/32560 |
| 5 | Custom Power Devices | https://www.ripublication.com/irph/ijeee_spl/ijeeev7n7_11.pdf |

**Text Book(s):**

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.

2. Power quality, C. Sankaran, CRC Press, 2001.

**Reference Book(s):**

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.

**Online Resources:**

1. https://pure.tue.nl/ws/files/2804575/712690.pdf
2. https://www.electrical4u.com/voltage-regulator/
3. https://www.brainkart.com/article/Devices-for-Controlling-Harmonic-Distortion_11725/
4. https://www.engineeringenotes.com/electrical-engineering/power-quality/standards-for-monitoring-power-quality-electricity/32560
5. https://www.ripublication.com/irph/ijeee_spl/ijeeev7n7_11.pdf

**Web References:**

1. https://onlinecourses.nptel.ac.in/noc21_ee103/preview

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4021 | **SMART GRID TECHNOLOGIES** | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

- To understand various aspects of smart grid
- To study various smart transmission and distribution technologies
- To appreciate distribution generation and smart consumption
- To know the regulations and market models for smart grid

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand technologies for smart grid (BL-2) |
| **CO 2** | Understand the smart transmission system and its technologies (BL-2) |
| **CO 3** | Understand the smart distribution system and its technologies (BL-2) |
| **CO 4** | Realize the distribution generation and smart consumption (BL-3) |
| **CO 5** | Know the regulations and market models for smart grid (BL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | 3 | 2 | | 2 | 2 | | | | | | 2 | 1 |
| **CO2** | 3 | 3 | 3 | 2 | | 2 | 2 | | | | | | 3 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | | 2 | 2 | | | | | | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | | 2 | 2 | 2 | | | | | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 2 | | 2 | 2 | 2 | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Introduction to Smart Grids** | **10 Hours** |
|---|---|---|

Definition, justification for smart grids, smart grid conceptual model, smart grid architectures, Interoperability, communication technologies, role of smart grids standards, intelligrid initiative, national smart grid mission (NSGM) by Govt. of India

At the end of the Module 1, students will be able to:

1. Understand technologies for smart grid (BL-2)

| **MODULE -2** | **Smart Transmission Technologies** | **10 Hours** |
|---|---|---|

Substation automation, Supervisory control and data acquisition (SCADA), energy management system (EMS), phasor measurement units (PMU), Wide area measurement systems (WAMS)

At the end of the Module 2, students will be able to:

1. Understand the smart transmission system and its technologies (BL-2)

| | | |
|---|---|---|
| **MODULE-3** | Smart Distribution Technologies | **09 Hours** |
| Distribution automation, outage management systems, automated meter reading (AMR), automated metering infrastructure (AMI), fault location isolation and service restoration (FLISR), Outage Management Systems (OMS), Energy Storage, Renewable Integration | | |
| At the end of the Module 3, students will be able to:<br>1. Understand the smart distribution system and its technologies (BL-2) | | |
| **MODULE-4** | Distributed Generation and Smart Consumption | **10 Hours** |
| Distributed energy resources (DERs), smart appliances, low voltage DC (LVDC) distribution in homes / buildings, home energy management system (HEMS), Net Metering, Building to Grid B2G, Vehicle to Grid V2G, Solar to Grid, Microgrid | | |
| At the end of the Module 4, students will be able to:<br>1. Realize the distribution generation and smart consumption (BL-3) | | |
| **MODULE-5** | Regulations and Market Models for Smart Grid | **09 Hours** |
| Demand Response, Tariff Design, Time of the day pricing (TOD), Time of use pricing (TOU), Consumer privacy and data protection, consumer engagement etc. Cost benefit analysis of smart grid projects. | | |
| At the end of the Module 5, students will be able to:<br>1. Know the regulations and market models for smart grid (BL-2) | | |
| **Total hours:** | | **48 hours** |

**Content beyond syllabus:**

1. Cost Estimation of Smart Gird in India

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | National smart grid mission (NSGM) by Govt. of India | https://www.nsgm.gov.in/#:~:text=NSGM%20Establishment,January%202016%20with%20dedicated%20team. |
| 2 | Wide area measurement systems (WAMS) | https://www.energy.gov/sites/default/files/oeprod/DocumentsandMedia/8-Securing_WAMS.pdf |
| 3 | Renewable Integration | https://www.energy.gov/oe/services/technology-development/renewable-energy-integration |
| 4 | Home energy management system (HEMS) | https://www.osti.gov/servlets/purl/1423114 |
| 5 | Cost benefit analysis of smart grid projects | https://www.slideshare.net/sustenergy/multicriteria-and-cost-benefit-analysis-for-smart-grid-projects |

**Text Book(s):**

1. Clark W Gellings, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response"- CRC Press, 2009.
2. Jean Claude Sabonnadière, Nouredine Hadjsaïd, "Smart Grids", Wiley-ISTE, IEEE Press, May 2012

**Reference Book(s):**

- Janaka Ekanayake, Kithsiri Liyanage, Jianzhong. Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid: Technology and Applications"- Wiley, 2012.
- James Momoh, "Smart Grid: Fundamentals of Design and Analysis" – Wiley, IEEE Press, 2012.

**Online Resources:**

1. https://www.nsgm.gov.in/#:~:text=NSGM%20Establishment,January%202016%20with%20dedicated%20team.
2. https://www.energy.gov/sites/default/files/oeprod/DocumentsandMedia/8-Securing_WAMS.pdf
3. https://www.energy.gov/oe/services/technology-development/renewable-energy-integration
4. https://www.osti.gov/servlets/purl/1423114
5. https://www.slideshare.net/sustenergy/multicriteria-and-cost-benefit-analysis-for-smart-grid-projects

**Web References:**

1. India Smart Grid Knowledge Portal

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4002 | System Modelling and Identification | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | ACS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1.To Understand the Modelling of Dynamic Systems
2 To Understand the Stability margins, correlation of frequency domain and time domain
3. To Understand the Concepts of linear sampled data systems
4. To Understand the computation Z-transform
5. To Understand the compensation in Z domain and W plane

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Learn the design of Modelling of Dynamic Systems |
| **CO 2** | Analyze the Stability margins, correlation of frequency domain and time domain |
| **CO 3** | Analyse linear sampled data systems |
| **CO 4** | Learn the computation Z-transform |
| **CO 5** | Understand the compensation in Z domain and W plane |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 1 | 1 | | | | | | | | | | 1 | 1 |
| **CO2** | 3 | | 1 | | | | | | | | | | 1 | 1 |
| **CO3** | 1 | 2 | | | | | | | | | | | | 1 |
| **CO4** | 1 | 2 | 1 | | | | | | | | | | 1 | 1 |
| **CO5** | 1 | | 2 | | | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**Modelling of Dynamic Systems**

State variable Modelling of Continuous Dynamic Systems.
Solution methods for Nonlinear Differential equations. Bond Graph Techniques.

At the end of the Module 1, students will be able to:

1. Understand the importance of State variable approach
2. Analyze Nonlinear Differential equations

**MODULE -2**

**Classical control theory:**

Review of classical control theory: Stability margins, correlation of frequency domain and time domain parameters, design specifications, compensation of continuous systems, actuator selection and design.
State variable modelling of linear continuous systems, controllability and observability

At the end of the Module 2, students will be able to:

1. Understand the Stability margins
2. Analyze correlation of frequency domain and time domain parameters, design
3. Understand the concepts of controllability and observability

**MODULE-3**

**Concepts of linear sampled data systems:** Discrete equivalents of continuous data systems, reconstruction of sampled signals, sample and 0 order holds, stability of linear sampled data systems.
State variable modelling of linear discrete data systems, controllability and observability.

At the end of the Module 3, students will be able to:

1. Analyze stability of linear sampled signals.
2. Understand the State variable modelling of linear discrete data systems

**MODULE-4**

**Digital Control Theory**: **I**
Review of Z-transform. Computation of time response of Discrete Data system. Bilinear Transformation. W-plane, prewarping, inverse transformation. Design of discrete controllers.

At the end of the Module 4, students will be able to:

1. Understand the Z-transform & Bilinear Transformation
2. Analyze the design of discrete controllers

**MODULE-5**

**Digital Control Theory**: **II**
Z-domain compensation, w-plane compensation, state variable feedback, deadbeat controller sampled data version of PID controllers. Effect of Data Digitization. Effect of finite word size, limit cycle Determination.

At the end of the Module 5, students will be able to:

1. Analyze compensations in Z domains, W domains
2. Understand the concepts of controllers

| **Total hours:** | **50 hours** |
|---|---|

**Term work:**
Assignments followed by quizzes

**Content beyond syllabus:**
Simulation Software. Skeletal Structure of Simulation software

**Self-Study:**
Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Bond Graph Techniques | CO1 | https://researchonline.gcu.ac.uk/ws/portalfiles/portal/3218404/bond_graph_modeling_postprint.pdf |
| 2 | State variable modelling of linear continuous systems | CO2 | https://www.ijert.org/state-variable-analysis-of-continuous-time-systems |
| 3 | controllability and observability | CO3 | https://www.ece.rutgers.edu/~gajic/psfiles/chap5traCO.pdf |
| 4 | W-plane, prewarping | CO4 | https://en.wikibooks.org/wiki/Digital_Signal_Processing/Bilinear_Transform |
| 5 | Effect of finite word size | CO5 | http://www.dsp-book.narod.ru/DSPMW/03.PDF |

**Text Book(s):**

1. G.P. Rao, "Identification of continuous-time systems" suggested by Kranthi Deveerasetty (Entry level)

2. Modeling & Identification of Dynamic Systems Hardcover – Import, 23 August 2016
by Lennart Ljung (Author), Torkel Glad (Author)

3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

| |
|---|
| **Reference Book(s):**<br>1. Highlights of system identification provided by Manuel De la Sen.<br>. Heij, A.C.M. Ran, F. van Schagen, "Introduction to Mathematical Systems Theory: Linear Systems, Identification and Control" suggested by Mahmood Dadkhah<br>2.System Identification: An Introduction Book by Karel J. Keesman |
| **Online Resources:**<br>1. https://ptolemy.berkeley.edu/books/Systems/PtolemyII_DigitalV1_02.pdf |
| **Web Resources:**<br>1. https://hal.archives-ouvertes.fr/hal-00718864/document<br>2. https://www.mathworks.com/help/ident/gs/about-system-identification.html |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4007 | ADVANCED CONTROL SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | ACS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To Understand state feedback control and state observer
2. To Understand the phase plane analysis
3. To Understand the Analysis of describing functions with non-linearities
4. To Understand the design of optimal controller
5. To Understand the design of optimal estimator including Kalman Filter, Lyapunov's Stability

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Learn the design of state feedback controller and state observer |
| **CO 2** | Analyze the linear and nonlinear systems using phase plane method. |
| **CO 3** | Analyse nonlinear systems using describing function method.. |
| **CO 4** | Learn the optimal control problem |
| **CO 5** | Understand the Solution of Kalman Filter by duality principle, Direct method of Lypanov for Linear and Nonlinear continuous time autonomous systems. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 1 | 1 | | | | | | | | | | 1 | 2 |
| **CO2** | 3 | | 1 | | | | | | | | | | 1 | 1 |
| **CO3** | 1 | 2 | | | | | | | | | | | | 1 |
| **CO4** | 2 | 2 | 3 | | | | | | | | | | 1 | 2 |
| **CO5** | 2 | | 1 | | | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**STATE VARIABLE DESIGN**:

Introduction to state model: Effect of state feedback - Pole placement design: Necessary and sufficient condition for arbitrary pole placement, State regulator design - Design of state observers- Separation principle- Design of servo systems: State feedback with integral control

At the end of the Module 1, students will be able to:

1. Understand the importance of State variable approach
2. Analyze the state observers and pole placement
3. Develop the State feedback with integral control

**MODULE -2**

**PHASE PLANE ANALYSIS:**

Features of linear and non-linear systems - Common physical non-linearities – Phase plane method: Basic concept, Singular points, Limit cycles, Phase trajectories - Construction of phase trajectories of linear and non-linear systems: Analytical method, Isocline method.

At the end of the Module 2, students will be able to:

1. Understand the Features of linear and non-linear systems
2. Implement the Phase plane method
3. Understand the Construction of phase trajectories of linear and non-linear systems

**MODULE-3**

**DESCRIBING FUNCTION ANALYSIS:**

Basic concepts, Derivation of describing functions for common non-linearities: Dead zone, Saturation, Relay, Hysteresis, Backlash – Describing function analysis of non-linear systems, Limit cycles, Stability of oscillations.

At the end of the Module 3, students will be able to:

1. Derive the describing functions for common non-linearities.
2. Understand the concept of Stability of oscillations

**MODULE-4**

**OPTIMAL CONTROL:**

Introduction: Classical control and optimization, formulation of optimal control problem, Typical optimal control performance measures - Optimal state regulator design: Lyapunov equation, Matrix Riccati equation - LQR steady state optimal control – Application examples.

At the end of the Module 4, students will be able to:

1. Understand the formulation of optimal control problem
2. Analyze the optimal control performance measures
3. Understand the Lyapunov and Matrix Riccati equations

**MODULE-5**

**OPTIMAL ESTIMATION:**

Introduction: Discrete systems - Optimal estimation: Kalman Filter, Kalman Bucy Filter, Solution by duality principle - Application examples.

**STABILITY ANALYSIS:**

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems. Direct method of Lypanov for the Linear and Nonlinear continuous time autonomous systems.

At the end of the Module 5, students will be able to:

1. Analyze the operation of Kalman and Kalman Bucy Filter
2. Understand the Solution by duality principle
3. Understand the Direct method of Lypanov for autonomous systems.

| **Total hours:** | **50 hours** |
|---|---|

**Term work:**

Assignments followed by quizzes

**Content beyond syllabus:**

Real-time Embedded Control Systems

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | state feedback controller and state observer | CO1 | https://nptel.ac.in/content/storage2/courses/108103008/PDF/module9/m9_lec3.pdf |
| 2 | linear and nonlinear systems using phase plane method | CO2 | https://nptel.ac.in/courses/108/106/108106162/ |
| 3 | Analysis of describing functions with non-linearities | CO3 | https://people.unica.it/eliousai/files/2015/10/Describing-Function-analysis-v1.pdf |
| 4 | Optimal control problem | CO4 | https://nptel.ac.in/courses/108/105/108105019/# |
| 5 | Solution of Kalman Filter by duality principle | CO5 | https://nptel.ac.in/content/storage2/courses/101108047/module15/Lecture%2040.pdf https://nptel.ac.in/courses/101/108/101108047/ |

**Text Book(s):**

1. M.Gopal, “Digital Control and State Variable Methods”, 4th edition, Mc Graw Hill India, 2012
2. K. Ogata, ‘Modern Control Engineering’, 5th Edition, Pearson, 2012
3. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006.

**Reference Book(s):**

1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group, 2011.
2. M.Gopal, Modern Control System Theory, 3rd edition, New Age International Publishers, 2014

**Online Resources:**

1. https://b-ok.asia/book/1193802/dec93b
2. https://b-ok.asia/book/459450/7e89ab

**Web Resources:**

1. https://www.youtube.com/watch?v=bbm79-UcNN0&list=PLbMVogVj5nJTNkhtkCEKQHhPOr2bpS3za
2. https://www.youtube.com/watch?v=DSvBXXnZv34&list=PLUY5PVaLSLNEKzeQv13ZevTL5AhnQOkWX

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4012 | Digital Signal Processing | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | ACS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To Understand Discrete-time signals and systems & properties
2. To Understand z- Transform, inverse z- Transform & properties
3. To Understand the design of low pass, high pass, band pass & stop band IIR digital filters
4. To Understand Computer aided design of Equiripple Linear phase FIR filters
5. To Understand arithmetic round off errors, Low sensitivity digital filters

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand Discrete-time signals and systems & properties |
| **CO 2** | Analyze the z- Transform, inverse z- Transform & properties |
| **CO 3** | Understand the design of low pass, high pass, band pass & stop band IIR digital filters |
| **CO 4** | Learn Computer aided design of Equiripple Linear phase FIR filters |
| **CO 5** | Understand arithmetic round off errors, Low sensitivity digital filters. |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 2 | 1 | | | | | | | | | | 1 | 2 |
| **CO2** | 1 | | 3 | | | | | | | | | | 1 | 2 |
| **CO3** | 2 | 2 | | | | | | | | | | | | 1 |
| **CO4** | 2 | 1 | 3 | | | | | | | | | | 1 | 2 |
| **CO5** | 2 | | 1 | | | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

Short introduction, Analog to digital and Digital to Analog conversion, sampled and Hold circuit, Continuous time Fourier Transforms. Discrete-time signals and systems, Discrete-time Fourier transform- its properties and applications, Fast Fourier Transform (in time-domain and Frequency domain) , IDFT and its properties.

At the end of the Module 1, students will be able to:

1. Understand Analog to digital and Digital to Analog conversion
2. Analyze Discrete-time signals & Continuous time Fourier Transforms

**MODULE -2**

**z- Transforms**

Definition and properties, Rational z-transforms, Region of convergence of a rational z- Transform, The inverse z-Transform, Z-Transform properties, Computation of the convolution sum of finite length sequences, The transfer function

**Digital Filter Structures:** Block Diagram representation, Equivalent structures, Basic FIR Digital Filter structures, Basic IIR Digital Filter structures, Realization of Basic structures using MATLAB, All pass filters, Computational complexity of Digital filter structures.

At the end of the Module 2, students will be able to:

1. Understand the Digital Filter structures
2. Able to Compute of the convolution sum of finite length sequences
3. Able to form Basic structures using MATLAB

**MODULE-3**

**IIR Digital Filter Design:**
Preliminary considerations, Bilinear transformation method of IIR Filter design, Design of low pass IIR Digital filters, Design of High pass, Band pass and band stop IIR digital filters, Spectral Transformations of IIR filter, IIR digital filter design using MATLAB, Computer aided design of IIR digital filters.

At the end of the Module 3, students will be able to:

1. Able to design Computer aided IIR digital filters
2. Understand the concept Bilinear transformation

**MODULE-4**

**FIR Digital Filter Design:**
Preliminary considerations, FIR filter design based on windowed Fourier series, Computer aided design of Equiripple Linear phase FIR filters, Design of Minimum phase FIR filters, FIR digital filter design using MATLAB, Design of computationally efficient FIR digital filters.

At the end of the Module 4, students will be able to:

1. Understand the concept of windowed Fourier series
2. Analyze the Design of Minimum phase FIR filters

**MODULE-5**

**Analysis of Finite word length effects**:
The quantization process and errors, quantization of Fixed point numbers, Quantization of floating point numbers, Analysis of coefficient quantization effects, Analysis of arithmetic round off errors, Low sensitivity digital filters, Reduction of product round off errors using error feedback, Round off errors in FFT algorithms. The basic sample rate alteration devices, Multi rate structures for sampling rate conversion, Multistage design of decimator and interpolator, The Poly phase decomposition, Arbitrary-rate sampling rate converter.

At the end of the Module 5, students will be able to:

1. Analyze the coefficient quantization effects
2. Understand the Multi rate structures for sampling rate conversion
3. Understand the Multistage design of decimator and interpolator.

| **Total hours:** | **50 hours** |
|---|---|

**Term work:**
Assignments followed by quizzes

**Content beyond syllabus:**
Nyquist Filters and some applications of digital signal processing.

**Self-Study:**
Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Discrete-time Fourier transform- its properties | CO1 | https://cnx.org/contents/KilsjSQd@10.18:AMguPRlV@11/Properties-of-the-DTFT |
| 2 | Basic FIR Digital Filter structures | CO2 | https://www.ni.com/docs/en-US/bundle/labview-2014-digital-filter-design-toolkit-api-ref/page/lvdfdtconcepts/fir_filter_specs.html |
| 3 | Computer aided design of IIR digital filters. | CO3 | https://www.tutorialspoint.com/digital_signal_processing/dsp_computer_aided_design.htm |
| 4 | Design of Minimum phase FIR filters | CO4 | https://www.dsprelated.com/freebooks/filters/Minimum_Phase_Filters.html |
| 5 | Analysis of arithmetic round off errors | CO5 | https://en.wikipedia.org/wiki/Round-off_error |

**Text Book(s):**

1. S.K. Mitra, Digital Signal Processing-, Tata McGraw-Hill, Third Edition, 2006.
2. B.P. Lathi, Principle of Signal Processing and Linear Systems-, Oxford International Student Version, 2009
3. M. Mondal and A Asif, Continuous and Discrete Time Signals and Systems, Cambridge,2007

**Reference Book(s):**

1. Li Tan, Digital Signal Processing- Fundamentals and Applications-, Indian reprint, Elsevier, 2008.
2. Alan V. Oppenheim, Ronald W. Schafer, and John R.Buck, Discrete- Time Signal Processing-, Pearson Edu, 2008.

**Online Resources:**

1. https://www.tutorialspoint.com/digital_signal_processing/dsp_unstable_systems.htm
2.softwaretestinghelp.com/digital-signal-processing-tutorial/

**Web Resources:**

1. https://www.youtube.com/watch?v=6dFnpz_AEyA
2. https://www.youtube.com/watch?v=JpHXMcDxNiA
3.https://www.youtube.com/watch?v=p8cina5Ke_c

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4017 | MULTIVARIABLE CONTROL SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | ACS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To Understand Multivariable Connections, Multivariable Representation
2. To Understand Performance Specification in Multivariable Systems
3. To Understand Stability of Multivariable Feedback
4. To Understand Controllability and Observability and Realization in Multivariable Systems
5. To Understand Multivariable Control System Design

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Learn the Multivariable Connections, Multivariable Representation |
| **CO 2** | Analyze the Performance Specification in Multivariable Systems. |
| **CO 3** | Analyse Stability of Multivariable Feedback |
| **CO 4** | Learn the Controllability and Observability and Realization in Multivariable Systems |
| **CO 5** | Understand the Multivariable Control System Design |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 1 | 1 | | | | | | | | | | 1 | 2 |
| CO2 | 3 | | 1 | | | | | | | | | | 1 | 1 |
| CO3 | 1 | 2 | | | | | | | | | | | | 1 |
| CO4 | 2 | 2 | 3 | | | | | | | | | | 1 | 2 |
| CO5 | 2 | | 1 | | | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

**Introduction in Multivariable Control Systems:**
Multivariable Connections, Multivariable Representation
**Poles and Zeros in Multivariable Systems** : Multivariable Poles and Zeros, Direction of Poles and Zeros, Smith-McMillan Form, Matrix Fraction Description, Transmission Zero Assignment

At the end of the Module 1, students will be able to:

1. Understand the Multivariable Control Systems
2. Analyze the Transmission Zero Assignment

**MODULE -2**

**Performance Specification in Mulivariable Systems and Their Limitations:**
A Brief Review of Linear Control System, Scaling and Performance, Shaping Closed-loop Transfer Function, Fundamental Limitation on Performance

At the end of the Module 2, students will be able to:

1. Understand the Performance Specification in Mulivariable Systems
2. Understand the Limitations

**MODULE-3**

**Stability of Multivariable Feedback Control Systems:** Well-Posedness of Feedback Loop, Internal Stability, The Nyquist Stability Criterion, Co-prime Factorization over Stable Transfer Functions, Stabilizing Controllers, Strong and Simultaneous Stabilization

At the end of the Module 3, students will be able to:

1. Understand the concept of Stabilizing Controllers
2. Understand the concept of Stability

**MODULE-4**

**Controllability and Observability and Realization in Multivariable Systems:**

Controllability and Observability, Output Controllability, Realization, Model Order Reduction

At the end of the Module 4, students will be able to:

1. Understand the concept of Controllability and Observability
2. Analyze the Realization techniques

**MODULE-5**

**Multivariable Control System Design**: Sequential Loop Closing, Characteristic-Locus Method, PI Controller for MIMO Systems ,Decoupling, Diagonal Controller, Nyquist-Array Method

At the end of the Module 5, students will be able to:

1. Analyze the Sequential Loop Closing
2. Understand the Decoupling, Diagonal Controllers

| **Total hours:** | **50 hours** |
|---|---|

**Term work:**

Assignments followed by quizzes

**Content beyond syllabus:**

Robust stability and performance analysis via integral quadratic constraints.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Multivariable Control Systems | CO1 | https://www.youtube.com/watch?v=mMtFuYeJp5A |
| 2 | Scaling and Performance ns | CO2 | https://www.dynatrace.com/news/blog/performance-vs-scalability/ |
| 3 | Stability of Multivariable Feedback Control Systems | CO3 | https://www.sciencedirect.com/topics/engineering/multivariable-control-systems |
| 4 | Model Order Reduction | CO4 | https://www.hindawi.com/journals/sv/2021/6631180/ |
| 5 | Controllability and Observability and Realization in Multivariable Systems | CO5 | http://profsite.um.ac.ir/~karimpor/multi/Multivariable_lec5.pdf |

| |
|---|
| **Text Book(s):**<br>**1.Multivariable Control Systems: An Engineering Approach (Advanced Textbooks in Control and Signal Processing) 2004th Edition, Kindle Edition by Pedro Albertos (Author), Sala Antonio (Author) Format: Kindle Edition** |
| **Reference Book(s):**<br>1. Multivariable Feedback Control - Analysis and Design 2e (English, Paperback, Skogestad S) |
| **Online Resources:**<br>1. https://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_3352.pdf |
| **Web Resources:**<br>1. https://research.iaun.ac.ir/pd/mahmoodian/pdfs/UploadFile_3352.pdf |

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4022 | REAL TIME CONTROL SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | ACS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To Understand Real - time systems
2. To Understand Hierarchical representation of complex DES
3. To Understand Real - time Operating Systems, Interrupts
4. To Understand Real – time Programming.
5. To Understand Real - time process and applications

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Analyze the Characteristic features of RT applications and develop features from Non - RT and Off - line system |
| **CO 2** | Understand the Hierarchical representation and analyzing Logical properties |
| **CO 3** | Derive the Example of checking safety and timing properties and also understand the Requirements and features of real - time Computing Environments |
| **CO 4** | Understand and analyze the Real – time Programming for real-time systems. |
| **CO 5** | Analyze the Real - time process, Applications and understand the Distributed Real - time systems |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | 2 | 2 | | | | | | | | | 1 | 2 |
| **CO2** | 3 | 3 | 2 | 2 | | | | | | | | | 1 | 1 |
| **CO3** | 3 | 3 | 2 | 2 | | | | | | | | | | 1 |
| **CO4** | 3 | 3 | 2 | 2 | | | | | | | | | 1 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

**MODULE – 1**

Introduction to Real - time systems: Typical examples of RTS, Characteristic features of RT Applications. Structural, Functional and Performance requirement of Reactive RTS. Distinctive Features from Non - RT and Off - line system. Modelling RTS: Representation of time, Concurrency and Distributedness in discrete event systems.

At the end of the Module 1, students will be able to:

1. Understand the Real - time systems
2. Analyze the Characteristic features of RT applications
3. Develop features from Non - RT and Off - line system

**MODULE -2**

Hierarchical representation of complex DES. Input, Output and Communication. Examples of Modelling practical systems as RT DES. Modelling programs as RTS. Analyzing RTS: Analyzing Logical properties of DES such as Reachability, Deadlock etc. Analyzing timing related properties, Specification and Verification of RT DES properties.

At the end of the Module 2, students will be able to:

1. Understand the Hierarchical representation
2. Analyzing Logical properties

**MODULE-3**

Temporal logic, Model checking of industrial systems. Requirements and features of real - time Computing Environments: Real - time Operating Systems, Interrupts, clock, Device support.

At the end of the Module 3, students will be able to:

1. Derive the Example of checking safety and timing properties.
2. Understand the Requirements and features of real - time Computing Environments

**MODULE-4**

Real time System, Multi tasking, Static and Dynamical Scheduling of resource Allocation, Real – time Programming.

At the end of the Module 4, students will be able to:

1. Understand the Real time System
2. Analyze the Real – time Programming.

**MODULE-5**

Real - time process and applications, Distributed Real - time systems.

At the end of the Module 5, students will be able to:

1. Analyze the Real - time process
2. Understand the Real - time Applications
3. Understand the Distributed Real - time systems

| **Total hours:** | **48 hours** |
|---|---|

**Term work:**

Assignments followed by quizzes

**Content beyond syllabus:**

Dynamic Scheduling Algorithms

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Distributedness in discrete event systems | CO1 | https://www.intechopen.com/chapters/38818 |
| 2 | Specification and Verification of RT DES properties | CO2 | https://hal.archives-ouvertes.fr/hal-01589479/document |
| 3 | Requirements and features of real - time Computing Environments | CO3 | https://www.sciencedirect.com/topics/computer-science/real-time-computing |
| 4 | Multi tasking of Real time System | CO4 | https://www.razorrobotics.com/multitasking-real-time-operating-systems/ |
| 5 | Distributed Real - time systems | CO5 | https://link.springer.com/book/10.1007/978-3-030-22570-4 |

**Text Book(s):**

1. Jane W S Liu, “Real- Time Systems”, Pearson publications, 1st edition, 2006.

**Reference Book(s):**

**1.** Rajib Mall**, “**Real-Time Systems: Theory and Practice”, Pearson Education India**,** 2009.

**Online Resources:**

1. https://www.intechopen.com/chapters/38818
2. https://hal.archives-ouvertes.fr/hal-01589479/document
3. https://www.sciencedirect.com/topics/computer-science/real-time-computing
4. https://www.razorrobotics.com/multitasking-real-time-operating-systems/
5. https://link.springer.com/book/10.1007/978-3-030-22570-4

**Web Resources:**

1. https://onlinecourses.nptel.ac.in/noc21_cs98/preview

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4003 | MACHINE MODELING AND ANALYSIS | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | **hrs** | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Fundamental concepts of Electrical Machines and Electro Magnetic Fields.

**Course Objectives:**

Able to understand the

1. Able to analyze the Basic Concepts of Modeling Electrical machines.
2. To understand Mathematical model of the DC Motor.
3. Able to analyze the dynamic modeling and phase transformation.
4. To understand the Modeling of Induction Machine.
5. To understand the Dynamic Analysis of Synchronous Machine.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the basic concepts of AC/ DC machine modeling. (BL-2) |
| **CO 2** | Understand the Mathematical model of the DC Machine. (BL-2) |
| **CO 3** | Analyze the Reference frame theory model of Electrical machine.(BL-3) |
| **CO 4** | Analyze the steady state and dynamic state operation of three-phase induction machine.(BL-3) |
| **CO 5** | Analyze the modeling and simulation of three phase synchronous machine .(BL-3) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | 2 | 2 | | 2 | | | | | | | 1 | 3 |
| **CO2** | 2 | 2 | 2 | | | | | | | | | | 2 | 3 |
| **CO3** | 2 | 2 | 2 | | | 2 | | | | | | | 2 | 3 |
| **CO4** | 3 | 2 | | | | | | | | | | | 2 | 3 |
| **CO5** | 2 | 3 | | | | 2 | | | | | | | 1 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **BASIC CONCEPTS OF MODELING** | **08 Hours** |
|---|---|---|

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.

At the end of the Module 1, students will be able to:

1. Understand the Two - pole Machine representation of Commutator machines. (BL-2)
2. Study the Kron's primitive Machine. (BL-2)
3. Understand the voltage, current and Torque equations. (BL-2)

| **MODULE -2** | **MODELING OF DC MACHINES** | **08 Hours** |
|---|---|---|

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.

At the end of the Module 2, students will be able to:

1. Compare the Mathematical model of Different of DC Motors. (BL-2)
2. Explain the Steady State analysis. (BL-2)
3. Understand the Linearization Techniques for small perturbations. (BL-2)

| MODULE-3 | REFERENCE FRAME THEORY | 08 Hours |
|---|---|---|

Reference frame theory Real time model of a two phase induction machine - three phase to two phase transformation - Dynamic modeling of three phase Induction Machine - Stator reference frame model - Rotor reference frame model Synchronously rotating reference frame model.

At the end of the Module 3, students will be able to:

1. Understand the Real time model of a two phase induction machine. (BL-2)
2. Explain the three phase to two phase transformation. (BL-2)
3. Understand the Stator and Rotor reference frame model. (BL-2)

| MODULE-4 | MODELING OF INDUCTION MACHINES | 08 Hours |
|---|---|---|

Three phase induction machine, equivalent circuit and analysis of steady state operation – free acceleration characteristics – voltage and torque equations in machine variables and arbitrary Reference frame variables – analysis of dynamic performance for load torque variations.

At the end of the Module 4, students will be able to:

1. Demonstrate on steady state operation of induction machine. (BL-2)
2. Understand the voltage and torque equations in induction machines. (BL-2)
3. Analysis of dynamic performance of induction machines. (BL-3)

| MODULE-5 | MODELING AND ANALYSIS OF SYNCHRONOUS MACHINES | 08 Hours |
|---|---|---|

Synchronous machine inductances – voltage equations in the rotor's dq0 reference frame - electromagnetic torque - current in terms of flux linkages - simulation of three phase synchronous machine.

Dynamic performance of synchronous machine, three -phase fault, comparison of actual and approximate transient torque characteristics, Equal area criteria.

At the end of the Module 5, students will be able to:

1. Understand the electromagnetic torque.(BL-2)
2. Explain the Synchronous machine inductances. (BL-2)
3. Demonstrate on simulation of three phase synchronous machine.(BL-2)

| **Total hours:** | **40 hours** |
|---|---|

**Term work:**

1. Compare and Contrast the Mathematical model of different types of DC Motors submit the report.
2. Compare and Contrast the 3 phase synchronous machine with and without damper bars and submit the report.
3. Analyze the two phase induction machine and three phase induction machine and submit the report.
4. Analyze the Synchronous motor and PM Synchronous motor and submit the report.

**Content beyond syllabus:**

1. Symmetrical Two phase Induction Machine.
2. Unsymmetrical Two phase Induction Machine.
3. Modeling of PM Synchronous motor.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Module | Reference |
|---|---|---|
| 1 | BASIC CONCEPTS OF MODELING | https://nptel.ac.in/courses/112/107/112107220/ |
| 2 | MODELING OF DC MACHINES | https://nptel.ac.in/courses/108/106/108106023/ |
| 3 | REFERENCE FRAME THEORY | http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php |
| 4 | MODELING OF INDUCTION MACHINES | https://nptel.ac.in/courses/108/106/108106023/ |
| 5 | MODELING AND ANALYSIS OF SYNCHRONOUS MACHINES | https://nptel.ac.in/courses/108/101/108101004/ |
| 6 | DYNAMIC ANALYSIS OF SYNCHRONOUS MACHINES | https://nptel.ac.in/courses/108/106/108106023/ |

**Text Book(s):**


1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis & Control", PHI Learning Private Ltd, 2009.
2. Paul C.Krause, Oleg Wasyzczuk, Scott S, Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley, Second Edition, 2010.
2. Sawhney, A.K., "A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2013.


**Reference Book(s):**


1. P S Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers, 5th Edition, 2014.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, "Electric Machinery", Tata McGraw Hill, 5th Edition, 1992.
3. Chee Mun Ong –"Dynamic simulation of Electric machinery using MATLAB / Simulink", Prentice Hall of India Publications.
4. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.


**Online Resources/ Web References:**

1. https://books.google.co.in/books?id=0_D6gfUHjcEC&printsec=frontcover#v=onepage&q&f=false
2. http://nptel.ac.in/courses/108106023/
3. https://easyengineering.net/electrical-machinery-by-bimbhra/
4. https://www.hindawi.com/journals/mpe/2017/7348263/
5. https://nptel.ac.in/courses/108/106/108106023/
6. https://nptel.ac.in/courses/108/102/108102146/
7. http://www.ijrimsec.com/assoc_art/volume7_1/Ch_10.pdf
8. https://nptel.ac.in/courses/108/106/108106023/#

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4008 | **Electrical Machine Design** | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Basic Electrical Engineering, DC Machines, Induction machines, Transformers and Synchronous machines**

**Course Objectives:**

1. To discuss the properties of electrical, magnetic and insulating materials used in the design of electrical machines.
2. To design armature and field systems for D.C. machines.
3. To design core, yoke, windings and cooling systems of transformers.
4. To design stator and rotor of induction machines.
5. To design stator and rotor of synchronous machines and study their thermal behavior.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the basic principles of machine design. (BL-2) |
| **CO 2** | Analyze the performance design DC motor. (BL-4) |
| **CO 3** | Analyze the performance design winding and core of transformer. (BL-4) |
| **CO 4** | Analyze the performance design winding and core of rotating electrical machine. (BL-4) |
| **CO 5** | Analyze the short circuit ratio and its effects on performance of synchronous machines. (BL-4) |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | | | | | | | | | | | | | |
| **CO2** | 2 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| **CO3** | 2 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| **CO4** | 2 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| **CO5** | 2 | 3 | 3 | 3 | 3 | | | | | | | | 3 | |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| **COURSE CONTENT** | | |
|---|---|---|
| **MODULE – 1** | **PRINCIPLES OF ELECTRICAL MACHINE DESIGN** | **8Hrs** |
| Introduction, considerations for the design of electrical machines, limitations. Different types of materials and insulators used in electrical machines. | | |
| At the end of the Module 1, students will be able to:<br>1. Understand the limitations of electrical machines. . (BL-2)<br>2. Understand the different types of material used in electrical machines. (BL-2)<br>3. Understand the different types of Insulators used in electrical Machines. (BL-2) | | |
| **MODULE -2** | **DESIGN OF DC MACHINES** | **10Hrs** |
| Output equation, choice of specific loadings and choice of number of poles, design of Main dimensions of the DC machines, Design of armature slot dimensions, commutator and brushes, magnetic circuit - estimation of ampere turns, design of yoke and poles- main and inter poles, field windings – shunt, series and inter poles. | | |

At the end of the Module 2, students will be able to:

1. Explain the output equation of DC machine. (BL-2)
2. Explain the choice of specific loadings for DC machine. (BL-2)
3. Understand the design of main dimension of DC machine and Design of armature slot, commutator yoke and pole. (BL-2)

| MODULE-3 | DESIGN OF TRANSFORMERS | 10Hrs |
|---|---|---|

Output Equations for single phase and three phase transformers, expression for volts/turn, Main Dimensions, Window space factor, Design of core and winding, Overall dimensions , expression for leakage reactance and voltage regulation, No load current , Temperature rise in Transformers ,Design of Tank, Methods of cooling of Transformers.

At the end of the Module 3, students will be able to:

1. Understand the main dimensions of transformers. (BL-2)
2. Understand the calculation of no load current.(BL-2)
3. Understand the design of transformer tank. (BL-2)

| MODULE-4 | Design of Induction Motors | 10Hrs |
|---|---|---|

Output Equation, Choice of Specific Loadings, Main Dimensions of Stator. Design of stator slots and Winding, Choice of Length Air Gap, Estimation of Number of Slots for Squirrel Cage Rotor. Design of Rotor Bars and End Ring. Design of Slip Ring rotor. Estimation of No Load Current and Leakage Reactance of single phase and Three Phase Induction motor.

At the end of the Module 4, students will be able to:

1. Understand the specific loadings and main dimensions of single phase and three phase induction motor. (BL-2)
2. Understand the design of slip ring and squirrel cage rotor. (BL-2)
3. Understand the Design of end rings and slip rings. (BL-2)

| MODULE-5 | Design of Three Phase Synchronous Machines | 10Hrs |
|---|---|---|

Output Equation, Choice of Specific Loadings, Short Circuit Ratio, Main Dimensions of Stator. Design of stator slots and Winding. Design of Salient and non- salient Pole Rotors. Magnetic Circuit and Field Winding.

At the end of the Module 6, students will be able to:

1. Understand the output equation of synchronous machines. (BL-2)
2. Understand the knowledge applied by designing a machine for an industrial application. (BL-2)
3. Explain the Magnetic Circuit and Field Winding of a synchronous machine. (BL-2)

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

1. Field trip visit at Voltactive Power Technologies Pvt Ltd Vijayawada to understand the design of transformer .
2. Develop armature winding diagram for DC and AC machines Develop a layout for substation using the standard symbols for substation equipment through Auto CADD
3. Draw sectional views of core and shell types transformers using the design data through Auto CADD
4. Draw sectional views of assembled DC machine or its parts using the design data or the sketches through Auto CADD.

**Content beyond syllabus:**

1. Design of small transformer
2. Modelling Of Electro Static and Magnetic Device.

**3.** Estimation of material and electrical installation of motor in different industry

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | Reference |
|---|---|---|
| 1 | Principles Of Electrical Machine Design | http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php |
| 2 | Design of DC Machines | https://nptel.ac.in/courses/108/106/108106023/ |
| 3 | Design of Transformers | http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php |
| 4 | Design of Induction Motors | https://nptel.ac.in/courses/108/106/108106023/ https://nptel.ac.in/courses/108/106/108106023/ |
| 5 | Design of Three Phase Synchronous Machines | https://nptel.ac.in/courses/108/106/108106023/ |

**Text Book(s):**


1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, 2011.
2. M.V.Deshpande "Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.
3. V.N. Mittle and A. Mittle, "Design of Electrical Machines", 5th Edition, Standard Publications and Distributors, 2014, New Delhi.


**Reference Book(s):**


1. A.Shanmuga Sundaram, G.Gangadharan, R.Palani 'Electrical Machine Design Data Book', New Age International Pvt. Ltd., Reprint, 2007.
2. R.K.Agarwal " Principles of Electrical Machine Design" Esskay Publications, 5th Edition Delhi, 2014.
3. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 1987
4. Ramamoorthy M, "Computer Aided Design of Electrical Equipment", East-West Press.
5. M. N. O. Sadiku, " Numerical techniques in Electromagnetics", CRC Press Edition-2001.
6. M.V. Deshpande, "Design and Testing of Electrical Machines"PHI learning, New Delhi.


**Online Resources:**

https://nptel.ac.in/courses/108/106/108106023/

**Web Resources:**

http://nptel.vtu.ac.in/econtent/courses/EEE/06EE63/index.php


JuhaPyrhonen, TapaniJokinen, Valeria Hrabovcova "Design of Rotating Electrical Machines", ISBN: 978-0-470-69516-6. Willey Publication Hardcover. 538 pages. February 2009. .

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4013 | **Programmable Control Devices and Applications** | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite**: To Learn about Power Electronic devices, Semiconductor drives, Energy storage systems( Battery, Fuel Cell, Super Capacitor etc).

**Course Objectives:**

1. Understand the basic functions and types of PLCs.
2. Get exposure of Easy Veep software, its applications.
3. Classification of PLCs and applications
4. Programming using PLCs .
5. Troubleshooting aspects using PLCs.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand different types of PLCs (BL-2) |
| **CO 2** | Understand the usage of Easy Veep software (BL-1) |
| **CO 3** | Understand the hardware details of Allen Bradley PLC . (BL-2) |
| **CO 4** | Programming of PLCs . (BL-2) |
| **CO 5** | Know about few applications of PLCs in different fields of Science and Technology . (BL-2) |

| **CO-PO Mapping** | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | | | | | | 2 | | | | | | 2 | 3 |
| **CO2** | 2 | | | | | | | | | | | | 2 | 2 |
| **CO3** | 3 | | 1 | | | | | | | | | | 1 | 2 |
| **CO4** | 2 | | | | | | | | | | | | 1 | |
| **CO5** | 2 | | | | | | | | | | | | 2 | 1 |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| **COURSE CONTENT** | | |
|---|---|---|
| **MODULE – 1** | **INTRODUCTION** | **8 Hours** |

Basic functions of PLCs, Mechanical relays versus PLC, Different types of PLC's – AllenBradley – Micrologix: ML1000, ML1100, SLC500, Compact Logix, Mitsubishi FX series, HMI's, Processor and I/O cards.

At the end of the Module 1, students will be able to:

1. To understand about basic functions of PLCs. (BL-2)
2. To distinguish between PLCs and Mechanical relays. (BL-2)
3. To know about Processor and I/O cards. (BL-2)

| **MODULE -2** | **Logic diagrams** | **8 Hours** |
|---|---|---|

Introduction to Easy Veep software, Link between mechanical, electrical and programming documentation, Logic diagrams, Flip-Flop Logic, M8000, M8001 internal bits interpretation, Binary code, data table, manipulation.

At the end of the Module 2, students will be able to:

1. To know about Easy Veep software .(BL-1)
2. To know about Logic diagrams. (BL-2)

| MODULE-3 | PLC software and applications | 8 Hours |
|---|---|---|

PLC software and applications, Boolean algebra – understanding binary code, ADD and SUB functions, UP and Down Counters, Introduction to k1Y0, MOV function, CPR and ZCP functions, SHWT and SHRD instructions, Introduction to Absolutely Drum Instruction.

At the end of the Module 3, students will be able to:

1. To know about basic features of PLCs. (BL-2)
2. To know about various instructions of PLC. (BL-2)

| MODULE-4 | PLC Hardware | 10 Hours |
|---|---|---|

Allen Bradley PLC: Introduction to Rockwell Software, Hardware focus, Hardware considerations (Field wiring, Master Control Relay, VFD), Basic programming and applications, Cascade control – subroutine, Different programs.

At the end of the Module 4, students will be able to:

1. To know about various PLC versions. (BL-2)
2. To understand about Cascade control and subroutines. (BL-1)

| MODULE-5 | PLC IC applications | 10 Hours |
|---|---|---|

Programming instructions: Instructions and binary interpretation, Bit Instruction, Timers and counters, Comparison instructions, Programming Instructions - Math instructions, Move and Logical Instructions, Discussions of programming, communications for PLC-Robotic arm, Exercise of setup and monitoring.

At the end of the Module 6, students will be able to:

1. To know about various Programming instructions. (BL-1)
2. To understand Math instructions in PLCs. (BL-2)
3. To understand about Communications with PLC using set up and monitoring. (BL-2)

| | |
|---|---|
| **Total hours:** | **44 hours** |

**Term work:**

Term work contains minimum two group assignments followed by seminars and quiz's

**Content beyond syllabus:**

1. Hybridization of different energy storage devices
2. Mechanics of Electric Vehicles

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Introduction to PLC | CO1 | https://www.youtube.com/watch?v=PbAGl_mv5XI |
| 2 | PLC logic circuits | CO2 | https://www.youtube.com/watch?v=X3xGqdb0DAA |
| 3 | PLC software applications | CO3 | https://www.youtube.com/results?search_query=PLC+software+ |

| | | | | |
|---|---|---|---|---|
| | 4 | PLC Hardware applications | CO4 | https://www.youtube.com/results?search_query=plc+hardware+components |
| | 5 | PLC IC applications | CO5 | https://www.youtube.com/watch?v=JvTCgq5vss0 |

**Text Book(s):**

1. C. Mi, M. A. Masrur and D. W. Gao, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, "Hybrid Electric Vehicles: Energy Management Strategies", Springer, 2015.
3. Electric Vehicle Technology Explained-James Larminie, John Lowry-John Wiley & Sons Ltd,-2003
4. Electric & Hybrid Vehicles-Design Fundamentals-Iqbal Hussain, Second Edition, CRCPress,2011

**Reference Book(s):**

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.
2. T. Denton, "Electric and Hybrid Vehicles", Routledge, 2016.
3. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
4. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017

**Online Resources / Web References:**

1. https://b-ok.asia/book/1226776/eceb4b
2. https://b-ok.asia/book/3357286/21e776
3. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric,%20Hybrid%20Electric%20&%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
4. https://b-ok.asia/book/3516646/6fe038
5. https://nptel.ac.in/courses/108/103/108103009/
6. https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl
7. https://www.youtube.com/watch?v=11e_d3Q9jEc

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|---|---|---|---|---|---|---|---|---|
| 20EE4018 | HYBRID ELECTRICAL VEHICLES | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite**: To Learn about Power Electronic devices, Semiconductor drives, Energy storage systems( Battery, Fuel Cell, Super Capacitor etc).

**Course Objectives:**

1. To understand Importance of Hybrid Electric Vehicles
2. To Know the various drive-train topologies
3. To Learn the operation and configurations of DC & AC Drives
4. To Know the importance of various Energy storage systems and Energy management strategies
5. To provide knowledge about supervisory control of EVs

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the models to describe hybrid vehicles and their performance (BL-2) |
| **CO 2** | Classify various hybrid drive-train topologies(BL-1) |
| **CO 3** | Understand the various configurations of DC & AC Motor drives. (BL-2) |
| **CO 4** | Understand the different possible ways of energy storage and different strategies related to Energy management strategies. (BL-2) |
| **CO 5** | Understand the mode of operation and control Architecture. (BL-2) |

| CO-PO Mapping | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | | | | | | 2 | | | | | | 2 | 3 |
| **CO2** | 2 | | | | | | | | | | | | 2 | 2 |
| **CO3** | 3 | | 1 | | | | | | | | | | 1 | 2 |
| **CO4** | 2 | | | | | | | | | | | | 1 | |
| **CO5** | 2 | | | | | | | | | | | | 1 | |
| 1: Low, 2-Medium, 3- High | | | | | | | | | | | | | | |

| COURSE CONTENT | | |
|---|---|---|
| **MODULE – 1** | **INTRODUCTION TO ELECTRIC VEHICLES** | **8 Hours** |

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

At the end of the Module 1, students will be able to:

1. Understand the importance of Electric vehicles over Conventional vehicles. (BL-2)
2. Understand the social and environmental importance of hybrid and electric vehicles. (BL-2)
3. Understand the impact of modern drive-trains on energy supplies. (BL-2)

| MODULE -2 | Hybrid Electric Drive-trains | 8 Hours |
|---|---|---|
| Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis | | |
| At the end of the Module 2, students will be able to:<br>1. Compare various hybrid drive-train topologies. (BL-1)<br>2. Explain power flow control in hybrid drive-train topologies. (BL-2)<br>3. Understand the Fuel efficiency analysis. (BL-2) | | |
| **MODULE-3** | **Electric Propulsion unit** | **8 Hours** |
| Configuration and control of DC Motor drives, Induction Motor drives, Permanent Magnet Motor drives, Switch Reluctance Motor drives | | |
| At the end of the Module 3, students will be able to:<br>1. Understand Configuration of DC Motor drives. (BL-2)<br>2. Understand Configuration of Induction Motor drives. (BL-2)<br>3. Understand Configuration of SRM drives. (BL-2) | | |
| **MODULE-4** | **Energy Storage Systems and Energy Management** | **10 Hours** |
| Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery, Fuel Cell, Super Capacitor based energy storage and its analysis.<br>Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies. | | |
| At the end of the Module 4, students will be able to:<br>1. Understand the requirements of Energy storage systems. (BL-2)<br>2. Know the Battery based Energy storage systems. (BL-1)<br>3. Understand the importance of energy management strategies. (BL-2) | | |
| **MODULE-5** | **Hybrid Vehicle Control Strategy** | **10 Hours** |
| HEV supervisory control - Selection of modes - power spilt mode - parallel mode - engine brake mode - regeneration mode - series parallel mode. | | |
| At the end of the Module 6, students will be able to:<br>1. Know the speed control techniques of HEV. (BL-1)<br>2. Distinguish the different modes of operation of control strategies. (BL-2) | | |
| | **Total hours:** | **44 hours** |

**Term work:**

Term work contains minimum two group assignments followed by seminars and quiz's

**Content beyond syllabus:**

1. Hybridization of different energy storage devices
2. Mechanics of Electric Vehicles

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Introduction to | CO1 | https://nptel.ac.in/content/storage2/courses/108103009/ |

| | | | | |
|---|---|---|---|---|
| | | Electric Vehicles | | download/M1.pdf<br>https://www.youtube.com/watch?v=KOLBGKMo3zQ |
| | 2 | Hybrid Electric Drive-trains | CO2 | https://www.youtube.com/watch?v=oydKVcJqPQ0<br>https://nptel.ac.in/content/storage2/courses/108103009/download/M3.pdf |
| | 3 | DC & AC Motor drives | CO3 | https://www.youtube.com/watch?v=1AT1yuQ9awM&list=PLFW6lRTa1g83sIfVY1p1xGqPGYUmXyahx |
| | 4 | Energy Storage Systems & Energy Management Strategies | CO4 | https://www.youtube.com/watch?v=j7RaL_XKywk<br>https://nptel.ac.in/content/storage2/courses/108103009/download/M10.pdf |
| | 5 | Hybrid Vehicle Control Strategy | CO5 | https://nptel.ac.in/content/storage2/courses/108103009/download/M12.pdf |

**Text Book(s):**

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.
3. Electric Vehicle Technology Explained-James Larminie, John Lowry-John Wiley & Sons Ltd,-2003
4. Electric & Hybrid Vehicles-Design Fundamentals-Iqbal Hussain, Second Edition, CRCPress,2011

**Reference Book(s):**

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.
3. Iqbal Husain, "Electric and Hybrid Electric Vehicles", CRC Press, 2011.
4. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control", Second Edition, WILEY, 2017

**Online Resources / Web References:**

1. https://b-ok.asia/book/1226776/eceb4b
2. https://b-ok.asia/book/3357286/21e776
3. http://ceb.ac.in/knowledge-center/E-BOOKS/Modern%20Electric,%20Hybrid%20Electric%20&%20Fuel%20Cell%20Vehicles%20-%20Mehrdad%20Ehsani.pdf
4. https://b-ok.asia/book/3516646/6fe038
5. https://nptel.ac.in/courses/108/103/108103009/
6. https://www.youtube.com/watch?v=V004WUdpHeA&list=PLlYm0-AHZdZRLYSylFinxkspWmcgNvbtl
7. https://www.youtube.com/watch?v=11e_d3Q9jEc

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4023 | AUTOMOTIVE ELECTRICAL ENGINEERING | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | hrs | C | CIE | AEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To understand the various types of Batteries and their ratings
2. To understand the starting condition and its behavior
3. To understand the various charging systems in Automobiles
4. To learn different Lighting systems in Automobiles
5. To learn electronic engine management system in Automobiles
6. To understand the various electrical and non electrical sensors

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Compute the efficiency of Batteries through various test's |
| **CO 2** | Understand the working of different starter drive units and their maintenance and the concept of vehicle charging system with its auxiliaries |
| **CO 3** | Understand the dazzling of head light and its preventive methods |
| **CO 4** | Understand the electronic dashboard instruments & onboard diagnostic system |
| **CO 5** | Understand the various sensors used in Automobiles |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | | 1 | | | | 2 | | | | | | 2 | 2 |
| **CO2** | 2 | 1 | 1 | | | | | | | | | | | |
| **CO3** | 2 | | 1 | | | | | | | | | | 1 | |
| **CO4** | 2 | 1 | 2 | | | | | | | | | | 2 | 2 |
| **CO5** | 2 | 1 | 1 | | | | | | | | | | 1 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **10 Hours** |
|---|---|

**BATTERIES ACCESSORIES AND CHARGING SYSTEM**

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries, various tests on batteries, maintenance and charging.

Generation of direct current, shunt generator characteristics, armature reaction, third brush regulation, cutout. Voltage and current regulators, compensated voltage regulator, alternators.

At the end of the Module 1, students will be able to:

1. Explain the Principle and construction of lead acid battery
2. Identify the ratings of various Batteries
3. Understand the importance of voltage and current regulators in charging system

| **MODULE -2** | **10 Hours** |
|---|---|

**STARTING SYSTEM**

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenances of starter motor, starter switches.

At the end of the Module 2, students will be able to:

1. Understand the importance of starter
2. Understand the principle and construction of starter motor
3. Explain the various types of starter switches

| **MODULE-3** | **10 Hours** |
|---|---|

**LIGHTING**

Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn, wiper system and trafficator.

At the end of the Module 4, students will be able to:

1. Understand the arrangement of insulated and earth return system
2. Understand the working of wiper system and trafficator.

| **MODULE-4** | **10 Hours** |
|---|---|

**FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS**

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

At the end of the Module 5, students will be able to:

1. Understand the use of electronics in engine management system
2. Understand the concept of electromagnetic interference suppression
3. Understand the Automobile security and warning system

| **MODULE-5** | **10 Hours** |
|---|---|

**SENSORS AND ACTUATORS**

Types of sensors: sensor for speed, throttle position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors, relay.

At the end of the Module 6, students will be able to:

1. Identify various types of sensors in Automobiles
2. Explain about air mass flow in engine application

| **Total hours:** | **50 hours** |
|---|---|

**Term work:**

Individual Assignments, followed by Quiz's

**Content beyond syllabus:**

1. Advanced charging system in Automobiles

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Construction of lead acid battery | CO1 | https://circuitglobe.com/lead-acid-battery.html https://www.howacarworks.com/basics/how-the-charging-system-works |
| 2 | Principle and construction of starter motor | CO2 | https://www.samarins.com/glossary/starter.html |
| 3 | Lighting system | CO3 | https://what-when-how.com/automobile/lighting-circuit-automobile/ |
| 4 | Automotive electronic engine management system | CO4 | https://www.ukessays.com/essays/engineering/electronic-control-unit-and-engine-management-system-engineering-essay.php |
| 5 | Types of sensors | CO5 | https://www.my-cardictionary.com/electronics/sensors.html |

**Text Book(s):**

1. Tom Weather Jr and Cland C.Hunter, *"Automotive Computers and Control system"*, Prentice Hall Inc., New Jersey.
2. A. Bonnick, *"Automotive Computer Controlled Systems"*, 2011.
3. Young A. P & Griffiths L, *"Automobile Electrical and Electronic Equipments"* English Languages Book Society & New Press, 1990.

**Reference Book(s):**

1. Santini Al, *"Automotive Electricity and Electronics"*, Cengage Learning, 2012.
2. Tom Denton, *"Automotive Electrical and Electronic System"*, SAE International, 2004.
3. William B. Ribbens, *"Understanding Automotive Electronics"*, 6th Edition, Newnes, 2003.
4. BOSCH, *"Automotive Handbook"*, 8th Edition, BENTLEY ROBERT Incorporated, 2011.
5. Norm Chapman, *"Principles of Electricity and electronics for the Automotive Technician"*, Delmar Cengage Learning, 2008.
6. Judge A.W, *"Modern Electrical Equipment of Automobiles"*, Chapman & Hall, London, 1992.

**Online Resources:**

1. https://b-ok.asia/book/526451/802478
2. https://b-ok.asia/book/2161298/3ad7b5

**Web Resources:**

1. https://www.youtube.com/watch?v=hs7bABMtOMI&list=PLyqSpQzTE6M9G2SNxKfsVEjcM9MlJau4F
2. https://www.youtube.com/watch?v=HHgPBMMZ26w

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4004 | RENEWABLE ENERGY CONVERSION SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | RECS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Nil

**Course Objectives:**

1. To create awareness about various Electric Energy Conversion Systems.
2. Learn the fundamental concepts about solar energy conversion systems and devices
3. To understand the solar thermal conversion systems for high temperature applications.
4. To learn Thermal and Bio-energy conversion systems
5. To Understand the various technologies that are used in WECS
6. To Understand the Fuel cell technology

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand various Electric Energy Conversion Systems (BTL-2) |
| **CO 2** | Analyze the solar thermal conversion system (Also for high temperature applications) (BTL-4) |
| **CO 3** | Analyze the Photovoltaic & Bio-Energy Conversion Systems (BTL-4) |
| **CO 4** | Illustrate the existing Wind Energy Conversion System (BTL-2) |
| **CO 5** | Extend the knowledge about working principle of various Fuel cell technology (BTL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 1 | 1 | | | | | | | | | | 3 | |
| CO2 | 2 | 2 | | | | | | | | | | | 3 | 2 |
| CO3 | 2 | 1 | | | | | | | | | | | 3 | 1 |
| CO4 | 2 | 1 | 1 | | | | | | | | | | 2 | 2 |
| CO5 | 1 | 1 | 1 | | | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

| COURSE CONTENT | | |
|---|---|---|
| **MODULE – 1** | **ELECTRIC ENERGY CONVERSION SYSTEM** | 12 Hrs |

Generation of electricity using different sources, Transmission and distribution losses, AC to DC and DC to AC conversions, Electric motors: Types, losses, efficiency, Lightning systems, Diesel generating systems.

At the end of the Module 1, students will be able to:

1. Understand various Electric Energy Conversion Systems.
2. Understand losses, efficiency related to Electric Energy Conversion Systems.

| | | |
|---|---|---|
| **MODULE -2** | **SOLAR THERMAL CONVERSION SYSTEM** | 12 Hrs |

Relevance of solar thermal power generation; Components of solar thermal power plant, Design and performance, characteristics of different solar concentrator types suitable for thermal power generation

**HIGH TEMPERATURE APPLICATIONS:** Types of solar thermal conversion system used in high temperature application, Tracking of solar concentrators; performance characterization of solar concentrators both line focus and point focus, Comparative analysis of the both mode focus system.

At the end of the Module 2, students will be able to:

1. Describe the existing solar Energy Conversion System
2. understand characteristics of different solar concentrators
3. Evaluate the solar thermal conversion systems for high temperature applications.
4. understand the working of various solar concentrators

| **MODULE-3** | **THERMAL ENERGY CONVERSION & BIO-ENERGY CONVERSION SYSTEMS** | 8 Hrs |
|---|---|---|

Thermo-electric generator, Concepts and design considerations of MHD generators, Cycle analysis of MHD systems, Thermionic power conversion and plasma diodes, Thermo chemical Conversion. Bio-energy conversion, bio methanation technology.

At the end of the Module 4, students will be able to:

1. Understand the Photovoltaic & Bio-Energy Conversion Systems
2. Analyze Thermo chemical and Bio-energy conversion

| **MODULE-4** | **WIND ENERGY CONVERSION SYSTEM (WECS)** | 8 Hrs |
|---|---|---|

Rotor Selection, Annual Energy Output, HAWT, VAWT, Rotor Design Considerations-Number of Blades, Blade Profile -2/3 Blades and Teetering, Coning- Upwind/Downwind, Power Regulation, Yaw System- Tower, Synchronous and Asynchronous Generators and Loads, Integration of Wind Energy Converters to Electrical Networks, Inverters.

At the end of the Module 5, students will be able to:

1. Describe the existing Wind Energy Conversion System.
2. understand the Rotor Design Considerations

| **MODULE-5** | **FUEL CELL TECHNOLOGY** | 8 Hrs |
|---|---|---|

Overview of fuel cells, Fuel cell thermodynamics, fuel cell efficiency, Fuel cell characterization, Fuel cell modelling and system integration, Balance of plant, Hydrogen production from renewable sources and storage, life cycle analysis of fuel cells

At the end of the Module 6, students will be able to:

1. Understand the Fuel cell technology
2. Understand the Fuel cell modelling and system integration

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

Individual assignment, followed by Quiz and End semester examinations

**Content beyond syllabus:**

Advance energy conversion process

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Electric Energy Conversion Systems | CO1 | https://www.britannica.com/technology/energy-conversio |

| | | | | |
|---|---|---|---|---|
| 2 | solar energy conversion systems | CO2 | https://www.appropedia.org/Solar_energy_conversion_system<br>https://www.sciencedirect.com/topics/engineering/thermal-solar-energy-system-technology | |
| 3 | Thermal and Bio-energy conversion systems | CO3 | http://www.fao.org/3/T1804E/t1804e06.htm | |
| 4 | Wind Energy Conversion Systems | CO4 | https://www.appropedia.org/Wind_energy_conversion_system | |
| 5 | Fuel cell technology | CO5 | https://www.hydrogenics.com/technology-resources/hydrogen-technology/fuel-cells/ | |

**Text Book(s):**

1. S. S. L. Chang, Energy Conversion, Prentice Hall, 1963
2. R. J. Rosa, Magneto hydrodynamic Energy Conversion, Springer, 1987.
3. V. S. Bagotsky, Fuel Cell Problems and Solutions, John Wiley & Sons, 2009

**Reference Book(s):**

1. Kettani, M.A., Direct energy conversion, Addison-Wesley, Reading, Mass, 1970
2. Hand book Batteries and Fuel Cells. Linden, McGraw Hill, 1984

**Online Resources:**

1. https://archive.org/details/energyconversion00chan
2. https://www.trine.edu/books/documents/de_text1.0.0.pdf

**Web Resources:**

1. https://www.youtube.com/watch?v=mpHZWYpKDJg
2. https://www.youtube.com/watch?v=GExTwRNkQBg

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4009 | SOLAR AND FUEL CELL ENERGY SYSTEMS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To make students understand the fundamental theory governing the photovoltaic devise and make them carry out preliminary system design.
2. To learn the fundamental knowledge about various fuel cell technologies.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the need of radiation of sun and discuss the various performance characteristics of solar radiation.(BL-2) |
| **CO 2** | Discuss the photovoltaic effect, PV Cell efficiency and its limits along with the concepts of fabrication technology for solar cell (BL-2) |
| **CO 3** | Predict the performance of solar photovoltaic device and analyze its performance. (BL-2) |
| **CO 4** | Carry out the application of photovoltaic system as power system. (BL-3) |
| **CO 5** | Analyze the performance of fuel cells under different operating conditions and also defend appropriate fuel cell technology for a given application. (BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | 1 | | | 2 | 2 | | | | | | 2 | 1 |
| CO2 | 3 | 3 | 3 | | | 2 | 2 | | | | 2 | | 3 | 2 |
| CO3 | 2 | 2 | 1 | | | 2 | 2 | | | | 2 | | 2 | 2 |
| CO4 | 2 | 2 | | | | 2 | 2 | 2 | | | 2 | | 3 | 3 |
| CO5 | 2 | 3 | 2 | | | 2 | 2 | | | | 2 | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Solar Radiation | 08 Hours |
|---|---|---|

Sun as Energy Source, Solar Radiation at The Earth's Surface, Solar Radiation Geometry, Solar Time and Equation of Time, Sun Earth angles, Sun path diagram, Sunshine hours, Measurement of Solar Diffuse, Global and Direct Solar Radiation, Equipments, Estimation of Solar radiation on horizontal and tilted Surfaces, Global Solar radiation data, Indian Solar Radiation data analysis

At the end of the Module 1, students will be able to:

1.Understand the need of radiation of sun (BL-2)

2. Discuss the various performance characteristics of solar radiation.(BL-2)

| MODULE -2 | Solar Cells and its Fabrication | 07 Hours |
|---|---|---|

**Solar Cells**

Conversion of Solar energy into Electricity - Photovoltaic Effect, Equivalent Circuit of the Solar Cell, Analysis of PV Cells: Dark and illumination characteristics, Figure of merits of solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, Role of nano-technology in Solar cells

**Fabrication Technology for Solar Cells**

High efficiency multi-junction solar cell, Quantum well solar cell, Technology for the fabrication of thin film cells, Optical concentration, Effect of temperature on Cell performance, Thermo photovoltaic effect

At the end of the Module 2, students will be able to:

| | | |
|---|---|---|
| 1. Discuss the photovoltaic effect, PV Cell efficiency and its limits (BL-2)<br>2. Discuss the concepts of fabrication technology for solar cell (BL-2) | | |
| **MODULE-3** | **Solar Photovoltaic System** | **10 Hours** |
| **Solar Photovoltaic System Design**<br>Solar cell array system analysis and performance prediction, Shadow analysis: Reliability, Solar cell array design concepts, PV system design, Design process and optimization: Detailed array design, Voltage regulation, Maximum tracking, Quick sizing method, Array protection.<br>**Solar Photo Voltaic System Testing**<br>Sun Simulator, Testing and performance assessment of Solar PV generator, Electronic Control and Regulation, Power Conditioning, Converters and inverter, Concentrating system, System design and configuration | | |
| At the end of the Module 3, students will be able to:<br>1. Predict the performance of solar photovoltaic device and analyze its performance. (BL-2) | | |
| **MODULE-4** | **SPV Power Systems** | **12 Hours** |
| Centralized and decentralized SPV systems, Stand alone, hybrid and, grid connected system, System installation, Operation and Maintenance, Application of PV for lighting, Water pumping. Refrigeration, Telecommunication, Cathodic Protection, Solar PV Power Plant-Status-Case Studies, Hybridization Engineering, Hybrid systems, Grid integration. Building Integrated PV Systems, PV market analysis and Economics of SPV systems. | | |
| At the end of the Module 4, students will be able to:<br>1. Carry out the application of photovoltaic system as power system. (BL-3) | | |
| **MODULE-5** | **FUEL CELLS** | **12 Hours** |
| History, Working principle of fuel cells, Fuel cell thermodynamics, fuel cell electrochemistry - Nernst equation, Electrochemical kinetics, Butler-Volmer equation, performance evaluation of fuel cells, Types of Fuel Cells: AFC, PAFC, SOFC, MCFC, DMFC, relative merits and demerits.<br>**Fuel cell characterization** In-situ and ex-situ characterization techniques, I-V curve, frequency response analyses; Fuel cell system integration<br>**Application of Fuel Cells** Fuel Cell usage for domestic power systems, large scale power generation, Automobile, environmental analysis. Future trends in fuel cells, portable fuel cells, laptops, mobiles, submarines. | | |
| At the end of the Module 6, students will be able to:<br>1. Analyze the performance of fuel cells under different operating conditions. (BL-4)<br>2. Select and defend appropriate fuel cell technology for a given application. (BL-4) | | |
| | **Total hours:** | **48 hours** |

| |
|---|
| **Term work:**<br>1. Field trip |
| **Content beyond syllabus:**<br>1. Introduction of hydrogen energy systems<br>2. Hydrogen production processes<br>3. Hydrogen storage and safety |

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | Indian Solar Radiation data analysis | https://www.nrel.gov/docs/fy21osti/78025.pdf |
| 2 | Role of nano-technology in Solar cells | https://www.intechopen.com/chapters/73145 |
| 3 | Converters and inverter in solar energy | https://www.energy.gov/eere/solar/solar-integration-inverters-and-grid-services-basics |
| 4 | Economics of SPV systems | https://extensionpublications.unl.edu/assets/pdf/g2182.pdf |
| 5 | Types of Fuel cells with relative merits and demerits | https://www.energy.gov/eere/fuelcells/types-fuel-cells |

**Text Book(s):**

1. Fundamentals of Solar Cells: PV Solar Energy Conversion by AL Fahrenbruch and RH Bube, Academic Press, New York.
2. Solar Photovoltaics. Fundamental Technologies and Application by Chetan Singh Solanki, PHI Publicaton.
3. Principles of Fuel Cells by Xianguo Li, Taylor & Francis.
4. Fuel cell Systems Explained by James Larminie and Andrew Dicks, John Wiley & Sons, Inc.
5. Fuel Cells: From Fundamentals to Applications by S Srinivasan, Springer.

**Reference Book(s):**

1. Principles of Solar Engineering by F Kreith and JF Kreider, McGraw-Hill.
2. Fuel Cell Fundamentals by O'Hayre, SW Cha, W Colella and FB Prinz, Wiley.
3. Fuel Cell Science and Technology by Basu, S. (Ed) Springer, N.Y.

**Online Resources:**

1. https://www.nrel.gov/docs/fy21osti/78025.pdf
2. https://www.intechopen.com/chapters/73145
3. https://www.energy.gov/eere/solar/solar-integration-inverters-and-grid-services-basics
4. https://extensionpublications.unl.edu/assets/pdf/g2182.pdf
5. https://www.energy.gov/eere/fuelcells/types-fuel-cells

**Web References:**

1. https://www.youtube.com/watch?v=--GfdbavEk8
2. https://www.youtube.com/watch?v=qFnAIxyPXuQ
3. https://www.youtube.com/watch?v=px239v5o6xU
4. https://www.youtube.com/watch?v=pH03Y5KwpjU
5. https://www.youtube.com/watch?v=6oeN9VDFLig

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4014 | **WIND & BIOMASS ENERGY SYSTEM** | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | hrs | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To acquire the knowledge on wind power generation
2. To Understand the concept of wind turbine design
3. To Discuss the Current trends in worldwide applications of wind power
4. To Understand the various methods Bio- Chemical Conversion systems
5. To Discuss the various applications of biomass

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the present wind energy scenario (BL-2) |
| **CO 2** | Explain the various wind energy technologies. (BL-3) |
| **CO 3** | Identify various applications of wind energy .(BL-2) |
| **CO 4** | Explain the various biomass conversion technologies and testing of performance of biogas. (BL-2) |
| **CO 5** | Understand the Bio-Energy Systems with Efficient Applications. (BL-2) |

**CO-PO Mapping**

| **CO** | **PO** | | | | | | | | | | | | **PSO** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 3 | 2 | 2 | | | | | | | | | 2 | 1 |
| **CO2** | 3 | 1 | 1 | 2 | | | | | | | | | 3 | 2 |
| **CO3** | 3 | 3 | 2 | 1 | | | | | | | | | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 2 | | | | | | | | | 3 | 3 |
| **CO5** | 1 | 2 | 1 | | 2 | | | | | | | | 2 | 1 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Wind Power Generation** | **08 Hours** |
|---|---|---|

Introduction – Basic principles of wind energy conversion power in the wind-Forces on blades and thrust on turbines – Wind energy conversion – site selection Considerations -Basic components of WECS – Classification- Advantages and disadvantages – Power, torque and speed characteristics.

At the end of the Module 1, students will be able to:

1.Understand the need of wind energy (BL-2)

2. Explain the various performance characteristics of wind energy.(BL-1)

3. Understand the Basic principles of wind energy conversion system (BL-2)

| **MODULE -2** | **WECS design** | **07 Hours** |
|---|---|---|

Design of wind turbine :Wind turbine design considerations; Methodology; Theoretical simulation of wind turbine characteristics; Test methods.

Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element and combine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip loss Correction.

At the end of the Module 2, students will be able to:

1. Discuss Wind turbine design considerations & characteristics (BL-2)
2. Discuss the concepts of Aerodynamic theories (BL-2)
3. Understand the concept of Maximum power coefficient (BL-2)

| MODULE-3 | Wind Energy Applications & Measurements | 10 Hours |
|---|---|---|

Wind energy measurements: Wind speed, Wind direction, Data measurement and analysis, Performance evaluation of Wind energy system, Wind potential assessment

Wind energy application Wind pumps: Performance analysis, design concept and testing; Principle of WEG; Stand alone, grid connected and hybrid applications of WECS; Economics of wind energy. Utilization; Wind energy in India; Case studies.

At the end of the Module 3, students will be able to:

1. Explain the various measuring instruments used in wind systems (BL-2)
2. Understand the wind energy applications(BL-2)
3. Understand the Current trends in worldwide applications of wind energy (BL-2)

| MODULE-4 | Biomass conversion Technologies | 12 Hours |
|---|---|---|

**Bio Energy:** Introduction – Biomass conversion technologies – Bio gas generation – Factors affecting bio digestion or generation of gas – Classification of bio gas plants – advantages and disadvantages –Materials used for biogas plant – selection of site for biogas plant

**Thermo-chemical conversions:** Direct Combustion, Technology of Biomass gasification, Pyrolysis and Liquefaction, Bio- Chemical Conversion: anaerobic digestion, alcohol production from biomass,

**Chemical conversion process:** hydrolysis and hydrogenation

**Biomass Gasifiers:** History, Principle, Design of Biomass Gasifiers, updraft gasifier, down draft gasifier, zero carbon biomass gasification plants, Gasification of plastic-rich waste, applications for cooking, electricity generation, Gasifier Engines, Operation of spark ignition and compression ignition engine with wood gas, methanol, ethanol and biogas, Biomass integrated gasification/combined cycles systems.

At the end of the Module 4, students will be able to:

1. Discuss Biomass conversion technologies (BL-2)
2. Explain the concept of Bio- Chemical Conversion & Thermo-chemical conversions (BL-2)
3. Explain Direct & In-Direct Combustion methods (BL-2)
4. Discuss the historical perspective of biomass energy (BL-2)
5. Explain the Biomass Gasifiers (BL-2)
6. Discuss the concept of various Gasifier Engines (BL-2)

| MODULE-5 | Bio-Energy Systems with Efficient Applications | 12 Hours |
|---|---|---|

Traditional Stoves, Energy Efficient Cooking and Space heating Stoves, Metal Stoves Improved Gasifier Stoves, Pollution due to smoke emissions, Biogas Systems : Technology of Bio-gas production, Biogas Plants , Digester types, Digester design, Chemical kinetics and mathematical modeling of bio-methanation process, Dung, Vegetable Waste, Night Soil and Municipal Waste based Bio-gas plants, Bio gas as fuel for transportation, Lighting, Running Dual Fuel Engines, Electricity generation, Bio gas Bottling Plant Technology, Application of Bio gas slurry in agriculture , Design of Biogas for cold climates.

At the end of the Module 6, students will be able to:

1. Explain the Bio-Energy Systems with Efficient Applications (BL-2)
2. Identify various real time applications. (BL-3)
3. Discuss the various applications of bio- energy (BL-2)

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

1. Field trip

**Content beyond syllabus:**

1. Betz limit & Wind resource assessment

**Self-Study:**

Contents to promote self-Learning:

| SNO | MODULE | Reference |
|---|---|---|
| 1 | Basic components of WECS | https://www.youtube.com/watch?v=uUzqfckAlbg |
| 2 | Prandlt's tip loss Correction | https://www.youtube.com/watch?v=F9J2BdprXOQ |
| 3 | Wind energy measurements | https://www.youtube.com/watch?v=-N-QJkY1GEM |
| 4 | Biomass conversion technologies Design of Biomass Gasifiers | https://www.youtube.com/watch?v=H1hrkC--dto https://www.youtube.com/watch?v=RrBOqjCtkk0 |
| 5 | Night Soil and Municipal Waste based Bio-gas plants | https://www.youtube.com/watch?v=ehNEtJtaFR8 |

**Text Book(s):**

1. S.N.Bhadra,D.Kastha, S.Banerjee, " wind electrical systems" Oxford University Press
2. S.Rao & B.B.Parulekar, "Energy Technology", 4th edition, Khanna publishers, 2005.
3. "Energy conversion systems" by Rakosh das Begamudre, New age international publishers, New Delhi - 2000.

**Reference Book(s):**

1. "Renewable Energy sources & Conversion Technology" by N.K.Bansal, Manfred Kleemann, Michael Meliss. Tata Mcgraw Hill Publishers.
2. "The Electrical Energy Storage" by IEC Market Strategy Board.
3. Jim Eyer, Garth Corey, "Energy Storage for the Electricity Grid: Benefits and Market Potential Assessment Guide, Report", Press, Feb 2010.

**Online Resources:**

1. https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
2. https://www.lathamathavan.edu.in/lmgi/antiragging/WECS-%20EEE%20new.pdf
3. https://engineering.purdue.edu/~dionysis/EE452/Lab9/Wind_Energy_Conversion.pdf
4. https://energystorage.org/why-energy-storage/technologies/
5. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118029008

**Web References:**

1. https://www.youtube.com/watch?v=mh51mAUexK4
2. https://www.youtube.com/watch?v=GExTwRNkQBg
3. https://www.youtube.com/watch?v=4a4XGu1mR5E
4. https://www.youtube.com/watch?v=xzY3CK43C98
5. https://www.youtube.com/watch?v=_OQtT4yhhWc

| NARAYANA ENGINEERING COLLEGE::GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4019 | UTILIZATION OF ELECTRICAL ENERGY | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | UCE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To Summarize various electric drives and traction motors with applications
2. To Understand the concepts of Mechanics of Train movement and associated calculations
3. To Explain the laws of illumination and their application for various lighting schemes
4. To understand the different methods of electric heating and electric welding
5. To identify how to utilize the solar radiation into electrical energy for different applications and to understand the basic principles of wind energy conversion

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Utilize the suitable electric drives for different applications(BL=3) |
| **CO 2** | Analyze the Speed-Time Curves of Different Services(BL=4) |
| **CO 3** | Identify the energy saving based on Illumination system (BL=3) |
| **CO 4** | Understand the utilization of electrical energy for heating and welding purposes(BL=2) |
| **CO 5** | Illustrate the effective usage of solar and wind energy for electrical applications(BL=2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | | | | | | | | | | | | 3 | 3 |
| **CO2** | 3 | 2 | | | | | | | | | | | 2 | 3 |
| **CO3** | 3 | 2 | | 2 | | | | | | | | | 3 | 2 |
| **CO4** | 2 | | | 1 | | | | | | | | | 3 | 2 |
| **CO5** | 2 | 2 | 1 | | | | 2 | | | | | | 3 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **ELECTRIC DRIVES AND TRACTION** | 12 Hrs |
|---|---|---|

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear

At the end of the Module 1, students will be able to:

1. Select the various Electric drives and Traction motors(BL=1)
2. Understand the types of railway electrification and track equipment(BL=2)
3. Explain the various electrical braking methods(BL=2)

| **MODULE -2** | **MECHANICS OF ELECTRIC TRACTION** | 12 Hrs |
|---|---|---|

Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, Specific Energy Consumption, Adhesive Weight and Coefficient of Adhesion.

At the end of the Module 2, students will be able to:

1. Understand the Speed-Time Curves of Different Services(BL=2)
2. Explain the mechanics of train movement(BL=2)
3. Understand the factors effecting Specific Energy Consumption(BL=2)

| **MODULE-3** | **ILLUMINATION** | 08 Hrs |
|---|---|---|

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapor lamps, fluorescent lamps –design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting – UPS- energy saving lamps, LED – working principle of air conditioning system

At the end of the Module 3, students will be able to:

1. Explain the various light sources (BL=2)
2. Understand the various lighting schemes(BL=2)
3. Illustrate the Energy conservation through LED usage(BL=2)

| **MODULE-4** | **HEATING AND WELDING** | 08 Hrs |
|---|---|---|

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating -resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types -resistance welding - arc welding - power supply for arc welding - radiation welding

At the end of the Module 4, students will be able to:

1. Understand the various electrical heating methods(BL=2)
2. List the advantages of electric heating(BL=1)
3. Explain the electrical welding methods(BL=2)

| **MODULE-5** | **SOLAR & WIND ENERGY CONVERSION SYSTEM** | 08 Hrs |
|---|---|---|

**Solar Energy Conversion System:** Introduction - solar constant – terrestrial solar radiation - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency -concentrating collector - advantages and disadvantages of concentrating collectors

**Wind Energy Conversion System:** Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind machines - analysis of aerodynamic forces acting on the blade

At the end of the Module 5, students will be able to:

1. Understand the principles of the conversion of solar radiation into electrical energy(BL=2)
2. Explain the various solar energy collectors(BL=2)
3. Understand merits and demerits of concentrating collectors(BL=2)
4. Understand the principles of wind energy conversion(BL=2)
5. Illustrate the components of Wind Energy Conversion System(BL=2)
6. Understand the aerodynamic forces acting on the blade(BL=2)

| **Total hours:** | **48 hours** |
|---|---|

**Term work:**

1.Report on different DC drives used in electric traction system in India
2.Report on different AC drives used in electric traction system in India
3.study different Electrification systems in traction and submit the report
4.Field trip to electric locomotive limited ,Tirupati and submit report on protection system used in electric locomotive
5. Field trip to electric locomotive limited ,Tirupati and submit report on energy consumption for different electric locomotives
6.Study the different lighting schemes & its line diagrams in Damodharam sanjeevaiah thermal power plant
7.Visit Nelcast industries,Gudur and submit the report on different types electric furnaces and its Rating
8. Visit Nelcast industries,Gudur and submit the report on protective schemes used for electric furnaces
9.Report on complete solar power utilization in India
10.Report on complete wind power utilization in India

**Content beyond syllabus:**

1. Energy Efficient Technologies in Electrical Systems

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | Reference |
|---|---|---|
| 1 | Electric Drives And Traction | https://www.electronicshub.org/electric-traction-system/ |
| 2 | Mechanics Of Electric Traction | https://www.engineeringenotes.com/electrical-engineering/electric-traction-electrical-engineering/train-movement-and-energy-consumption-electrical-engineering/37136 |
| 3 | Illumination | https://nptel.ac.in/courses/108/105/108105060/ |
| 4 | Heating And Welding | https://www.electrical4u.com/electric-heating/ **twi-global.com/technical-knowledge/faqs/what-is-arc-welding** |
| 5 | Solar & Wind Energy Conversion System | https://www.sciencedirect.com/topics/engineering/solar-collector https://www.awea.org/wind-101/basics-of-wind-energy https://www.slideshare.net/BansiKansagara/et-wind |

**Text Book(s):**

1. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1993
3. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000.
4. G.D.Rai,” Non-Conventional Energy sources”, Khanna publications Ltd.,New Delhi 1997
5. D.P.Kothari, K.C.Singal, Rakesh Ranjan, “Renewable Energy Sources and Emerging Technologies”, PHI Learing Private Limited, 2013.

**Reference Book(s):**

1. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited,1993
2. R.K.Rajput, Utilisation of Electric Power, Laxmi publications private Limited.,2007
3. H.Partab, Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi-2004.

**Online Resources:**

1. https://b-ok.asia/book/5441788/abf631
2. https://b-ok.asia/book/2871150/836618

**Web Resources:**

1.https://www.youtube.com/watch?v=fQrZMMWo1mA&list=PLbMVogVj5nJThs8VThC-DA8CZYsmaQypX&index=1
2. https://www.youtube.com/watch?v=5ZGh08q9K7E&list=PLEprwsbQ0B8ITTiaONpKN3Q-bEBJKTMlQ
3. https://www.youtube.com/watch?v=p3PkcLjNUhI
4.https://www.youtube.com/watch?v=TpvmJBeGUrg&list=PLyqSpQzTE6MKwjFQByBvRx464XpCgOEC&index=2
5. https://www.youtube.com/watch?v=GzMuLpsRY-8
6. https://www.youtube.com/watch?v=GExTwRNkQBg

| NARAYANA ENGINEERING COLLEGE::GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4024 | ENERGY AUDIT & DEMAND SIDE MANAGEMENT | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | EMS | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To learn about energy consumption and situation in India
2. To learn about Energy Management.
3. To learn about Energy Measuring Instruments.
4. To understand the Demand Side Management (DSM).
5. To understand the cost effectiveness for DSM.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Understand the importance of energy audit and the basic ideas of conduction an energy audit (BTL-2) |
| **CO 2** | Analyze various techniques of energy management and conservation (BTL-4) |
| **CO 3** | Understand energy efficient methods and power factor improvement techniques (BTL-2) |
| **CO 4** | Analyze demand side management concepts through case study (BTL-4) |
| **CO 5** | Understand various Cost effectiveness test for demand side management programs (BTL-2) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
| CO1 | 1 | | 1 | | | 2 | | | 2 | 1 | | | 2 | 2 |
| CO2 | 1 | 2 | 1 | 1 | | 1 | 1 | | 2 | | 1 | | 3 | 2 |
| CO3 | | 1 | | | | 1 | | | | | | | 3 | 2 |
| CO4 | 1 | 2 | | | | 1 | | | 1 | | | | 2 | 2 |
| CO5 | 1 | 1 | 2 | | | 1 | | | 1 | | | | 2 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Basic principles of Energy Audit | 12 Hrs |
|---|---|---|

Energy audit- definitions, concept, types of audit, energy index, cost index, pie charts, Sankey diagrams, load profiles, Energy conservation schemes-Energy audit of industries-energy saving potential, energy audit of process industry, thermal power station, building energy audit

At the end of the Module 1, students will be able to:

1. Understand the concept of energy audit
2. Understand the various Energy conservation schemes

| MODULE -2 | Energy management | 12 Hrs |
|---|---|---|

**Energy management-I**

Principles of energy management, organizing energy management program, initiating, planning , controlling, promoting, monitoring, reporting.

**Energy management-II**

Energy manger, Qualities and functions , language ,Questionnaire - check list for top management

At the end of the Module 2, students will be able to:

1. Conduct energy management, energy audit and energy conservation measures.
2. Understand the basic principles of energy management
3. Understand the need of energy management
4. Evaluate energy audit results
5. Illustrate electrical load management techniques

| MODULE-3 | ENERGY MANAGEMENT FOR LIGHTING AND ENERGY MOTORS | 08 Hrs |
|---|---|---|

Good Lighting System Design and Practice, Lighting Control, Lighting Energy Audit
Energy efficient motors , factors affecting efficiency, loss distribution , constructional details , characteristics - variable speed , variable duty cycle systems, RMS hp- voltage variation-voltage unbalance- over motoring- motor energy audit

At the end of the Module 4, students will be able to:

1. understand the characteristics of energy efficient motors
2. Implement energy efficient methods and power factor improvement techniques

| MODULE-4 | INTRODUCTION TO DEMAND SIDE MANAGEMENT | 08 Hrs |
|---|---|---|

Introduction to DSM, Concept of DSM, Benefits of DSM, Different Techniques of DSM – Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for Planning. Load Management, Load Priority Technique, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Management and Organization of Energy Conservation Awareness Programs.

At the end of the Module 5, students will be able to:

1. Analyze demand side management concepts through case study
2. Understand the load management

| MODULE-5 | ECONOMICS AND COST EFFECTIVENESS TESTS OF DSM PROGRAMS | 08 Hrs |
|---|---|---|

Basic payback calculations, Depreciation, Net present value calculations. Taxes and Tax Credit – Numerical Problems. Importance of evaluation, measurement and verification of demand side management programs. Cost effectiveness test for demand side management programs - Ratepayer Impact Measure Test, Total Resource Cost, Participant Cost Test, Program Administrator Cost Test

At the end of the Module 6, students will be able to:

1. Analyze economic impacts of energy management and auditing
2. Understand various Cost effectiveness test for demand side management programs

| **Total hours:** | **48 hours** |
|---|---|

**Term work:**

Term work contains assignments ,seminars and quiz

**Content beyond syllabus:**

1. Energy Instruments For Audit

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Energy Audit | CO1 | http://www.opexworks.com/KBase/Energy _Management/Energy_Audit_and _Management/Energy_Audit/Energy _Audit_Types_and_Methodology.htm |
| 2 | Overview of energy management | CO2 | https://beeindia.gov.in/sites/default/files/1Ch3.pdf<br><br>https://www.nrcan.gc.ca/sites/oee.nrcan.gc.ca /files/files/pdf/energy-audit-manual-and-tool.pdf |
| 3 | Energy management for motors | CO3 | https://www.youtube.com/watch?v=T9Vmp3Qo8Mo |
| 4 | Demand side management | CO4 | http://africa-toolkit.reeep.org/modules/Module14.pdf |

| | | | | |
|---|---|---|---|---|
| | 5 | Cost effective test of DSM | CO5 | https://www.youtube.com/watch?v=P4yfHQWYfLc |

**Text Book(s):**

**1.** Industrial Energy Management Systems**,** Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere Publishing Corporation, New York, 1994.

**2.** Fundamentals of Energy Engineering - Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey, 1984.

**Reference Book(s):**

1) Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2) Energy management by Paul o" Callaghan, Mc-graw Hill Book company-1/e,1998
3) Energy efficient electric motors by John C. Andreas, Marcel Dekker Inc Ltd-2/e, 1995
4) Energy management hand book by W.C.Turner, john Wiley and sons
5). Energy management and good lighting practice: fuel efficiency- booklet12-EEO

**Online Resources:**

1. http://lab.fs.uni-lj.si/kes/erasmus/Energy%20Management%20Handbook.pdf
2. https://www.bsr.org/reports/bsr-energy-management-handbook.pdf

**Web Resources:**

1. https://freevideolectures.com/
2. https://www.academia.edu/33324894/Energy_Management_Handbook_7th_Ed_Doty_and_Turner_Fairmont_Press_2009--03-Oct-2009-.pdf?auto=download

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4005 | ADVANCED POWER ELECTRONICS | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | **hrs** | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Power Electronics

**Course Objectives:**

1. To explain the concepts of power electronic switches
2. To demonstrate the applications and analysis of switches in DC-DC converter and various single phase converters
3. To analyze the operation of single phase, three phase and multipulse converters
4. To analyze the power quality improvement techniques
5. To analyze the allocations of FACTS devices

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Explain basic Concept of Switches and their controlling process (B-2) |
| **CO 2** | Demonstrate the device physics, Application and Analysis of Switches in DC-DC converters and Single Phase Converter (B-2) |
| **CO 3** | Analyze the operation Single Phase Converter, Three Phase Converter, Multipulse Converter and Effect of Source Inductance and PWM Rectifiers (B-4) |
| **CO 4** | Analyze the Power Quality Improvement Techniques in electrical systems (B-4) |
| **CO 5** | Analyze the applications of FACTS Devices in electrical system (B-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 2 | | | | | | | | | | | 2 | 3 |
| **CO2** | 3 | 2 | | | | | | | | | | | 2 | 3 |
| **CO3** | 3 | 2 | | | | | | | | | | | 2 | 3 |
| **CO4** | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| **CO5** | 3 | 2 | 2 | | | | | | | | | | 2 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Advanced Solid State Devices** | **10 Hours** |
|---|---|---|

MOSFETs, IGBT, GTO, IGCT etc. Power modules, intelligent power modules, gating circuits. Thermal design, protection. Digital signal processors used in their control.

At the end of the Module 1, students will be able to:

**1.** Recall the basic concepts of Switching characteristics **(BL-1)**

**2.** Understand the controlling techniques of switches **(BL-2)**

| **MODULE -2** | **DC – DC and Single Phase converters** | **10 Hours** |
|---|---|---|

Non-isolated dc-dc converters: Buck, boost, buck-boost, Cuk, SEPIC, Zeta in DCM and CCM. Isolated dc-dc converters: Flyback, forward, Cuk, SEPIC, Zeta, half bridge, push-pull and bridge in DCM and CCM. Single-phase, single-stage converters (SSSSC), power factor correction at ac mains in these converters. Their application in SMPS, UPS, welding and lighting systems.

| | | |
|---|---|---|
| At the end of the Module 2, students will be able to:<br>**1.** understand the concept of DC-DC conversion **(BL-2)**<br>**2.** explain the concept of single-pahse and single stage converters **(BL-2)** | | |
| **MODULE-3** | **AC-DC Converters** | **10 Hours** |
| Single-phase improved power quality ac-dc converters: Buck, boost, buck-boost, PWM VSC (Voltage source converters), multilevel VSCs, PWM CSC (Current voltage source converters). Three-phase improved power quality ac-dc converters: VSC, multilevel VSCs, multipulse VSCs, PWM CSC (Current voltage source converters). Multipulse ac-dc converters: Diode and thyristor based converters | | |
| At the end of the Module 3, students will be able to:<br>**1.** Understand the concept of power quality **(BL-2)**<br>**2.** Apply the various converters to improve the power quality **(BL-3)**<br>**3.** Analyze the various ac-dc converters **(BL-4)** | | |
| **MODULE-4** | **Passive and Active Filters** | **10 Hours** |
| Power quality mitigation devices: Passive filters, active filters, hybrid filters. DSTATCOM (Distribution static compensator), DVR (Dynamic voltage restorer) and UPQC (Universal power quality conditioner). | | |
| At the end of the Module 4, students will be able to:<br>**1.** Explain the concept of passive and active filters **(BL-2)**<br>**2.** Analyze different types of power quality mitigation devices **(BL-4)** | | |
| **MODULE-5** | **FACTS Devices** | **08 Hours** |
| FACTS devices: TCR (Thyristor Controlled Reactor), TSC (Thyristor Switched Capacitors). STATCOM (Static Synchronous Compensator). SSSC (Static Series Synchronous Compensator). UPFC (Unified Power Flow Controller), IPFC (Interline Power Flow Controller). | | |
| At the end of the Module 5, students will be able to:<br>**1.** Understand the concept of FACTS devices **(BL-2)**<br>**2.** Analyze the operation of different types of FACTS Devices **(BL-4)** | | |
| **Total hours:** | | **48 Hours** |

**Term work:**

**Content beyond syllabus:**

1. Advanced controlling techniques to improve Power Quality

**Self-Study:**

Contents to promote self-Learning:

| S.NO | Module | Reference |
|---|---|---|
| 1 | **Advanced Solid State Devices** | https://youtu.be/XgY3HiBhHEE |
| 2 | **DC – DC and Single Phase converters** | https://www.youtube.com/watch?v=p5NZw5fUvgQ |
| 3 | **AC-DC Converters** | https://www.youtube.com/watch?v=JXJaRPXPwjQ |
| 4 | **Passive and Active Filters** | https://www.youtube.com/watch?v=EoPGgrMAAJo |

| | | | | |
|---|---|---|---|---|
| | 5 | **FACTS Devices** | https://www.youtube.com/watch?v=GVxY3nE5mO8&list=PLLy_2iUCG87AVyRAN4QwVQrC8vSg1vWa6 | |

**Text Book(s):**

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Narain G. Hingorani, Laszlo Gyugyi, "Understanding FACTS", IEEE Press.

**Reference Book(s):**

1. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
4. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

**Online Resources / Web References:**

1. https://www.youtube.com/watch?v=MeOYUx07SCk
2. https://www.youtube.com/watch?v=ErMz2MI5DQo
3. https://www.youtube.com/watch?v=ohwGWysVuXU
4. https://www.academia.edu/38805211/Advanced_Power_Electronics_Converters_PWM_Converters_Processing_AC_Voltages
5. https://www.electronicbo.com/2019/06/Advanced-Power-Electronics-Converters.html
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
7. https://nptel.ac.in/courses/108/106/108106073/
8. https://www.youtube.com/watch?v=MeOYUx07SCk&list=PLUpFmz4G8ZyZx2fG5B_GRVIhTquypoAWZ
9. https://www.youtube.com/watch?v=ohwGWysVuXU
10. https://www.youtube.com/watch?v=0jevuayGmmU&list=PLLy_2iUCG87DzWK9cLYKxjH1LRACxdEKi

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4010 | ADVANCED ELECTRICAL DRIVES | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite: Nil**

**Course Objectives:**

1. To understand steady state operation and transient dynamics of a motor load system.
2. To acquire knowledge of fuzzy logic and neural network concepts in various drives

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Analyze the Power electronic converters for electrical drives.(BL-4) |
| **CO 2** | Analyze the field oriented control of machines.(BL-4) |
| **CO 3** | Understand the vector control of electrical drives.(BL-2) |
| **CO 4** | Understand the sensor less control of AC drives.(BL-2) |
| **CO 5** | Analyze the direct torque control of Induction Machines.(BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 2 | 2 | 3 | | 2 | | | | | | | | 1 | 2 |
| CO2 | 2 | 2 | 3 | | 2 | | | | | | | | 1 | 2 |
| CO3 | 2 | 2 | 2 | | 2 | | | | | | | | 1 | 2 |
| CO4 | 2 | | 3 | | 2 | | | | | | | | | 2 |
| CO5 | 2 | 2 | 2 | | 2 | | | | | | | | | 2 |

1: Low, 2-Medium, 3- High

## COURSE CONTENT

### MODULE – 1 (08 Hrs)

**INTRODUCTION TO POWER CONVERTERS FOR ELECTRIC DRIVES**

Switching converters and their applications to variable frequency drives - Power electronic converters for control of amplitude-AC variable frequency drives - Mathematical representation of switching functions- reduction of switching losses in practical switches. MATLAB simulation -study on 'D0Q' transformation in various frames of reference. Free acceleration characteristics of Induction motor from 'D0Q' model viewed from various reference frames

At the end of the Module 1, students will be able to:

1. Explain the switching converters ad their application.(BL-2)
2. Understand the Power electronic converters for control of drives.(BL-2)
3. Explain the characteristics of Induction motor from various reference frames. (BL-2)

### MODULE -2 (10 Hrs)

**FIELD ORIENTATED CONTROL**

Field oriented control of induction machines - Theory – DC drive analogy.

At the end of the Module 2, students will be able to:

1. Understand the field orientated control and its application. (BL-2)
2. Analyze the Field oriented control of induction machines. (BL-4)
3. Analyze the Field oriented control of DC drive. (BL-4)

**MODULE-3 (10 Hrs)**

**VECTOR CONTROL**

Vector control concept- Direct or Feedback vector control - Indirect or Feed forward vector control – Flux vector estimation - Space vector modulation control-PWM current control-MATLAB simulation direct & indirect vector control induction motor- closed loop speed control of VVVF PMAC motor drive & FPGA based closed loop control of BLDC motor drive.

At the end of the Module 3, students will be able to:

1. Understand the vector control concept. (BL-2)
2. Understand the MATLAB simulation direct & indirect vector of control induction motor. (BL-2).
3. Explain FPGA based closed loop control of BLDC motor drive. (BL-2)

**MODULE-4 (10 Hrs)**

**SENSORLESS CONTROL OF AC DRIVES**

Introduction to sensor less control of AC drives – Advantages – speed estimation methods-State synthesis method – model reference adaptive system – observer based techniques -MATLAB simulation model reference adaptive system for speed estimation.

At the end of the Module 4, students will be able to:

1. Understand the sensor less control of AC drives.(BL-2)
2. Explain the state synthesis method. (BL-2)
3. Understand the MATLAB simulation model reference adaptive system for speed estimation. (BL-2)

**MODULE-5 (10 Hrs)**

**DIRECT TORQUE CONTROL**

Direct torque control of Induction Machines – Torque expression with stator and rotor fluxes, DTC control strategy – optimum switching vector selection – reduction of torque ripple methods- adaptive control. MATLAB simulation-open loop control-DTC of induction motor drive-adaptive control.

At the end of the Module 5, students will be able to:

1. Understand the Direct torque control of Induction Machines. (BL-2)
2. Explain the Torque expression with stator and rotor fluxes.(BL-2)
3. Explain optimum switching vector selection.(BL-2)

| **Total hours:** | **48 hours** |
|---|---|

**Content beyond syllabus:**

1. GA based drives

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | CO | Reference |
|---|---|---|---|
| 1 | Reduction of switching losses in practical | CO1 | https://www.youtube.com/watch?v=7kGPLVXvsPk |

| | | | |
|---|---|---|---|
| | switches | | |
| 2 | Field oriented control of induction machines | CO2 | https://www.youtube.com/watch?v=2jtk1_rcYYQ |
| 3 | FPGA based closed loop control of BLDC motor drive | CO3 | https://www.youtube.com/watch?v=V0XP3N5c2GY |
| 4 | MATLAB simulation model reference adaptive system for speed estimation | CO4 | https://www.youtube.com/watch?v=9W2CzT0wq3Q |
| 5 | DTC of induction motor drive | CO5 | https://www.youtube.com/watch?v=mG7AxRkGrr8 |

**Text Book(s):**

1. Bimal.K. Bose, "Power Electronics and Variable frequency drives", Standard Publishers Distributors, New Delhi, 2000.
2. Dubey G.K., "Power Semiconductor controlled drives", Prentice Hall inc, A division of Simon and Schester England cliffs, New Jersey, 1989.

**Reference Book(s):**

1. Murphy J.M.D, Turnbull, F.G, "Thyristor control of AC motor", Pergamon press, Oxford, 1988.
2. Sheperal, Wand Hully, L.N. "Power Electronic and Motor control" Cambridge University Press Cambridge, 1987.
3. Dewan, S. Slemon B., Straughen, A. G.R., "Power Semiconductor drives", John Wiley and Sons, NewYork, 1984.

**Online Resources:**

1. https://doku.pub/documents/electric-drives-by-gk-dubey-59qge6y3vm0n
2. https://nptel.ac.in/courses/108/104/108104011/

**Web Resources:**

1. https://www.youtube.com/watch?v=6DctdwlDKhc&list=PLA5CA7D35114BA425
2.https://www.youtube.com/watch?v=WsDPqDqnpyw&list=PLuv3GM6gsE3UGP1cSOl1KuEXscGFdKXB

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4015 | HVDC and FACTS | | | | | | | R2020 |
| | Hours / Week | | | Total hrs | Credit | Max Marks | | |
| | L | T | P | | C | CIE | HVDC | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Transmission and Distribution, Power Electronics and High voltage engineering

**Course Objectives:**

1. To introduce the extra high voltage AC and DC transmission
2. To introduce the HVDC transmission system with types, control and protection.
3. To discuss about the design factors of lines and cables.
4. To provide knowledge on FACTS controllers.
5. To introduce the reactive power control techniques.
6. To study the characteristics, modelling and operating schemes of different types of shunt and series switched reactive power generating devices.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Find the applications of different types of HVDC links.(BL-2) |
| **CO 2** | Apply converters for HVDC transmission for control of converters.(BL-3) |
| **CO 3** | Understand the concept of filters to mitigate harmonics, concept of reactive power requirements.(BL-2) |
| **CO 4** | Understand the working principles of FACTS devices.(BL-2) |
| **CO 5** | Analyze the performance of Series, Shunt and combined FACTS controllers.(BL-4) |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 |
| CO1 | 3 | 2 | 2 | | | | | | | | | | 3 | 2 |
| CO2 | 3 | | 3 | | | | | | | | | | 2 | 2 |
| CO3 | 2 | 2 | 2 | | | | | | | | | | 2 | 2 |
| CO4 | 2 | 3 | 2 | | | | | | | | | | 3 | 2 |
| CO5 | 2 | 2 | 3 | | | | | | | | | | 3 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| MODULE – 1 | Introduction | 10Hrs |
|---|---|---|

Comparison of AC and DC transmission systems, application of DC transmission, types of DC links, typical layout of a HVDC converter station, HVDC converts, pulse number, analysis of Gratez circuit with and without overlap, converter bridge characteristics, equivalent circuits or rectifier and inverter configurations of twelve pulse converters.

At the end of the Module 1, students will be able to:

1. Explain the comparison of HVDC and HV AC.(BL-2)
2. Understand the Application of the HVDC Transmission.(BL-2)
3. Understand the Characteristics of 6 pulse and 12 pulse converters.(BL-2)

| MODULE -2 | CONVERTER & HVDC SYSTEM CONTROL | 10Hrs |
|---|---|---|

Principle of DC link control –Converters control characteristics- system control hierarchy, firing angle control, current and excitation angle control, starting and stopping of DC link.

At the end of the Module 2, students will be able to:

1. Understand the principle of DC link control.(BL-2)
2. Understand the Firing Angle Control for the Converters.(BL-2)
3. Explain the starting and stopping of DC link. (BL-2)

| MODULE-3 | HARMONICS, FILTERS AND REACTIVE POWER CONTROL | 10Hrs |
|---|---|---|

Introduction, generation of Harmonics, AC and DC Filters. Reactive power requirements in steady state, sources of reactive power, static VAR systems.

**POWER FLOW ANALYSIS IN AC/DC SYSTEMS:** Modeling of DC/AC converts, controller equations solutions of AC/DC load flow- simultaneous method, sequential method.

At the end of the Module 3, students will be able to:

1. Understand the Basics generation of harmonics.(BL-2)
2. Explain the calculation of voltage & Current harmonics. (BL-2)
3. Explain the types of AC filters.(BL-2)

| MODULE-4 | INTRODUCTION TO FACTS | 10Hrs |
|---|---|---|

Flow of power in AC parallel paths and meshed systems, basic types of FACTS controllers, brief description and definitions of FACTS controllers.

**STATIC SHUNT COMPENSATION**: Objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators, SVC and STATCOM, comparison between SVC and STATCOM.

At the end of the Module 4, students will be able to:

1. Explain the basic principles, characteristics of different types of FACTS controllers. (BL-2)
2. Explain the new methods adopted in power system control. (BL-2)
3. Understand the static shunt compensation. (BL-2)

| MODULE-5 | STATIC SERIES COMPENSATORS | 8Hrs |
|---|---|---|

Objectives of series compensation, variable impedance type- thyristor switched series capacitors (TCSC), and switching converter type series compensators, static series synchronous compensator (SSSC)- power angle characteristics-basic operating control schemes.

At the end of the Module 5, students will be able to:

1. Understand the objectives of series compensation of power systems. (BL-2)
2. Understand the power angle characteristics. (BL-2)
3. Explain the basic operating control schemes. (BL-2)

| | |
|---|---|
| **Total hours:** | **48 hours** |

**Term work:**

1. Develop HVDC Transmission system using mat lab software
2. The steady-state and transient performance of a 12-pulse, 1000 MW (500 kV-2kA) 50/60 Hz HVDC transmission system.
3. FACTS and HVDC Technologies for the Development and Enhancement of Future Power Systems.
4. Use of HVDC and FACTS which can be applied in transmission and distribution systems
5. Simulation of various applications using FACTs devices.
6. AC-DC Power flow analysis using FACTS devices.
7. Stabilty of Power Transmission Capability of HVDC system using facts controllers.
8. Design of DC breakers modelling using MATLAB
9. Design of Power control in HVDC using MATLAB
10. Modelling and digital simulation of STATACOM using MATLAB

**Content beyond syllabus:**

1. Design of real-time industrial projects.
2. Application of various compensation techniques in power system.

**Self-Study:**

Contents to promote self-Learning:

| SNO | Topic | Reference |
|---|---|---|
| 1 | Introduction of DC power transmission | https://www.cet.edu.in/noticefiles/229_HVDC_NOTE.pdf |
| 2 | Analysis of HVDC converters | https://aits-tpt.edu.in/wp-content/uploads/2018/08/HVDC-2-Unit.pdf |
| 3 | Control of HVDC converter and systems | https://sari-energy.org/oldsite/PageFiles/What_We_Do/activities/HVDC_Training/Presentations/Day_2/3.HVDC_CONTROLS.pdf |
| 4 | Introduction To Facts | https://nptel.ac.in/courses/108/107/108107114/ |
| 5 | Static Series Compensators | https://nptel.ac.in/courses/108/107/108107114/ |

**Text Book(s):**

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.
4. R.MohanMathur,RajivK.Varma,"Thyristor–Based Facts Controllers for Electrical Transmission Systems", IEEE press andJohnWiley&Sons,Inc,2002.
5.Narain G.Hingorani, "Understanding FACTS-Concepts and Technology of Flexible AC Transmission Systems", Standard Publishers Distributors,Delhi-110006,2011.

**Reference Book(s):**

1. Direct Current Transmission, Vol. 1, E. W. Kimbark, Wiley, 1971
2. High Voltage Direct Current Transmission, Jos Arrillaga, IEE Power and Energy series 29, 2nd Edition, 1998
3. EHV-AC, HVDC Transmission & Distribution Engineering, S Rao, Khanna Publishers, 4 th Edition, 2008.
4.K.R.Padiyar,"FACTS Controllersin Power Transmission and Distribution", New Age International (P) Limited, Publishers, New Delhi, 2008
5. A.T.John,"FlexibleA.C.TransmissionSystems",InstitutionofElectricalandElectronic Engineers(IEEE), 1999.
6. V.K.Sood, HVDC and FACTS controllers–Applications of Static Converters in Power System, APRIL2004,KluwerAcademic Publishers,2004.

**Online Resources/ Web Resources:**

1. https://nptel.ac.in/courses/108/104/108104013/
2. http://www.ee.uidaho.edu/ee/power/ee
3. https://www.powereng.com/our-services/power-delivery/hvdc-fact/
4. https://en.wikipedia.org/wiki/High-voltage_direct_current
5. https://www.ti.com/lit/an/sloa289a/sloa289a.pdf?ts=1592377419880&ref_url=https%253A%252F%2www.google.co.in%252F
7. https://pv-magazine-usa.com/2020/03/31/hvdc-transmission-helps-investors-but-may-not-help-solar/
8. http://www.renewableenergyfocus.com/view/3567/hvdc-transmission-from-energy-source-to-consumer/

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4020 | ADVANCED POWER CONVERTERS | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | **hrs** | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Power Electronics

**Course Objectives:**

1. To analyze the dc-dc voltage regulators
2. To describe the operation of resonant converters
3. To describe the operation of multi level converters and multi pulse converters with switching strategies for high power
4. To understand Principle of Operation DC power supplies
5. To analyze the AC power supplies

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Evaluate different dc-dc voltage regulators**(BL-3)** |
| **CO 2** | Analyze resonant converters**(BL-3)** |
| **CO 3** | Evaluate various multi-level inverter configurations **(BL-3)** |
| **CO 4** | Select appropriate phase shifting converter for a multi-pulse converter**(BL-3)** |
| **CO 5** | Analyze the various DC power supplies **(BL-3)** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 2 | 2 | | | | | | | | | | | 2 | 3 |
| **CO2** | 3 | 2 | 2 | | | | | | | | | | 3 | 3 |
| **CO3** | 1 | 1 | 1 | | | | | | | | | | 2 | 3 |
| **CO4** | 2 | 2 | | | | | | | | | | | 2 | 2 |
| **CO5** | 1 | 3 | | | | | | | | | | | 2 | 3 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **Switching Voltage Regulators** | 10**Hours** |
|---|---|---|

Introduction; Linear power supply (voltage regulators); Switching voltage regulators; Review of basic dc-dc voltage regulator configurations -Buck, Boost, Buck-Boost converters and their analysis for continuous and discontinuous mode; Other converter configurations like Flyback converter, Forward converter, Half bridge, Full bridge configurations, Push-pull converter; Design criteria for SMPS; Multi-output switch mode regulator.

At the end of the Module 1, students will be able to:

**1.** Recall the basic concepts of voltage regulators **(BL-1)**

**2.** Understand the other converter configurations **(BL-2)**

**3.** Evaluate the different dc voltage regulators**(BL-3)**

| **MODULE -2** | **Resonant Converters** | **10 Hours** |
|---|---|---|

Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, zerovoltage switching dc-dc converters, zero current switching dc-dc converters, clamped voltage topologies.

At the end of the Module 2, students will be able to:

1. understand the concept of resonant conversion**(BL-2)**
2. compare & analyzethe zero voltage and current switching dc-dc converters**(BL-2)**

| **MODULE-3** | **Multi-level converters** | **10 Hours** |
|---|---|---|

Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode Clamped, Flying capacitor and Cascaded H-bridge multilevel Converters configurations; Features and relative comparison of these configurations applications, Introduction to carrier based PWM technique for multi-level converters.

At the end of the Module 3, students will be able to:

1. Understand the concept of multi-level **(BL-2)**
2. Evaluate various multi-level inverter configurations **(BL-3)**
3. Understandcarrier based PWM technique for multi-level converters**(BL-2)**

| **MODULE-4** | **Multipulse Converters** | **08 Hours** |
|---|---|---|

Concept of multi-pulse, Configurations for m-pulse (m=12,18,24 ….) converters, Different phase shifting transformer (Y-Δ1, Y-Δ2, Y-Z1 and Y-Z2) configurations for multi-pulse converters, Applications.

At the end of the Module 4, students will be able to:

1. Explain the concept of multi-pulse**(BL-3)**
2. Analyze different phase shifting transformer configurations for multi-pulse converters**(BL-4)**
3. Understand the applications of multipulse converters**(BL-2)**

| **MODULE-5** | **DC & AC Power Supplies** | **10 Hours** |
|---|---|---|

DC Power Supplies – Types – Switched Mode DC Power Supplies – Fly Back Converter –Forward Converter – Push-Pull Converter – Half Bridge Converter – Full Bridge Converter –Resonant DC Power Supplies – Bidirectional Power Supplies – Applications –AC Power Supplies – Types – Switched Mode Ac Power Supplies – Resonant AC Power Supplies – Bidirectional Ac Power Supplies – Multistage Conversions – Control Circuits – Power Line Disturbances – Power Conditioners – Uninterruptible Power Supplies – Applications

At the end of the Module 5, students will be able to:

1. Understand the switched mode dc power supplies**(BL-2)**
2. Analyze the types of dc power supplies **(BL-3)**
3. Analyze Bidirectional Power Supplies (BL-3)

| **Total hours:** | **48 Hours** |
|---|---|

**Term work:**

1. Evaluate the performance and operating modes of SLR/PLR dc-dc converter with the change in switching frequency.
2. Simulate/Design a circuit for a Buck Converter with ZVS/ZCS to regulate the output voltage Vo with a given input voltage Vin.
3. Carrier based Sine PWM control of a CHB multilevel inverter and study of harmonic spectrum.
4. Study the operation and performance of second order converters like Buck-Boost, Fly back, forward converters etc.
5. Study the operation and performance of fourth order converters like C'uk or Sepic converters
6. Study of harmonic spectrum for 12 and 18 pulse converters.
7. Design based Problems (DP)/Open Ended Problem: Course coordinator can assign the design based problem/open ended problem.
8. Major Equipment: Simulation software like MATLAB, PSIM, Scilab, Power Electronic Converters, CRO/DSO, meters, Current/Voltage Probes, Isolation transformer etc. as demanded by the course.

**Content beyond syllabus:**

1.Advanced multilevel converters

**Self-Study:**

Contents to promote self-Learning:

| S.NO | Module | Reference |
|---|---|---|
| 1 | **Switching Voltage Regulators** | https://www.youtube.com/watch?v=Q0E-ZAsqzKE |
| 2 | **Resonant Converters** | https://www.youtube.com/watch?v=53avTO3BYnI |
| 3 | **Multi-level converters** | https://www.youtube.com/watch?v=J3iEhAtcwZs |
| 4 | **Multipulse Converters** | https://www.youtube.com/watch?v=cqT6oOh3ggc |
| 5 | **DC Power Supplies** | https://www.youtube.com/watch?v=flAETm0RreY |
| 6 | **AC Power Supplies** | https://www.youtube.com/watch?v=DwiBp-Oohvs |

**Text Book(s):**

1. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics – Converters, Applications and Design", John Willey & sons, Inc., 3rd ed., 2003.
2. Muhammad H. Rashid, "Power Electronics - Circuits, Devices and Applications", Prentice Hall of India, 3rd ed., 2009.
3. Bin Wu, "High Power Converters and AC Drives", John Willey & sons, Inc., 2006.

**Reference Book(s):**

1. Derek A. Paice "Power Electronic Converter Harmonics – Multipulse Methods for Clean Power", IEEE Press, 1996.
2. Muhammad H. Rashid , "Power Electronics Handbook", Elsevier, 3rd ed., 2011.
3. P.C.Sen, "Modern Power Electronics ", S. Chand and Co. Ltd., New Delhi, 2000.
4. Vijay K. Sood, "HVDC and FACTS Controllers Applications of Static Converters in Power Systems", Kluwer Academic Publishers, Boston, 2004.
5. L. Umanand, "Power Electronics Essentials and Applications", Wiley India Ltd., 2009

**Online Resources / Web References:**

1. https://www.youtube.com/watch?v=MeOYUx07SCk
2. https://www.youtube.com/watch?v=ErMz2MI5DQo
3. https://www.youtube.com/watch?v=ohwGWysVuXU
4. https://www.academia.edu/38805211/Advanced_Power_Electronics_Converters_PWM_Converters_Processing_AC_Voltages
5. https://www.electronicbo.com/2019/06/Advanced-Power-Electronics-Converters.html
6. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/
7. https://nptel.ac.in/courses/108/106/108106073/
8. https://www.youtube.com/watch?v=MeOYUx07SCk&list=PLUpFmz4G8ZyZx2fG5B_GRVIhTquypoAWZ
9. https://www.youtube.com/watch?v=ohwGWysVuXU
10. https://www.youtube.com/watch?v=0jevuayGmmU&list=PLLy_2iUCG87DzWK9cLYKxjH1LRACxdEKi

| NARAYANA ENGINEERING COLLEGE:GUDUR | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 20EE4025 | ADVANCED POWER SEMICONDUCTOR DEVICES AND PROTECTION | | | | | | | R2020 |
| | Hours / Week | | | Total | Credit | Max Marks | | |
| | L | T | P | **hrs** | C | CIE | SEE | TOTAL |
| | 3 | 0 | 0 | 48 | 3 | 40 | 60 | 100 |

**Pre-requisite:** Review of introductory concepts of power semiconductor devices

**Course Objectives:**

**OBJECTIVES:**

1. To improve power semiconductor device structures for adjustable speed motor controlapplications.
2. To understand the static and dynamic characteristics of current controlled powersemiconductor devices
3. To understand the static and dynamic characteristics of voltage controlled powersemiconductor devices
4. To enable the students for the selection of devices for different power electronicsApplications
5. To understand the control and firing circuit for different devices.

**Course Outcomes**: After successful completion of the course, the student will be able to:

| | |
|---|---|
| **CO 1** | Analyze power switching devices **(BL-4)** |
| **CO 2** | Design of current controlled devices and their parameters**(BL-3)** |
| **CO 3** | Analyze the voltage controlled devices and their parameters **(BL-2)** |
| **CO 4** | Understand new power semiconductor devices**(BL-2)** |
| **CO 5** | Design of protecting circuit**(BL-3)** |

**CO-PO Mapping**

| CO | PO | | | | | | | | | | | | PSO | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **PO 1** | **PO 2** | **PO 3** | **PO 4** | **PO 5** | **PO 6** | **PO 7** | **PO 8** | **PO 9** | **PO 10** | **PO 11** | **PO 12** | **PSO 1** | **PSO 2** |
| **CO1** | 3 | 2 | | | | | | | | | | | 2 | 2 |
| **CO2** | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |
| **CO3** | 3 | 2 | | | | | | | | | | | 2 | 2 |
| **CO4** | 3 | 2 | | | | | | | | | | | 2 | 2 |
| **CO5** | 3 | 2 | 2 | | | | | | | | | | 2 | 2 |

1: Low, 2-Medium, 3- High

**COURSE CONTENT**

| **MODULE – 1** | **POWER SWITCHING DEVICES** | 10**Hours** |
|---|---|---|

Power switching devices overview – Attributes of an ideal switch, application requirements,circuit symbols; Power handling capability – (SOA); Device selection strategy – On-state andswitching losses – EMI due to switching - Power diodes - Types, forward and reverse characteristics, switching characteristics – rating.

At the end of the Module 1, students will be able to:

1. Understand the Power switching devices overview**(BL-2)**
2. Analyze the Device selection strategy **(BL-3)**
3. Analyze the Power diodes **(BL-3)**

| MODULE -2 | CURRENT CONTROLLED DEVICES | 10 Hours |
|---|---|---|
| BJT's – Construction, static characteristics, switching characteristics; Negative temperaturecoefficient and second breakdown; - Thyristors – Physical and electrical principle underlyingoperating mode, Two transistor analogy – concept of latching; Gate and switchingcharacteristics; converter grade and inverter grade and other types; series and paralleloperation; comparison of BJT and Thyristor – steady state and dynamic models of BJT Thyristors- Basics of GTO, MCT, FCT, RCT | | |
| At the end of the Module 2, students will be able to:<br>**1.** Analyze the switching characteristicsofBJT**(BL-3)**<br>**2.** Analyze the Two transistor analogy**(BL-3)**<br>**3.** Understand the basics of thyristors**(BL-3)** | | |
| **MODULE-3** | **VOLTAGE CONTROLLED DEVICES** | **10 Hours** |
| Power MOSFETs and IGBTs – Principle of voltage controlled devices, construction, types,static and switching characteristics, steady state and dynamic models of MOSFET and IGBTs -and IGCT | | |
| At the end of the Module 3, students will be able to:<br>**1.** Understand the principle of voltage controlled devices**(BL-2)**<br>**2.** Analyze the switching characteristics of MOSFET & IGBT**(BL-3)** | | |
| **MODULE-4** | **NEW SEMICONDUCTOR MATERIALS FOR DEVICES** | **10 Hours** |
| New semiconductor materials for devices – Intelligent power modules- Integratedgate commutated thyristor (IGCT) - Comparison of all power devices. | | |
| At the end of the Module 4, students will be able to:<br>**1.** Understand the Intelligent power modules**(BL-2)**<br>**2.** Analyze the Integratedgate commutated thyristor**(BL-3)**<br>**3.** Compare all power devices**(BL-2)** | | |
| **MODULE-5** | **FIRING AND PROTECTING CIRCUITS** | **08 Hours** |
| Necessity of isolation, pulse transformer, optocoupler – Gate drives circuit: SCR, MOSFET,IGBTs and base driving for power BJT. - Over voltage, over current and gate protections;Design of snubbers.Heat transfer – conduction, convection and radiation; Cooling – liquid cooling, vapour – phase cooling | | |
| At the end of the Module 5, students will be able to:<br>**1.** Understand the necessity of isolation**(BL-2)**<br>**2.** Analyze the Gate drives circuit**(BL-3)**<br>**3.** Understand the design of snubbers**(BL-2)** | | |
| **Total hours:** | | **48 hours** |

**Term work:**

1. Study of design of SiC MOSFETs
2. Tabulate the details of SCRs of different ratings
3. Derivation and explanation of transient thermal impedance of SCR
4. Study of thermal design of SCR with derivations
5. Study and explain paper on the state of the art and future trends of power semiconductors

**Content beyond syllabus:**

Protection against external & internal over voltages.

**Self-Study:**

Contents to promote self-Learning:

| S.NO | Module | Reference |
|---|---|---|
| 1 | Power Switching Devices | https://www.youtube.com/watch?v=7XsuRUXF4wE |
| 2 | Current Controlled Devices | https://www.youtube.com/watch?v=5Jf_WWt-5vg |
| 3 | Voltage Controlled Devices | https://www.youtube.com/watch?v=lzwqcMvuYxU |
| 4 | New Semiconductor Materials For Devices | https://www.youtube.com/watch?v=88lo7MgCpNo |
| 5 | Firing And Protecting Circuits | https://www.youtube.com/watch?v=XyuY8OgMQL4 |

**Text Book(s):**


1. B.W Williams 'Power Electronics Circuit Devices and Applications'..
2. Rashid M.H., " Power Electronics Circuits, Devices and Applications ", Prentice Hall India, Third Edition, New Delhi, 2004
3. MD Singh and K.B Khanchandani, "Power Electronics", Tata McGraw Hill, 2001.
4. Mohan, Undeland and Robins, "Power Electronics – Concepts, applications and Design, John Wiley and Sons, Singapore, 2000.
5. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw-Hill, 2010.


**Reference Book(s):**


1. Advanced power electronics converters by Euzeli dos santos, Edison R. da silva.
2. Fundamentals of Power Semiconductor Devices by B. JayanthBaliga, Springer Press, 2008.
3. Power Semiconductor Devices and Circuits, Jaecklin, **A.A.**
4. Fundamentals of Power Semiconductor Devices, **Baliga**, B. Jayant


**Online Resources/ Web References:**

1. https://www.amazon.in/Power-Electronics-Drives-Advanced-Applications-ebook/dp/B086H4Z9WY
2. https://www.pdfdrive.com/25-advanced-power-semiconductor-devices-apsd-e456994.html
3. https://www.ttiinc.com/content/ttiinc/en/resources/product-types/discretes.html?utm=1267&channel=ppc&gclid=CjwKCAjw1K75BRAEEiwAd41h1AEeMfdQ65z0DUsEWQSBV_cFEI5VwuQnFLxopFizjnXDYRY4iPtUoRoCkAEQAvD_BwE
4. http://site.iugaza.edu.ps/malramlawi/files/RASHID_Power_Electronics_Handbook.pdf
5. https://www.youtube.com/watch?v=h0Y9jDKqScQ&list=PLgMDNELGJ1CaNcuuQv9xN07ZWkXE-wCGP
6. https://www.youtube.com/watch?v=m-uY4fja_Jw&list=PLOzRYVm0a65dVYOA7_3-N67Xu1NIrLnR0
7. https://www.youtube.com/watch?v=-YgHdIqkbs0
8. https://www.youtube.com/watch?v=5-uQ4rLlWPE

# List of Open Elective Subjects:

| S.No | BoS Subjects from department of EEE | Sem/Branch | Category |
|---|---|---|---|
| | **Open Elective Subjects** | | |
| 1. | Artificial Neural Networks and Fuzzy Logic | NA | OE |
| 2. | Basic Electrical and Electronic Engineering | NA | OE |
| 3. | Energy Auditing and Demand Side Management | NA | OE |
| 4. | Electrical Measurements and Instrumentation | NA | OE |
| 5. | Utilization of Electrical Energy | NA | OE |
| 6. | Industrial Automation Engineering | NA | OE |
| 7. | Industrial Electrical Systems | NA | OE |
| 8. | Renewable Energy Conversion Systems | NA | OE |
| 9. | Power Quality | NA | OE |

# 1.ARTIFICIAL NEURAL NETWORKS & FUZZY LOGIC

**MODULE – 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE 10 hrs**

Introduction to Artificial intelligence, Approaches to AI, Architectures of AI, Symbolic reasoning system, Rule based systems, Knowledge representation, Expert systems.

**MODULE -2 ARTIFICIAL NEURAL NETWORKS 10 hrs**

Basics of ANN, Comparison between Artificial and Biological Neural Networks, Basic Building Blocksof ANN, Artificial Neural Network Terminologies, McCulloch Pitts Neuron Model, Learning Rules, ADALINE and MADALINE Models, Perceptron Networks, Back Propagation Neural Networks – Associative Memories.

**MODULE-3 ANN APPLICATIONS TO ELECTRICAL SYSTEMS 8 hrs**

ANN approach to: Electrical Load Forecasting Problem, System Identification, Control Systems, Pattern Recognition.

**MODULE-4 CLASSICAL RELATIONS AND FUZZY RELATIONS 10 hrs**

Classical Sets, Fuzzy Sets, Operations on classical sets, Properties of crisp sets, Operations on fuzzy sets, Properties of Fuzzy sets, Fuzzy Relations- Cardinality, Cartesian product, Fuzzy compositions, Fuzzy Equivalence Relation & Fuzzy Tolerance Relation

**MODULE-5 FUZZY LOGIC AND APPLICATION 10 hrs**

Fuzzification & Defuzzification- Methods, Membership Functions, Fuzzy Rule base, Genetic Algorithm , Fuzzy Logic Controller Design, Features of a simple Fuzzy Logic Control system, NeuroFuzzy Controller. Fuzzy Logic Implementation for Induction Motor Control, Switched Reluctance Motor Control, Fuzzy Excitation Control Systems in Automatic Voltage Regulator, Fuzzy Logic Controller in an 18 Bus Bar System. **Total : 48 hrs**

**Text Book(s):**

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB",McGraw Hill Edition, 2006.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition,WILEY India Edition,2012.
3. Neural Networks – Simon Hakins , Pearson Education

**Reference Book(s):**

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", SpringerInternational Edition, 2013.
2. Yung C. Shin and Chengying Xu, "Intelligent System – Modeling, Optimization & Control, CRC Press,200
3. Elaine Rich, Kevin Knight ,Shivashankar B Nair, " Artificial intelligence" McGraw Hill third Edition

## 2. BASIC ELECTRICAL AND ELECTRONICS ENGINEERING

**MODULE – 1 DC & AC Circuits 08 hrs**

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem - Representation of sinusoidal waveforms - peak and rms values - phasor representation - real power - reactive power – apparent power.

**MODULE -2 DC Machines 08 hrs**

Principle and operation of DC Generator - EMF equations - principle and operation of DC Motor –Types of DC Motor - Brake Test on DC Shunt Motor - Characteristics of DC Motor - Applications.

**MODULE-3 AC MACHINES 08 hrs**

Principle and operation of Single Phase Transformer - OC and SC test on transformer - principle and operation of Three Phase Induction Motor - Characteristics and Applications.

**PART B:**

**MODULE-4 Semicondcutor Diodes 08 hrs**

PN diode, Diode as Switch, Zener Diode, Tunnel diode, Varactor diode, LED, Photodiode: their characteristics and applications

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**MODULE-5 Bipolar Junction Transistor 08 hrs**

Bipolar Junction Transistor (BJT) – Types of Transistors, Operation of NPN and PNP Transistors, Input- Output Characteristics of BJT-CB, CE and CC Configurations, Relation between IC, IB and IE, Transistor Applications- Transistor as an Amplifier, Transistor as a Switch.

**MODULE-6 Metal–Oxide–Semiconductor Field-Effect Transistor 08 hrs**

Introduction to MOSFET, Construction of depletion mode and enhancement mode of NMOS and PMOS, Drain characteristics of MOSFET, Transfer Characteristics of MOSFET, MOSFET as Switch, CMOS Inverter and it's Characteristics. **Total : 48 hrs**

**Text Book(s):**

1.D. P. Kothari and I. J. Nagrath - “Basic Electrical Engineering” - Tata McGraw Hill - 2010.

2.Basic Electrical and Electronics Engineering, M.S.Sukhija, T.K.Nagsarkar, Oxford University.

3.V.K. Mehta &Rohit Mehta, “Principles of Electronics” – S.Chand –2018.

4. Basic Electrical and Electronics Engineering, S.K Bhattacharya, Pearson Education,2012.

**Reference Book(s):**

1. L. S. Bobrow - “Fundamentals of Electrical Engineering” - Oxford University Press - 2011.

2 J. Millman, C. Halkias, “Electronic Devices and Circuits”, Tata Mc-Graw Hill, 4th Edition,2010.

3.David A.Bell, “Electronic Devices and Circuits”, Fifth Edition, Oxford University Press, 2009.

# 3.ENERGY AUDITING AND DEMAND SIDE MANAGEMENT

**MODULE – 1 INTRODUCTION TO ENERGY AUDITING 10 hrs**

Energy Situation – World and India, Energy Consumption, Conservation, Energy audit- definitions, concept, types of audit, energy index, cost index ,pie charts, Sankey diagrams , load profiles, Energy conservation schemes- Energy audit of industries

**MODULE -2 ENERGY MANAGEMENT 9 hrs**

Principles of energy management, organizing energy management program, initiating, planning , Controlling, promoting, monitoring, reporting. Energy manger, Qualities and functions ,language ,Questionnaire - check list for top management.

**MODULE-3 ENERGY EFFICIENT MOTORS AND POWER FACTOR IMPROVEMENT 10 hrs**

Energy Efficient Motors , Factors Affecting Efficiency, Loss Distribution , Constructional Details , Characteristics - Variable Speed , Variable Duty Cycle Systems, RMS Hp- Voltage Variation-Voltage Unbalance- Over Motoring- Motor Energy Audit. Power Factor – Methods of Improvement, Power factor With Non Linear Loads.

**MODULE-4 LIGHTING AND ENERGY INSTRUMENTS FOR AUDIT 9 hrs**

Good Lighting System Design and Practice, Lighting Control, Lighting Energy Audit - Energy Instruments- Watt Meter, Data Loggers, Thermocouples, Pyrometers, Lux Meters, Tong Testers, Application of PLC's.

**MODULE-5 CONCEPTS,ECONOMIC ASPECTS AND COSTEFFECTIVENESS TESTS OF DSM PROGRAMS 10 hrs**

Concept of DSM, Benefits of DSM, Different Techniques of DSM – Time of Day Pricing, Multi-Utility Power Exchange Model, Time of Day Models for Planning. Load Management, Load Priority Techniques, Peak Clipping, Peak Shifting, Valley Filling, Strategic Conservation, Energy Efficient Equipment. Basic payback calculations, Depreciation, Net present value calculations, Cost effectiveness test for demand side management programs. **Total : 48 hrs**

## Text Book(s):


1. Industrial Energy Management Systems, Arry C. White, Philip S. Schmidt, David R. Brown, HemispherePublishing Corporation, New York, 1994.
2. Fundamentals of Energy Engineering -Albert Thumann, Prentice Hall Inc, Englewood Cliffs, New Jersey1984.
3. Handbook on Energy Audit and Environment Management ,YPAbbi and Shashank Jain,TERI,2006


## Reference Book(s):


1. Energy management by W.R. Murphy & G. Mckay Butter worth, Heinemann publications.
2. Energy management by Paul o" Callaghan, Mc-graw Hill Book company-1/e,1998
3. Energy efficient electric motors by John C. Andreas, Marcel Dekker Inc Ltd-2/e, 1995
4. Energy management hand book by W.C.Turner, john Wiley and sons
5. Energy management and good lighting practice: fuel efficiency- booklet12-EEO
6. Economic Analysis of Demand Side Programs and Projects - California Standard Practice Manual, June2002 – Free download available online

## 4.ELECTRICAL MEASUREMENTS AND INSTRUMENTATION

**MODULE – 1 Measurement of voltage & current 10 hrs**

General principles of measurements –essentials of indicating instruments - deflecting, damping, controlling torques-Ammeters and voltmeters - moving coil, moving iron, constructional details, operation, Expression for deflecting & controlling torques and errors compensations- principles shunts and multipliers – extension of range.

**MODULE -2 Measurement of Power, Energy, Power factor 10 hrs**

**Power meters**: Dynamometer type wattmeter –1-phase and 3-phase - LPF and UPF- Double Element and Three Element wattmeter's.
**Energy meters**: Single Phase Induction Type Energy Meter – Driving and Braking Torques – Errors and Compensations. Three Phase Energy Meter-TOD meter
**P.F. Meters**: Dynamometer and Moving Iron Type – 1-ph and 3-ph Meters.

**MODULE-3 Measurement of Resistance, Inductance and Capacitance 9 hrs**

**Measurement of Resistance**: Kelvin's double bridge -Whetstone's bridge, sensitivity, limitations- loss of charge method -Megger method.
**Measurement of Inductance and Capacitance**: Maxwell's inductance and capacitance bridge-Hay's bridge- Anderson's bridge- Desauty's bridge -Schering bridge-weins bridge- Problems

**MODULE-4 Extension of Instrument Ranges 9 hrs**

**Instrument transformers**: Current Transformers and Potential Transformers – Ratio and Phase Angle Errors – Methods for Reduction of Errors-Design Considerations.
**Potentiometers:** Principle and Operation of D.C. Crompton‟s Potentiometer – Standardization – Measurement of unknown Resistance, Current, Voltage -AC Potentiometers: Polar and Coordinate types-Standardization – Applications.

**MODULE-5 Transducers 10 hrs**

Definition and classification - common transducers for measurement of displacement, velocity, flow, liquid level, force, pressure, strain and temperature -LVDT, electromagnetic and ultrasonic flow meters, piezoelectric force transducer, load cell, strain gauge- bridge configuration for four strain gauges, RTD, Thermistors, thermocouple, data acquisition system. **Total : 48 hrs**

**Text Book(s):**

1. Electrical & Electronic Measurements and Instrumentation by AK Sawhney, Dhanpat Rai & Sons Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw hill.-2017
2. J. B. Gupta - A course in Electronic and Electrical measurements and Instrumentation, S. K. Kataria Publication-2020
3.Electrical Measurements & Measuring Instruments by M.L.Anand (Author)-2014

**Reference Book(s):**

1 Electrical Measurements and Measuring Instruments (English, Paperback, F. C. Widdis, E. W. Golding) January 2011
2. Electrical & Electronic Measurement & Instrumentation by R. K. Rajput, 2nd Edition, S. Chand & Co., 2nd Edition, 2013.

# 5. UTILIZATION OF ELECTRICAL ENERGY

**MODULE – 1 Electric Drives and Traction 10 hrs**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services traction generator set, traction motors, power transformers - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear

**MODULE -2 Mechanics of Electric Traction 10 hrs**

Mechanics of Train Movement. Speed-Time Curves of Different Services – Trapezoidal and Quadrilateral Speed-Time Curves – Numerical Problems. Calculations of Tractive Effort, Power, Specific Energy Consumption, Adhesive Weight and Coefficient of Adhesion.

**MODULE-3 Illumination 10 hrs**

Introduction - definition and meaning of terms used in illumination engineering - classification of light sources - incandescent lamps, sodium vapour lamps, mercury vapor lamps, fluorescent lamps –design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting – UPS-energy saving lamps, LED – working principle of air conditioning system.

**MODULE-4 Heating And Welding 8 hrs**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating -resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types -resistance welding - arc welding - power supply for arc welding - radiation welding.

**MODULE-5 Solar & Wind Energy Conversion System 10 hrs**

**Solar Energy Conversion System:** Introduction - solar constant – terrestrial solar radiation - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors.

**Wind Energy Conversion System:** Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind machines - analysis of aerodynamic forces acting on the blade

**Total : 48 hrs**

**Text Book(s):**

1. Utilization of Electric Energy, E. Openshaw Taylor and V. V. L. Rao, Universities Press, 2009.
2. N.V. Suryanarayana, “Utilisation of Electric Power”, Wiley Eastern Limited, New Age International Limited, 1993
3. J.B.Gupta, “Utilisation Electric power and Electric Traction”, S.K.Kataria and sons, 2000.

**Reference Book(s):**

1. Generation, distribution and utilization of electrical energy, C.L Wadhwa, Wiley Eastern Limited,1993
2. R.K.Rajput, Utilisation of Electric Power, Laxmi publications private Limited.,2007
3. H.Partab, Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co., New Delhi-2004.
4. G.D.Rai,” Non-Conventional Energy sources”, Khanna publications Ltd.,New Delhi 1997

# 6. INDUSTRIAL AUTOMATION ENGINEERING

**MODULE – 1 FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION 10 hrs**

Definition of automation- Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Types of production and types of automation, automation strategies,levels of automation, Industrial bus systems: modbus & profibus

**MODULE -2 AUTOMATION COMPONENTS 9 hrs**

Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

**MODULE-3 PROGRAMMABLE LOGIC CONTROLLERS 10 hrs**

Introduction — Principles of operation – PLC Architecture and specifications – PLC hardware components Analog & digital I/O modules, CPU & memory module – Programming devices – PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram. PLC programming Simple instructions – Manually operated switches – Mechanically operated a Proximity switches - Latching relays.

**MODULE-4 APPLICATIONS OF PROGRAMMABLE LOGIC CONTROLLERS 9 hrs**

Timer instructions - On delay, Off delay, Cyclic and Retentive timers, Up /Down Counters, control instructions – Data manipulating instructions, math instructions; Applications of PLC – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle label detection and process control application.

**MODULE-5 DISTRIBUTION AUTOMATION & SCADA 10 hrs**

**DISTRIBUTION AUTOMATION:** Distribution Automation (DA)-Benefits- Communication Technologies- Automatic Meter Reading(AMR)- Geographical Information System (GIS)- Consumer Information Service (CIS), Internet of things (IoT) for plant automation

**SCADA:** Introduction, Block Diagram, Components of SCADA, Functions of SCADA,SCADA applied to DA-Communication protocols in SCADA systems. **Total : 48 hrs**

**Text Book(s):**

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies,2nd Edition 2003
2. Gary Dunning, Thomson Delmar,"Programmable Logic Controller", CeneageLearning,3rd Edition,2005.
3. Bolton , "Programmable Logic Controllers" 5th Edition Newnes, ,2009
4. Electric Power Distribution Automation, Dr. M. K. Khedkar and Dr. G. M. Dhole, University Science Press, 2010.
5. Electric Power Distribution, A.S. Pabla, Tata Mc Graw Hill (India) Pvt. Ltd., 6th Edition, 2011.

**Reference Book(s):**

1. C D Johnson, "Process Control Instrumentation Technology", Prentice Hall India,8th Edition, 2006.
2. E.A.Parr, Newnes ,NewDelhi,"Industrial Control Handbook",3rd Edition, 2000
3. Electric Power Distribution Engineering, Turan Gonen, CRC Press, 3rd Edition,2014.
4. Electrical Power Systems for Industrial Plants, Kamalesh Das, JAICO Publishing House, 2008.
5. Electrical Power Distribution Systems, V. Kamaraju, Jain Book Depot. 2012.

# 7.INDUSTRIAL ELECTRICAL SYSTEMS

**MODULE – 1 Electrical System Components 10 hrs**

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

**MODULE -2 Residential and Commercial Electrical Systems 10 hrs**

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection Devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

**MODULE-3 Illumination Systems 9 hrs**

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

**MODULE-4 Industrial Electrical Systems 10 hrs**

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction. Introduction to PCC, MCC panels. DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

**MODULE-5 Industrial Electrical System Automation 9 hrs**

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation. **Total : 48 hrs**

**Text Book(s):**

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.

**Reference Book(s):**

1.S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.. Web site for IS Standards.
2.. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

## 8. RENEWABLE ENERGY CONVERSION SYSTEMS

**MODULE – 1 ENERGY CONSERVATION 10 hrs**

Over view of conventional & renewable energy sources, need & development of renewable energy sources, types of renewable energy systems, Energy scenario — global and national; Renewable energy potential, Energy for sustainable development, Global climate change, concept of Hybrid systems.

**MODULE -2 SOLAR & WIND ENERGY SOURCES 10 hrs**

**SOLAR ENERGY SOURCE**: solar radiation, Measurements of Solar Radiation, Collectors, working principle of photo voltaic cell, Equivalent Circuit model, Performance Characteristics, Applications.

**WIND ENERGY SOURCE:** Introduction, site selection considerations for installing wind mill, Construction details of the wind mill (Wind Turbine Gear System), Types of Wind Power Plants.

**MODULE-3 THERMAL ENERGY & BIO-MASS 10 hrs**

**THERMAL ENERGY:** Thermo-electric generator, Concepts and design considerations of MHD generators, Cycle analysis of MHD systems

**BIO-MASS**: Biomass resources and their classification, Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking.

**MODULE-4 GEOTHERMAL ENERGY & OCEAN ENERGY 9 hrs**

**GEOTHERMAL ENERGY:** Principle of geothermal energy, Resources, types of wells, methods of harnessing the energy, Economic Aspects, scope in India.

**OCEAN ENERGY**: Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy.

**MODULE-5 FUEL CELL ENERGY 9 hrs**

Description, properties and operation of fuel cells, Major components & general characteristics offuel cells, Indirect methanol fuel cell systems. Phosphoric acid fuel cell systems and molten carbonate fuel cell systems, applications. **Total : 48 hrs**

**Text Book(s):**

1. Non conventional Energy sources, G.D. Rai, Khanna Publishers.
2. Renewable energy resources: Tiwari and ghosal, Narosa publication.
3. Renewable energy sources and conversion technology, Bansal Keemann, Meliss, Tata Mc Graw Hill 4.D.P.Kothari,Rakesh Ranjan and K.C.Singal,Renewable Energy Resources & Emerging Tech prenticeHall of India Pvt.Ltd
5.Non conventional energy resources "Prentice Hall Inc,India by Sawhney G.S

**Reference Book(s):**

1. Renewable Energy Sources: Twidell & Weir, CRC Press.
2. Solar Energy/ S.P. Sukhatme, Tata McGraw-Hill.
3. Non Conventional Energy Systems: K M. Mittal, A H WheelerPublishing Co Ltd.
4. Renewable Energy Technologies: Ramesh & Kumar, Narosa publication. 5. Biomass Energy, Oxford& IBH Publication Co.

# 9. POWER QUALITY

**MODULE – 1 Introduction** 10 hrs

Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude Versus Duration Plot - Power Quality Standards - Responsibilities of Suppliers and Users of Electric Power-CBEMA and ITI Curves.

**MODULE -2 Transients, Short Duration and Long Duration Variations** 10 hrs

Categories and Characteristics of Electromagnetic Phenomena in Power Systems- Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality
Disturbances- Principles of Regulating the Voltage- Conventional Devices for Voltage Regulation.

**MODULE-3 Fundamentals Of Harmonics & Applied Harmonics** 10 hrs

Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources from Commercial Loads, Harmonic Sources from Industrial Loads. Applied Harmonics**:** Effects Of Harmonics, Harmonic Distortion Evaluations, Principles of Controlling Harmonics, Devices for Controlling Harmonic Distortion.

**MODULE-4 Power Quality Monitoring** 10 hrs

Power Quality Benchmarking-Monitoring Considerations- Choosing Monitoring Locations-Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments-Assessment of Power Quality Measurement Data- Power Quality Monitoring Standards.

**MODULE-5 Power Quality Enhancement Using Custom Power Devices** 8 hrs

Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) –Solid State Transfer Switch (SSTS) – Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner(UPQC)-Principle of Operation Only.

**Total : 48 hrs**

**Text Book(s):**

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H.Wayne Beaty, Mc Graw Hill Education (India) Pvt. Ltd., 3rd Edition, 2012.
2. Power quality, C. Sankaran, CRC Press, 2001.
3. J.Arillaga, N.R.Watson and S.Chen, “Power System Harmonics”, John Wiley and Sons, England, 2005

**Reference Book(s):**

1. Understanding Power quality problems – Voltage Sags and Interruptions, Math H. J. Bollen IEEE Press Series on Power Engineering, WILEY, 2007.
2. Power quality – VAR Compensation in Power Systems, R. Sastry Vedam, Mulukutla S. Sarma, CRC Press, 2009, First Indian Reprint 2013.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2012.