# Curriculum Structure & Syllabi

**(As per National Education Policy 2020)**

*of*

# B. Tech

*In*

## ELECTRICAL ENGINEERING DEPARTMENT

**(w.e.f. 2021-22)**

Vision

Mission

Program Educational Objectives

Program Outcomes

Program Specific Outcomes

Overall Credit Structure

Curriculum

Syllabus

***Offered By***


**DEPARTMENT OF ELECTRICAL ENGINEERING**

**M. M. M. UNIVERSITY OF TECHNOLOGY,**

**GORAKHPUR-273 010, U.P., INDIA**


**August 2022**

# Department of Electrical Engineering

# CURRICULA & SYLLABI

# B. Tech. Electrical Engineering

**Vision:**

To develop intellectual potentials with excellence in electrical engineering & technology for the global needs.

**Mission:**

1. Empowering students with state-of-art knowledge, technological skills & ethics.
2. Provide research environment for sustainable technical growth in the area of power and energy.
3. Providing effective solutions for industries through research and consultancy.
4. Exposure to standard electrical safety measures and practices.
5. Encourage new and non-conventional energy technology for sustainable development and environmental stewardship.

**Programme Educational Objectives (PEO)**

PSO-1 To provide technical knowledge in electrical engineering to excel in electrical utility & services.

PSO-2 To nurture the students to become successful engineer with administrative acumen to ethically handle the critical situations timely.

PSO-3 To prepare and motivate the students for higher education, research, and continuous learning in multi-disciplinary areas with innovative ideas for sustainable development.

**Programme Outcome (POs)**

Students will demonstrate the ability to-

PO-1 Apply the knowledge of mathematics, science, and Engineering in all aspects of Electrical Engineering.

PO-2 To formulate the techniques of using appropriate tools to analyze and/or fabricate electrical systems.

PO-3 Design of different parts of electrical machines, drives &power system network.

PO-4 Align with and upgrade to higher learning and research activities.

PO-5 Model real life problems using different hardware and software platforms, both offline and in real-time.

PO-6 Possess an appreciation of professional, societal, environmental, and ethical issues and proper use of renewable resources.

PO-7 Develop the awareness about non-conventional sources of energy for sustainable development.

PO-8 Promote the good practices of electrical engineering with high ethical values.

PO-9 Work in a team and comprehend his/her scope of work, deliverables and issues in which help is needed by other members of the team.

PO-10 To communicate effectively and to prepare formal technical plans leading to solutions and detailed reports for electrical systems.

PO-11 To be familiar with project management problems and basic financial principles for a multi-disciplinary work such as biomedical instrumentation.

PO-12 A recognition of the need for identifying contemporary issues due to changing technical scenario and an ability to engage in life-long learning to update himself/herself.

## Programme Specific Outcome (PSOs)

PSO-1 Apply the fundamentals of mathematics, science, and engineering knowledge to identify, formulate, design, and investigate complex engineering problems of electrical circuits, control systems, electrical machines, and power system.

PSO-2 Apply the appropriate techniques and modern engineering hardware and software tools in electrical engineering to engage in life-long learning and to successfully adapt in multi-disciplinary environments.

PSO-3 Aware of the impact of professional engineering solutions in societal, environmental context, professional ethics and be able to communicate effectively.

**Syllabus and Credit Structure for B. Tech. (Electrical Engineering)**

**(Session 2021-2022 and onwards)**

## OVERALL CREDIT STRUCTURE FOR B.TECH. (EE) PROGRAM

| **Credit Courses** | | | |
|---|---|---|---|
| **Core Courses (CC)**** | | **Electives Courses (EC)**** | |
| **Category** | **Min. Credits** | **Category** | **Min. Credits** |
| Basic Sciences & Maths (BSM) | 20 | Program Electives (PE) | 12 |
| Engineering Fundamentals (EF) | 18 | Open Electives (OE) (Other Departments) | 3 |
| Professional Skill (PS) | 4 | | |
| Program Core (PC) | 67 | Humanities & Social Science elective (HSSE) | 2 |
| Management (M) | 4 | | |
| Humanities & Social Science (HSS) | 4 | | |
| Project (P) | 5 | | |
| Seminar (S) | 2 | | |
| Industrial Practice (IP)/ Industrial Elective (IE) | 12 | | |
| Program link basic science and engineering courses (PLBSE) (To be decided by the department) | 16 | | |
| **Sub-total** | **152** | **Sub-total** | **17** |
| **Grand Total** | **169** | | |

**** subjects to be taught for more than one branch may be scheduled both in odd and even semesters.**

| | |
|---|---|
| **1. Extracurricular Activities Courses (ECA)**<br><br>Two compulsory courses from the following S.No (ii) to (v) non-credit courses:<br>(i) Induction Program (compulsory)<br>(ii) Skill development<br>(iii) Unity and Discipline (NCC or NSS)<br>(iv) Sports, Cultural and Games<br>(v) Personality Development | **Non-Credit** |
| **2. Audit Courses (AC)**<br><br>Two of the Audit Courses are compulsory | **Non-Credit** |
| **3. Industrial Training (Mandatory)** | **Non-Credit** |

| **Minor Degree Courses (Optional) from any department** | **Credits** |
|---|---|
| Department Minor (DM) Courses | 18-20 |

**DEPARTMENT OF ELECTRICAL ENGINEERING**
**M.M.M. UNIVERSITY OF TECHNOLOGY**
**GORAKHPUR**

**Semester wise Credit Structure for B. Tech. (Electrical Engineering)**

| **Category**<br>**Semesters** | **I** | **II** | **III** | **IV** | **V** | **VI** | **VII** | **VIII** | **Total** |
|---|---|---|---|---|---|---|---|---|---|
| Basic Sciences & Maths (BSM) | 4 | 8 | 4 | 4 | - | - | - | - | **20** |
| Engineering Fundamentals (EF) | 7 | 7 | 4 | - | - | - | - | - | **18** |
| Professional Skill (PS) | 2 | 2 | - | - | - | - | - | - | **4** |
| Program Core (PC) | - | - | 9 | 18 | 14 | 14 | 12 | - | **67** |
| Management (M) | - | - | - | - | 2 | 2 | - | - | **4** |
| Humanities & Social Science (HSS) | - | 2 | 2 | - | - | - | - | - | **4** |
| Humanities & Social Science Elective (HSSE) | 2 | - | - | - | - | - | - | - | **2** |
| Project (P) | - | - | - | - | - | 2 | 3 | 0/4 | **5/9** |
| Seminar (S) | - | - | - | - | - | 2 | - | - | **2** |
| Industrial Practice (IP)/ Industrial Elective (IE)# | - | - | - | - | - | - | - | 12/8 | **12/8** |
| Program link basic science and engineering courses (PLBSE)<br>(To be decided by the department) | 4 | 4 | 2 | 2 | 4 | - | - | - | **16** |
| Program Electives (PE) | - | - | - | - | 4 | 4 | 4 | - | **12** |
| Open Electives (OE)<br>(Other Departments) | - | - | - | - | - | - | 3 | - | **3** |
| **Total** | **19** | **23** | **21** | **24** | **24** | **24** | **22** | **12** | **169** |

**First Year, Semester I**

| **S.N.** | **Category** | **Paper Code** | **Subject** | **L** | **T** | **P** | **Credits** |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-101 | Calculus and Linear Algebra | 3 | 1 | 0 | 4 |
| 2. | EF | BEC-101 | Fundamentals of Electronics Engineering | 3 | 1 | 2 | 5 |
| 3. | PS | BEE-106 | Electrical Wiring | 0 | 0 | 4 | 2 |
| 4. | EF | BME-101 | Technical Art | 0 | 0 | 4 | 2 |
| 5. | PLBSE | BCS-101 | Introduction to Computer Programming | 3 | 0 | 2 | 4 |
| 6. | HSSE | BHM-104 | Human Values & Professional Ethics | 2 | 0 | 0 | 2 |
| | | | **Total** | **11** | **2** | **12** | **19** |
| 1. | ECA-I | | Induction Program | - | - | - | 0 |

**First Year, Semester II**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-177 | Engineering Physics | 3 | 0 | 2 | 4 |
| 2. | EF | BEE-151 | Fundamentals of Electrical Engineering | 3 | 1 | 2 | 5 |
| 3. | BSM | BSM-152 | Ordinary and Partial Differential Equations | 3 | 1 | 0 | 4 |
| 4. | PS | BEE-157 | Basics of Measuring & Protective Equipments | 0 | 0 | 4 | 2 |
| 5. | EF | BCE-151 | Engineering Graphics | 0 | 0 | 4 | 2 |
| 6. | PLBSE | BME-154 | Fundamentals of Mechanical Engineering | 3 | 0 | 2 | 4 |
| 7. | HSS | BHM-151 | Professional Communication | 2 | 0 | 0 | 2 |
| | | | **Total** | **15** | **2** | **12** | **23** |
| 1. | ECA-II | | | - | - | - | 0 |

**Second Year, Semester III**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-201 | Complex Analysis and Numerical Methods | 3 | 1 | 0 | 4 |
| 2. | EF | BEC-206 | Digital Electronics & Circuits | 3 | 0 | 2 | 4 |
| 3. | HSS | BHM-201 | Scientific and Technical Writing | 2 | 0 | 0 | 2 |
| 4. | PC | BEE-201 | Electrical Machines-I | 3 | 1 | 2 | 5 |
| 5. | PC | BEE-202 | Basic System Analysis | 3 | 1 | 0 | 4 |
| 6. | PLBSE | BSM-241 | Environmental Chemistry | 2 | 0 | 0 | 2 |
| | | | **Total** | **16** | **4** | **2** | **21** |
| 7. | ECA-III | | | - | - | - | 0 |
| 8. | AC | AUC-01-AUC-15 | Audit Course | **1/2** | **-** | **-** | **½** |

**Second Year, Semester IV**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | BSM | BSM-251 | Integral Transforms and Statistical Methods | 3 | 1 | 0 | 4 |
| 2. | PC | BEE-251 | Electrical Measurement & Measuring Instruments | 3 | 0 | 2 | 4 |
| 3. | PC | BEE-252 | Network Analysis and Synthesis | 3 | 1 | 2 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4. | PC | BEE-253 | Electrical Machines-II | 3 | 1 | 2 | 5 |
| 5. | PC | BEE-254 | Power System-I | 3 | 1 | 0 | 4 |
| 6. | PLBSE | BEE-255 | Simulation Technique | 0 | 0 | 4 | 2 |
| | | | **Total** | **15** | **4** | **10** | **24** |
| 7. | ECA-IV | | | - | - | - | 0 |
| 8. | AC | AUC-01-AUC-15 | | 1/2 | - | - | ½ |
| 9. | DM1 | SEE-211 | Scientific Computing Using MATLAB | 3 | 1 | 0 | 4 |
| | DM2 | SEE-221 | Energy Management | 3 | 1 | 0 | 4 |
| | DM3 | SEE-231 | Introduction to Power Electronics | 3 | 1 | 2 | 5 |

**Third Year, Semester V**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | M | BHM-302/352 | Industrial Management | 2 | 0 | 0 | 2 |
| 2. | PC | BEE-301 | Power System-II | 3 | 0 | 2 | 4 |
| 3. | PC | BEE-302 | Control System Engineering | 3 | 1 | 2 | 5 |
| 4. | PC | BEE-303 | Power Electronics | 3 | 1 | 2 | 5 |
| 5. | PE1 | BEE-326-BEE-328 | Program Elective-1 | 3 | 1 | 0 | 4 |
| 6. | PLBSE | BEE-304 | Microprocessor: Architecture, Programming, and Interfacing | 3 | 0 | 2 | 4 |
| | | | **Total** | **17** | **3** | **8** | **24** |
| 7. | ECA-V | | | - | - | - | 0 |
| 8. | DM1 | SEE-312 | Fuzzy Sets, Logic and Systems & Applications | 3 | 1 | 0 | 4 |
| | DM2 | SEE-322 | Solar Energy Systems | 3 | 1 | 2 | 5 |
| | DM3 | SEE-332 | Advanced Power Electronics | 3 | 1 | 2 | 5 |

**Third Year, Semester VI**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | M | BHM-301/351 | Engineering and Managerial Economics | 2 | 0 | 0 | 2 |
| 2. | PC | BEE-351 | Instrumentation Engineering | 3 | 1 | 2 | 5 |
| 3. | PC | BEE-352 | Protection & Switchgear | 3 | 0 | 2 | 4 |
| 4. | PC | BEE-353 | Digital Control System | 3 | 1 | 2 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5. | PE2 | BEE-376-BEE-378 | Program Elective-2 | 3 | 1 | 0 | 4 |
| 6. | P | BEE-370 | Project Part-I | 0 | 0 | 4 | 2 |
| 7. | S | BEE-380 | Seminar | 0 | 0 | 4 | 2 |
| | | | **Total** | **14** | **3** | **14** | **24** |
| 8. | ECA-VI | | | - | - | - | 0 |
| 9. | DM1 | SEE-313 | Nonlinear System Analysis | 3 | 1 | 0 | 4 |
| | DM2 | SEE-323 | Facts Controllers & Devices | 3 | 1 | 0 | 4 |
| | DM3 | SEE-333 | Power Electronics Controlled Electric DC-Drives | 3 | 1 | 0 | 4 |

**Final Year, Semester VII**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | PC | BEE-401 | Electric Drives | 3 | 1 | 2 | 5 |
| 2. | PC | BEE-402 | Power System Operation and Control | 3 | 1 | 0 | 4 |
| 3. | PC | BEE-403 | Power Quality | 3 | 0 | 0 | 3 |
| 4. | PE3 | BEE-426-BEE-428 | Program Elective-3 | 3 | 1 | 0 | 4 |
| 5. | OE | OEE-401-OEE-402 | Open Elective | 2 | 1 | 0 | 3 |
| 6. | P | BEE-440 | Project Part-II | 0 | 0 | 6 | 3 |
| | | | **Total** | **14** | **4** | **8** | **22** |
| 7. | ECA-VII | | | - | - | - | 0 |
| 8. | DM1 | SEE-414 | Optimal And Adaptive Control Systems | 3 | 1 | 0 | 4 |
| | DM2 | SEE-424 | Restructured Flexible Ac Power System | 3 | 1 | 0 | 4 |
| | DM3 | SEE-434 | Power Electronics Applications | 3 | 1 | 0 | 4 |

**Final Year, Semester VIII**

| S.N. | Category | Paper Code | Subject | L | T | P | Credits |
|---|---|---|---|---|---|---|---|
| 1. | IP | IEE-400 | Industrial Practices | 0 | 0 | 24 | 12 |
| **Without Industrial Practice (IP)** | | | | | | | |
| 2. | MP | BEE-480 | Minor Project | 0 | 0 | 8 | 4 |
| 3. | IE1 | IEE-401 | Industrial Elective 1 | 3 | 1 | 0 | 4 |
| 4. | IE2 | IEE-405 | Industrial Elective 2 | 3 | 1 | 0 | 4 |
| | | | **Total** | **6** | **2** | **8** | **12** |
| | DM1 | SEE-415 | Research Project | 0 | 0 | 4 | 2 |
| | DM2 | SEE-425 | Research Project | 0 | 0 | 4 | 2 |
| | DM3 | SEE-435 | Research Project | 0 | 0 | 4 | 2 |

**List of Program Elective**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Program Elective-1 | | | | | | | |
| 1. | PE1 | BEE-326 | Power Plant Engineering | 3 | 1 | 0 | 4 |
| 2. | PE1 | BEE-327 | High Voltage Engineering | 3 | 1 | 0 | 4 |
| 3. | PE1 | BEE-328 | Intelligent Instrumentation | 3 | 1 | 0 | 4 |
| Program Elective-2 | | | | | | | |
| 4. | PE2 | BEE-376 | Conventional & CAD of Electrical Machines | 3 | 0 | 2 | 4 |
| 5. | PE2 | BEE-377 | EHV AC & DC Transmission | 3 | 1 | 0 | 4 |
| 6. | PE2 | BEE-378 | Advanced Microprocessor and Micro Controllers | 3 | 0 | 2 | 4 |
| Program Elective-3 | | | | | | | |
| 7. | PE3 | BEE-426 | Modern Control System | 3 | 1 | 0 | 4 |
| 8. | PE3 | BEE-427 | Energy Efficiency & Conservation | 3 | 1 | 0 | 4 |
| 9. | PE3 | BEE-428 | Bio Instrumentation | 3 | 1 | 0 | 4 |

**List of Open Elective**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | OE | OEE-401 | Non-Conventional Energy Resources | 2 | 1 | 0 | 3 |
| 2. | OE | OEE-402 | Fundamentals of Electric Drives | 2 | 1 | 0 | 3 |

**List of Industrial Elective**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | IE1 | IEE-401 | Utilization and Traction | 3 | 1 | 0 | 4 |
| 2. | IE2 | IEE-405 | SCADA & Energy Management System | 3 | 1 | 0 | 4 |

**List of Audit Courses (AC)**

| S.No. | Subjects | Codes |
|---|---|---|
| 1. | Constitution of India | AUC01 |
| 2. | Indian Culture and Heritage | AUC02 |
| 3. | Indian Architecture | AUC03 |
| 4. | Indian Festivals | AUC04 |
| 5. | Vaidic Mathematics | AUC05 |
| 6. | Astronomy | AUC06 |
| 7. | Arts of India | AUC07 |
| 8. | Intellectual Property Right | AUC08 |
| 9. | Human Rights | AUC09 |
| 10. | Logical Research | AUC10 |
| 11. | Professional Ethics | AUC11 |
| 12. | Environmental Law | AUC12 |
| 13. | Health Law | AUC13 |
| 14. | National Cadet Corps | AUC14 |
| 15. | Basics of Human Health and preventive medicines | AUC15 |

**Note: Detailed syllabus of Audit Courses (AC) is attached as Annexure-01.

**List of Extra Curricular Activity (ECA) Courses**

| ECA-II | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-I | ECA-151 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)-I | ECA-171 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)-I | ECA-172 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-I | ECA-181 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-I | ECA-182 | 2 | 0 |

| ECA-III | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-II | ECA-201 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- II | ECA-221 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)-II | ECA-222 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-II | ECA-231 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-II | ECA-232 | 2 | 0 |

| ECA-IV | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours /Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-III | ECA-251 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- III | ECA-271 | 2 | 0 |
| 3. | Open to all Branches | ECA | Unity and Discipline (NSS)- III | ECA-272 | 2 | 0 |
| 4. | Open to all Branches | ECA | Games & Sports-III | ECA-281 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-III | ECA-282 | 2 | 0 |

| ECA-V | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-IV | ECA-301 | 2 | 0 |
| 2. | Open to all Branches | ECA | Unity and Discipline (NCC)- IV | ECA-321 | 2 | 0 |
| 3. | Open to all | ECA | Unity and Discipline | ECA-322 | 2 | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Branches | | (NSS)-IV | | | |
| 4. | Open to all Branches | ECA | Games & Sports-IV | ECA-331 | 2 | 0 |
| 5. | Open to all Branches | ECA | Cultural, Art & Literary-IV | ECA-332 | 2 | 0 |
| | | | | | | |
| **ECA-VI** | | | | | | |
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-V | ECA-351 | 2 | 0 |
| 2. | Open to all Branches | ECA | Games & Sports-V | ECA-381 | 2 | 0 |
| 3. | Open to all Branches | ECA | Cultural, Art & Literary-V | ECA-382 | 2 | 0 |

| **ECA-VII** | | | | | | |
|---|---|---|---|---|---|---|
| S. No. | Branch | Category | Subject Name | Subject Code | Hours/ Week | Credit |
| 1. | Open to all Branches | ECA | Skill Development-VI | ECA-401 | 2 | 0 |
| 2. | Open to all Branches | ECA | Games & Sports-VI | ECA-431 | 2 | 0 |
| 3. | Open to all Branches | ECA | Cultural, Art & Literary-VI | ECA-432 | 2 | 0 |

**Note: Detailed syllabus of Extra Curricular Activity (ECA) Courses is attached as Annexure-02.

# FRAMEWORK FOR THE IMPLEMENTATION OF MOOC COURSES IN B. TECH PROGRAMME

As per the guidelines given by AICTE via GO. No. AICTE/P&AP/SWAYAM/2016 dated 17th August 2016, M. M. M. University of Technology Gorakhpur has decided to implement 20% subjects/courses from MOOCs from SWYAM portal in the curricula of B. Tech programme offered by University from the session 2022-23 onwards. The framework for incorporating the MOOC courses in the curricula of B. Tech programme is given below.

1. The MOOC Courses of Swayam portal will be offered in:
   (a) B. Tech-IInd semester for HSSE Courses of Humanities & Management Science Department.
   (b) B.Tech-IIIrd and IVth semester for Audit Courses (AC) of Humanities & Management Science Department.
   (c) B.Tech-Vth, VIth & VIIth semester as Program Elective (PE) Course of respective Engineering Departments.
   (d) B. Tech-VIIIth semester for Industrial Elective (IE) Course of respective Engineering Departments.
2. It has been indicated in the above GO of AICTE that MOOC Courses of Swayam portal will be announced on 1st June for odd semester and 1st November for the even semester every year. After the announcement of the subjects on Swayam portal, each department of University will identify the subjects against each of the MOCC courses in respective semester from the Swayam portal and send the list of identified subjects to the office of Dean UGS & E after the approval of BOS of respective department. Dean UGS & E will notify the same and notification will be uploaded on the University website well in advance so that students may get registered in the subject in time.
3. Concern department will nominate one of its faculty as a departmental MOOCs Coordinator for each of the MOOC Course and same will be intimated to Dean UGS & E along with the teaching load of the department. The departmental MOOCs Coordinator will be responsible for the registration, assignment submission, term end examination and result of the students who have opted MOOC courses.
4. For the reimbursement of MOOCs registration fee, student will write an application addressed to Dean UGS & E through the concerned Head of Department and departmental MOOCs Coordinator along with the receipt of MOOCs registration fee and admit card/hall ticket. The application of student for the reimbursement of fee will be entertained only if it is recommended by concerned MOOCs Coordinator and Head of Department.
5. Credit will be defined as per clause 6.1.5.5 of B. Tech ordinance for the MOOC Courses on Swayam portal in which credit is not mentioned,
6. If better practical facility is available at virtual lab of different premier institution of national and international importance, then the practical facility of that subject could be availed through the virtual lab. In any practical based subject, if practical lab is not assigned and better practical

facility is available on virtual lab then it may be conducted on the virtual lab and one credit will be added through the BOS of concerned department.

7. The evaluation scheme for practical based subjects conducted through virtual lab will be same as the existing evaluation scheme of practical courses of the University.

# SYLLABI

**BSM-101 Calculus and Linear Algebra**

| | | |
|---|---|---|
| **Course category** | : | Basic Sciences & Maths (BSM) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 0 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, and two minor tests and One Major Theory Examination |
| **Course Objectives** | : | The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Use of basic differential operators in various engineering problems.
2. Understand the concepts of limit theory and nth order differential equations and their applications to our daily life
3. Solve linear system of equations using matrix algebra.
4. Know about qualitative applications of Gauss, Stoke's and Green's theorem.
5. To know the applications of double and triple integration in finding the area and volume.
6. To inculcate the habit of mathematical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Differential Calculus:** Limit, Continuity and Differentiability, Mean value theorems. Leibnitz theorem, Partial derivatives, Euler's theorem for homogenous function, Total derivative, Change of variable. Taylor's and Maclaurin's theorem. Expansion of function of two variables, Jacobian, Extrema of function of several variables.

**UNIT-II** 9

**Linear Algebra:** Symmetric, Skew-symmetric matrices, Hermitian, Skew Hermitian Matrices, orthogonal and unitary matrices and basic properties, linear independence and dependence of vectors, Rank of Matrix, Inverse of a Matrix, Elementary transformation, Consistency of linear system of equations and their solution, Characteristic equation, Eigenvalues, Eigen-vectors, Cayley-Hamilton theorem, Diagonalization of matrices.

**UNIT-III** 9

**Multiple Integrals:** Double and triple integrals, change of order of integration, change of variables. Application of multiple integral to surface area and volume. Beta and Gamma functions, Dirichlet integral.

**UNIT-IV** 9

**Vector Calculus:** Gradient, Divergence and Curl. Directional derivatives, line, surface and volume integrals. Applications of Green's, Stoke's and Gauss divergence theorems (without Proofs).

**Books & References**


1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.,


## BEC-101/151 FUNDAMENTALS OF ELECTRONICS ENGINEERING

| | | |
|---|---|---|
| **Course category** | : | Engineering Fundamentals (EF) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 2 |
| **Number of Credits** | : | 5 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination. |
| **Course Objectives** | | The objective of this course is to gain knowledge of basic electronic components and develop the understanding of the working principle of different electronic devices such as voltmeter, multimeter, CRO, etc. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course: |

1. Able to memorize the basic concept of electronic circuits using Diode, BJT (Bipolar Junction Transistor), FET (Field Effect Transistor), etc.
2. Able to execute and examine the general characteristic of electronic circuits.
3. Illustrate the basics of Boolean algebra and logic gates with their realisation using discrete electronic components.
4. Compute different parameters for characterising different circuits like rectifier, amplifiers, integrators, etc.
5. Examine the working principle of digital voltmeter, multimeter using block diagram approach.
6. Discuss and calculate voltage, current, phase and frequency using CRO.

**Topics Covered**

**UNIT-I** 9

Semiconductor materials and properties: electron-hole concepts, Basic concepts of energy bands in materials, concept of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors impurities, Junction diode, p-n junction, depletion layer, v-I characteristics, diode resistance, capacitance, diode ratings (average current, repetitive peak current, non-repetitive current, peak-inverse voltage). Diode Applications in rectifier, filters, voltage multipliers, load regulators, clipper and clamper circuits, Breakdown mechanism (Zener and avalanche), Break down characteristics, Zener resistance, Zener diode ratings, Zener diode application as shunt regulator

**UNIT-II** 9

**Transistors (BJT);** Basic construction, transistor action, CB, CE and CC configurations, input/output characteristics, Biasing of transistors-fixed bias, emitter bias, potential divider bias, comparison of biasing circuits. Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gains, current gain, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE and CC amplifier configurations.

**UNIT-III** 9

**Field Effect Transistors (JFET and MOSFET)**: Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristic equation CG, CS and CD configurations, fixed & self-biasing.

MOSFET: depletion and enhancement type MOSFET-construction, operation, and characteristics. Computation of Av, Ri, Ro, of single FET amplifiers using all the three configurations

Switching theory and logic design: Number systems, conversion of bases, Boolean algebra, logic gates, concept of universal gate, canonical forms, Minimization using K-map.

**UNIT-IV** 9

**Operational Amplifiers and Electronics Instruments:**

Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non-inverting and unity gain amplifiers, adders, difference amplifiers, integrators Working principle of digital voltmeter, digital multi-meter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO

**EXPERIMENTS**

**Note: Minimum Five experiments are to be performed**

1. To plot the forward/ Reverse Characteristics of Si P-N junction diode.
2. To plot the forward/Reverse Characteristics of Zener diode
3. Study and plot the characteristic of Zener diode as voltage regulator
4. Study of half wave rectifier and draw the nature of input / output signal. Calculate the value of Idc, Irms and ripple factor.
5. Study of Full wave rectifier and draw the nature of input / output signal. Calculate the value of Idc, Irms and ripple factor.
6. Study of Bridge Rectifier and draw the nature of input / output signal. Calculate the value of Idc, Irmsand ripple factor.
7. Draw input output characteristic curve of n-p-n transistor in CE configuration
8. Draw input output characteristic curve of n-p-n transistor in CB configuration
9. Draw the drain and transfer curve of JFET
10. Study of OPAMP (741) and calculate the gain in (i) Inverting mode and(ii) non-inverting mode
11. Study of OP-AMP as a (i) Summer (ii) Integrator (iii) Differentiator; and plot the nature of input & output waveform
12. Study of CRO and multi-meter measurement voltage, frequency, phase difference using CRO along with the testing of electronics component

**Books & References**

1. Electronic Devices and Circuits-Boylestad and Nashelsky, 6e, PHI, 2001
2. Electronic Devices and Circuits, A Mottershead, PHI,2000, 6e

3. Digital Computer Design, Morris Mano, PHI,2003
4. Electronic Instrumentation-H.S. Kalsi, 2e, TMH, 2007

**BEE-106/ 156 ELECTRICAL WIRING**

| | | |
|---|---|---|
| **Course category** | : | Basics of Electrical Engineering |
| Pre-requisite Subject | : | NIL |
| Contact hours/week | : | Lecture: 0, Tutorial: 0, Practical: 4 |
| Number of Credits | : | 2 |
| Course Assessment methods | : | Continuous assessment through attendance, two viva-voce, Practical work/record, and Major Practical Examination. |
| **Course Objective** | : | **1.** To demonstrate and understand the Service mains, meter board and distribution board, concealed and conduit wiring, switching control schemes.<br>**2.** To demonstrate and understand the protective devices: fuse and Miniature Circuit Breaker (MCB's). Electric shock, precautions against shock, necessity of Earthing. |

**Course Outcomes:** The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Basics of Electrical home Wiring
2. Basics of earthing phenomena in home wiring and any premises.
3. Protection of human body from electric shocks and utility of MCB and fuses.
4. Basic principles Fan windings and small motor windings.
5. Learn different types of Joints of cable and overhead conductor.
6. Analysis of different types of wiring and Safety measures

**List of Experiments:**

1. To perform single way wiring system.

2. To perform two-way wiring system.

3. To perform staircase wiring system.

4. Design of earthing system.

5. To repair a fan and its winding.

6. Design of single-phase motor winding.

7. To perform tube light wiring.

8.To perform different types of cable joints

**Books & Reference Books:**

1. Electrical Wiring Estimating and Costing by S. L. Uppal. Khanna Publishers.
2. Practical Handbook on Electric Motors, Starters and Controllers by M.P. Krishna Pillai, Standard Publishers Distributers.

3. Advanced Home Wiring by Black & Decker, 5th Edition, Editors of Cool Spring press

**BME 101/BME 151 TECHNICAL ARTS**

| | | |
|---|---|---|
| **Course Category** | : | Engineering Fundamentals (EF) |
| **Pre-requisite Subject** | : | NIL |
| **Contact Hours/Week** | : | Lecture: 0, Tutorial: 0, Practical: 04 |
| **Number of Credits** | : | 02 |
| **Course Assessment Method** | : | Continuous assessment through attendance, two Viva-voce, Practical work/record, and Major Practical Examination. |
| **Course Outcomes** | : | After completion of this course the students are expected to be able to demonstrate following knowledge, skills, and attitudes |

1. Understand the importance, materials, applications, and safety in different shops for the development of a product/component.
2. The knowledge of tools and processes used in carpentry and foundry shops for the development of products through the casting process.
3. The knowledge of forming process will develop skills for producing products using different tools and processes in the black smithy and sheet metal shops.
4. The knowledge and practical skill of various welding processes and their application.
5. The knowledge and practical skill of various machining processes.
6. The knowledge of non-conventional machining will develop the ability to produce various products.

**Topics Covered (Make at least one job in each shop):**

**Introduction:**

- Need for and importance of Technical Arts.
- Shop Layout: Concept and Importance.
- Mechanical properties of metals& non-metals.
- Ferrous Metals and alloys- composition and applications.
- Non-Ferrous Metals and alloys- composition and applications.
- Safety precautions at shopfloor.

**Carpentry Shop:**

- Draw layout of carpentry shop
- Study of tools & operations and carpentry joints.
- Preparation of half-lap corner joint, mortise &Tennon joint
- Simple exercise on woodworking lathe

**Fitting Shop:**

- Layout of fitting shop
- Study of tools & operations
- Simple exercises involving fitting work
- Simple exercises involving drilling/tapping/die

**Black Smithy Shop:**

- Layout of Smithy Shop
- Study of tools & operations
- Hot and cold working
- Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

**Welding Shop:**

- Layout of welding shop
- Study of equipment of gas welding & arc welding
- Preparation of simple butt and lap welded joints.
- Oxy-acetylene flame cutting
- Study of welding defects.

**Sheet-metal Shop:**

- Layout of Sheet metal shop
- Metals used in sheet metal work such as Galvanized iron, Copper sheet, Aluminum sheet
- Study of tools & operations
- Fabrication of Funnel, toolbox, tray, electric panel box etc.

**Machine Shop:**

- Layout of Machine shop
- Study of Lathe, Drilling, Shaper, Planer and Milling Machines and commonly done operations on these machines
- Single point and Multi-point Cutting tools
- Making a job on lathe involving plane turning step turning, taper turning, and threading operations

**Foundry Shop:**

- Layout of foundry shop
- Study of tools & operations
- Study on pattern allowances
- To prepare a Mould with the use of a core and cast it
- Study of casting defects

**Advanced Machining Lab:**

- Layout of the Advanced Machining Lab.
- Study about Computerized Numerically Controlled and Non- conventional machining processes.
- Study of Flexible Manufacturing System.
- Simple experiments on CNC turning and milling.

**Project:**

- Each group will fabricate a simple utility project using above different shops.

**Books and References:**


1. Fundamental of Modern Manufacturing: Materials, Processes and Systems: M. P. Groover (John Wiley)
2. Fundamental of Manufacturing Processes: G. K. Lal and S. K. Choudhary (Narosa).
3. Manufacturing technology – Machine Tools: P. N. Rao (TMH)
4. Manufacturing technology – Foundry, Forming and Welding: P. N. Rao (TMH).
5. Manufacturing Engineering & Technology: Kalpakjian (Pearson)
6. Advanced Machining Processes: V. K. Jain (Allied Publishers)
7. Manufacturing Science: A. Ghosh and A.K. Mallik (East- West Press).
8. Workshop Technology Vol-I: B. S. Raghuvanshi (Dhanpat Rai and Sons)
9. Workshop Technology Vol-II: B. S. Raghubanshi (Dhanpat Rai and Sons)


## BCS-101 Introduction to Computer Programming

| | | |
|---|---|---|
| Course Category | : | PLBSE |
| Pre-requisite Subject | : | NIL |
| Contact Hours/Week | : | Lecture: 3, Tutorial: 0, Practical: 2 |
| Number of Credits | : | 4 |
| Course Assessment Methods | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination. |
| Course Outcomes | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course |

1. Read and understand C programs.
2. Discuss basic theory and practice of programming.
3. Design and implement practical programs using C language.
4. Use compiler and feel comfortable with Windows environment
5. Identify and fix common C errors.
6. To describe the techniques for creating program modules in C using functions and recursive functions.

**TOPIC COVERED**

**UNIT-I** 9

Basics of Computer: Introduction to Digital Computer, Basic Operations of Computer, Functional Components of Computer, Classification of Computers. Introduction to Operating System: DOS, Windows, Linux, Function, Services and Types. Basics of Programming: Approaches to Problem Solving, Concept of Algorithm and Flow Charts, Types of Computer Languages: Machine Language, Assembly Language and High-Level Language, Concept of Assembler, Compiler, Loader and Linker.

**UNIT-II** 9

Standard I/O in "C", Fundamental Data Types: char, int, short, long, float, double, long double. Storage Classes: Automatic, Register, Static, External. Operators and Expressions: Using Numeric and Relational Operators, Mixed Operands and Type Conversion, Logical Operators, Bit Operations, Operator Precedence and Associativity. C Conditional Program Execution: Applying if and Switch Statements, Nesting if and else, Restrictions on switch Values, Use of Break. Program Loops and Iteration: Uses of while, do and for Loops, Multiple Loop Variables, Assignment Operators, use of break and continue keywords.

**UNIT-III** 9

Functions: Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions. Arrays: One Dimensional, Multidimensional Array and their Applications, Declaration and Manipulation of Arrays. Strings: String Variable, String Handling Functions, Array of Strings. Storage Classes revisited.

**UNIT-IV** 9

Pointers: Pointer Variable and its Importance, Pointer Arithmetic and Scale Factor, Compatibility, Dereferencing, L value and R-Value, Pointers and Arrays. Structure and Union: Declaration and Initialization of Structures, Structure and array, Structure Pointers, Declaration and Initialization of union, Union vs Structure. Implement the concept of Ohm's law, Kirchhoff's current and voltage law, series and parallel RLC circuits. Implement the Bisection, Newton Raphson, Interpolation, Trapezoidal and Simpson methods.

**EXPERIMENTS**

1. Write a program that finds whether a given number is even or odd.
2. Write a program that tells whether a given year is a leap year or not.
3. Write a program that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
    a. Between 90-100%----------Print „A"
    b. 80-90%----------Print „B"
    c. 60-80%----------Print „C"
    d. Below 60%----------Print „D"
4. Write a program that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
5. Write a program to print sum of even and odd numbers from 1 to N numbers.
6. Write a program to print the Fibonacci series.
7. Write a program to check whether the entered number is prime or not.
8. Write a program to find the reverse of a number.

9. Write a program to print Armstrong Numbers from 1 to 100.
10. Write a program to convert binary number into decimal number and vice versa.
11. Write a program that simply takes elements of the array from the user and finds the sum of these elements.
12. Write a program that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
13. Write programs to implement the concept of Ohm's law, Kirchhoff's current and voltage law.
14. Write programs to implement the concept of Series and Parallel RLC circuits.
15. Write programs to implement the Bisection, Newton Raphson, Interpolation, Trapezoidal and Simpson methods.

**TEXTBOOK**


1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 7th Edition, Pearson.
2. Schildt, Herbert, Complete Reference with C, Tata McGraw Hill.
3. Kerninghan and Ritchie, The C programming Language, 2nd Edition, Prentice Hall.


**BHM-104/154 HUMAN VALUES & PROFESSIONAL ETHICS**

| | |
|---|---|
| **Course Category**: | Humanities & Social Science Elective (HSSE) |
| **Pre-requisite Subject**: | None |
| **Contact hours/week**: | Lecture: 2, Tutorial:0, Practical: 0 |
| **No of Credits**: | 2 |
| **Course Assessment Methods**: | Continuous assessment through, attendance, home assignments, quizzes and two minor test, one major theory examination. |

**Course Objective**: The Course aims:

To give basic insights and inputs to the students to inculcate Human values to grow as a responsible human being with holistic personality and enable them to understand and appreciate versatility and universality of human values and their pivotal role in professional field.

**Course Outcomes**: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. To create conducive environment for professionals to grow as good and responsible human beings imbibing values and ethics.
2. Understanding the significance of environment.
3. Developing humanitarian outlook.

4. Able to understand nature of the individual and legal aspects of environment.
5. Understanding g major ideas, values, beliefs, and experiences.
6. These issues will help to sensitise students to be broader towards the social, cultural and human issues involved in social changes.

**UNIT-I** **6**

Origin, Meaning, and Definition of Value, Types of Values, Individual Value, Family Value, Societal Value, Human Value, Value in Education System, Understanding Happiness and Prosperity, Self-Exploration and Natural Acceptance.

**UNIT-II** **6**

Harmony in family, Harmony in Society, Values Leading to Harmony, Creating a world family, Harmony in Nature, Environment and Sustainable Developmental, Legal aspects of Environment, Holistic Perspectives of Values, Existence and Co-existence.

**UNIT-III** **6**

Origin, Meaning and Definition of Ethics, Ethics: The science of the Morality of The Art of Correct Living, Ethics in Human Acts, Ethics and Religion, Ethical Norms and Laws, Ethics in Literature, Ethics in Science and Technology.

**UNIT-IV** **6**

Ethical Approaches: Theistic Approach, Atheistic Approach, General and Special Ethics, Professional Ethics: Ethics at work-place, Ethics as Skill, Values and Ethics, Ethics with Value Education, Managerial and Business & Corporate Ethics, Corporate Social Responsibilities.

**References:**


1. Bangaria, G. P et.al, (2010) A foundation course in Human Values and Professional Ethics, Excel books.
2. Govindrajan, M. (2013) Professional Ethics and Human Values, Eastern Economy Edition.
3. Naagrazan, R.S. (2018) Textbook on Professional Ethics and Human Values, New age International. Misra, Anuranjan and Shukla, Dr. R.K., Human values and Professional Ethics.
4. Fernando, A. C., (2009) Business Ethics: An Indian Perspective, Pearson, India.


| **BSM-127/177** | **ENGINEERING PHYSICS** |
|---|---|
| **Course category** | : Basic Sciences & Maths (BSM) |
| **Contact hours/week** | : Lecture: 3, Tutorial: 0, Practical: 2 |
| **Number of Credits** | : 4 |
| **Course Assessment methods** | : Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination. |
| **Course Objectives** | : Understanding of the principle and concepts of Crystallography, Quantum Mechanics, Basic principles of electricity and magnetism, Maxwell's Equations, of and Advanced Materials for their applications Engineering. |

**Course Outcomes** :The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Basics of crystallography and its applications in Engineering.
2. Quantum Mechanics and its application to understand material properties at atomic level.
3. Basic principles of electricity and magnetism applied in Engineering.
4. Maxwell's equation of electromagnetic theory and its applications in engineering.
5. Basic principles of semiconducting materials and its application.
6. Basic Principles of advanced materials and their applications in Engineering.

**Topics Covered**

**UNIT-I** 9

**Crystal Structures and X-ray Diffraction:** Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Crystal-System Structure, Packing factor (cubic, body and face), Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Laue's experiment, Bragg's Law, Bragg's spectrometer.

**UNIT-II** 9

**Quantum Mechanics:** De Broglie waves and Group velocity concept, Uncertainty principle and its application, Davisson-Germer experiment, Derivation of Schrodinger equation for time independent and time dependent cases. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a free particle; Particle in a box (one dimensional)

**UNIT-III** 9

**Electrodynamics –I:** Basic concepts of Gauss's law, Ampere's law and faradays law of electromagnetic induction. Correction of Ampere's law by Maxwell (concept of displacement current), Maxwell's equation, transformation from integral form to differential form, physical significance of each equation

**Electrodynamics –II:** Maxwell's equation in free space, velocity of electromagnetic wave, transverse character of the wave and orthogonality of E, H and k vectors, Maxwell's equations in dielectric and conducting medium, velocity of e. m. wave, comparison with free space, penetration depth

**UNIT-IV** 9

**Physics of Advanced Materials**

Semiconducting Materials**,** Concept of energy bands in solids, concept of direct and indirect band gap, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials**,** Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, BCS theory (Qualitative), Introduction of nanoscience and technology

***EXPERIMENTS***

1. To determine the specific resistance of a given wire using Carrey Foster's Bridge.
2. To study the variation of magnetic field along the axis of current carrying circular coil.
3. To study the Hall's effect and to determine Hall coefficient in n type Germanium.
4. To study the energy band gap of n- type Germanium using four probe method
5. To determine e/m of electron using Magnetron valve
6. To draw hysteresis curve of a given sample of ferromagnetic material

**Books & References**


1. Introduction to Solid State Physics- Kittel, 7th edition, Wiley Eastern Ltd.
2. Solid State Physics - S. O. Pillai, 5th edition, New Age International.
3. Quantum Mechanics: Theory and Applications- Ajoy Ghatak, Tata McGraw-Hill
4. Introduction to Electrodynamics- David J. Griffiths Pearson, New International Edition
5. Semiconductor Devices and Application - S.M. Sze, Wiley
6. Introduction to Nano Technology - Poole Owens, Wiley India
7. Engineering Physics by B. K. Pandey and S. Chaturvedi, 2e Cengage Learning Pvt. Limited, India


**BEE-101/ 151 FUNDAMENTALS OF ELECTRICAL ENGINEERING**

| | | |
|---|---|---|
| **Course category** | : | Engineering Fundamentals (EF) |
| Pre-requisite Subject | : | NIL |
| Contact hours/week | : | Lecture: 3, Tutorial: 1, Practical: 2 |
| Number of Credits | : | 5 |
| Course Assessment methods | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination. |
| **Course Objective** | : | **1.** To demonstrate and understand the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context.<br>**2.** To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits, Magnetic Circuits, Transformers and Electrical Machines. |

**Course Outcomes:** The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits & DC network theorems.
2. Understand the fundamental behaviour of AC circuits and solve AC circuit problems.
3. Apply the knowledge gained to explain the behaviour of the circuit at series & parallel resonance of circuit & the effect of resonance.
4. Understand 3 phase balanced and unbalanced, star and delta connected supply and load and to measure power in 3 phase circuits

5. Explain construction and working principle of transformer with background of magnetic circuits.
6. Classify and compare different types of Electrical machines.

**Topic Covered**

**UNIT I** **9**

**D C Circuit Analysis and Network Theorems:**

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem.

**UNIT II** **9**

**Steady- State Analysis of Single-Phase AC Circuits:**

AC fundamentals: Sinusoidal, square and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit

Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, Three-phase power, and its measurement

**UNIT III** **9**

**Magnetic Circuit & Single-Phase Transformers:**

Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.

**UNIT IV** **9**

**Electrical Machines:**

Concept of electromechanical energy conversion DC machines: Types, EMF equation of generators and torque equation of motor, Characteristics, and applications of DC Generators & motors.

Single Phase Induction motor: Principle of operation and introduction to methods of starting, applications.

Three Phase Induction Motor: Types, Principle of operation, Torque-slip characteristics, Applications

***EXPERIMENTS***

**(Note:** Minimum 8 experiments are to be performed**)**

1. Verification of Kirchhoff's Law.
2. Verification of Norton's Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.

5. Verification of Maximum Power Transfer Theorem.
6. Verification of Series R-L-C circuit.
7. Verification of Parallel R-L-C circuit.
8. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
9. To perform O.C. and S.C. test of a single-phase transformer.
10. To draw the magnetization characteristics of separately excited dc motor.
11. To perform the external load characteristics of dc shunt motor.

**Textbooks:**


1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Principles of Electrical Engineering, V. Del Toro; Prentice Hall International.
3. Electrical and Electronics Technology, Edward Hughes; Pearson.
4. Basic Electrical Engineering, D P Kothari, I.J. Nagarath; Tata McGraw Hill
5. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.


**BSM-102/BSM-152 Ordinary and Partial Differential Equations**

**Course category** : Basic Sciences & Maths (BSM)
**Pre-requisite Subject** : NIL
**Contact hours/week** : Lecture: 3, Tutorial: 1, Practical: 0
**Number of Credits** : 4
**Course Assessment methods** : Continuous assessment through tutorials, attendance, home assignments, quizzes, and two minor tests and One Major Theory Examination.
**Course Objectives** : The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
**Course Outcomes** : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To solve the ordinary differential equations.
2. To solve the partial differential equations using Lagrange and charpit's method.
3. To solve and understand the properties of Bessel`s and Legendre`s differential equation.
4. Application of partial differential equation in real life problems
5. To solve Wave, Heat and Laplace equation upto two dimensions.
6. To inculcate the habit of mathematical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Ordinary Differential Equations I:** Linear differential equations with constant coefficients ($n^{th} order$), complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

**UNIT-II** 9

**Ordinary Differential Equations II:** Series solution of second order differential equations with variable coefficient (Frobeneous method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

9

**UNIT-III**

**Partial Differential equations I:** Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.

**UNIT-IV** 9

**Partial Differential Equations II:** Method of separation of variables for solving partial differential equations, Wave equation up to two-dimensions, Laplace equation in two dimensions, Heat conduction equations up to two dimensions

**Books & References**


1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.
3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd..
5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.


**BEE- 107/ 157 Basics of Measuring & Protective Equipments**

| | | |
|---|---|---|
| Course category | : | Proficiency |
| Pre-requisite Subject | : | NIL |
| Contact hours/week | : | Lecture: 0, Tutorial: 0, Practical: 4 |
| Number of Credits | : | 2 |
| Course Assessment methods | : | Continuous assessment through attendance, two Viva-voce, Practical work/record, and Major Practical Examination. |
| **Course Objective** | : | **1.** To demonstrate and understand the basic principle of operation and construction of different types of electrical measuring instruments.<br>**2.** To demonstrate and understand the applications of different types of electrical measuring instruments. |

**Course Outcomes:** The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course:

1. Understand the basic concepts of measurement.
2. Understand the basic concepts of calibration of instruments like voltmeter, ammeter, wattmeter, and energy meter.
3. Understand the use of CT and PT for extension of range.
4. Understand the construction, working principle of operation and performances of different kind of measuring instruments.
5. Student gains knowledge on different Protective Equipment’s of Power Systems.
6. Understand the Single line diagram of Substation.

**List of Experiments:**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Verification of Kirchhoff's law.
2. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
3. Calibration of ac voltmeter and ac ammeter.
4. Calibration of single induction type energy meter with the help of wattmeter.
5. Extension of range instruments using CT & PT.
6. To study the IDMT over current relay and determine the time current characteristics.
7. To study percentage differential relay.
8. To study Impedance, MHO and Reactance type distance relays.
9. To understand the protection scheme of substation through visit to local high voltage substation and to sketch labelled schematic diagram/single line diagram of it.

**Textbooks:**


1. E.W. Golding & F.C. Widdis, "Electrical Measurement & Measuring Instrument", A.W. Wheeler & Co. Pvt. Ltd. India.
2. A.K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai& Sons, India .
3. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
4. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
5. B.Bhalja, R.P. Maheshwari& N. G. Chothani, Protection & Switch Gear, Oxford University Press.
6. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc. Graw Hill


**BCE-101/151 ENGINEERING GRAPHICS**

| | | |
|---|---|---|
| **Course category** | : | Engineering Fundamentals (EF) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 0, Tutorial: 0 , Practical: 4 |
| **Number of Credits** | : | 2 |
| **Course Assessment methods** | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, Two minor tests, One Major Theory Exam and major Practical Examination |
| **Course Objectives** | : | This course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two-dimensional engineering drawings. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course<br>1. How Engineering Drawing helps to sketch the imagination?<br>2. Able to effectively practice the different scales for drawings.<br>3. Effectively analyze the geometrical shapes and to be able to draw.<br>4. Know about out solids and discuss about their classification.<br>5. How to implement the different views for a solid placed in |

3dspace.

6. Construction of the object from different perspective.

**Topics Covered**

**UNIT-I**

**Conic Sections and Orthographic Projections Introduction**

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

**Orthographic Projections**

Orthographic Projections covering Principles of Orthographic Projections- Conventions Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane

**UNIT-II**

**Projection of Regular Solids**

Projections of Regular Solids covering those inclined to both the Planes- Auxiliary Views

**UNIT-III**

**Sections and Sectional Views of Right Angular Solids**

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

**UNIT-IV**

**Isometric Projections**

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. Overview of computer graphics, demonstrating knowledge of the theory of CAD software.

**Textbooks**

1. Engineering Drawing-Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008

**Reference Books**

1. Engineering Drawing and Computer Graphics- Shah, M.B. & B.C. Rana, Pearson Education, 2008
2. A Text Book of Engineering Drawing-Dhawan, R.K., S. Chand Publications,2007
3. Text book on Engineering Drawing-Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008

**BME-154 FUNDAMENTALS OF MECHANICAL ENGINEERING**

| | | |
|---|---|---|
| **Course category** | : | Program link basic science and engineering courses (PLBSE) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 0 , Practical: 2 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination. |
| **Course Objective** | | This course introduces basic fundamentals of mechanical engineering and their applications in solving engineering problems based on the concepts of thermodynamics, engine, measurement, engineering materials, mechanical properties and testing etc. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. The knowledge of basic laws of thermodynamics; steam generation and its properties; refrigeration cycles, properties and machines; and reciprocating engine such as two/four strokes IC engines.
2. The knowledge of measuring instruments, types of transducers for measurement of different geometrical parameters.
3. The knowledge of various engineering materials and their applications.
4. The ability to understand different types of stresses, Hooke's law and its applications,
5. Understand the different mechanical properties and testing of engineering materials.
6. The knowledge of different types of beams, shear force and bending moment diagrams for statically determinate beams, stresses in simple bending of beams and torsion in circular shafts.

**Topics Covered**

**UNIT-I** **(9)**

**Thermodynamics**

First and second law of thermodynamics, statements of Second Law of Thermodynamics and their equivalence, Third law of thermodynamics, Steam properties, Steam processes at constant pressure, volume, enthalpy and entropy, Classification of steam boilers, boiler mounting and accessories, Refrigeration, Basics of Vapour compression and vapour absorption system, Coefficient of performance (COP), Refrigerants properties.

**Reciprocating Machines**

Carnot cycle, Otto and Diesel cycles, Working of two and four strokes petrol and diesel engines.

**UNIT-II** **(9)**

**Measurement & Metrology**

Introduction to measurement and measuring instruments, Types of sensors and transducers and their characteristics, measuring error uncertainty analysis, Temperature, pressure, velocity, flow, strain, force and torque introduction of dial gauges, slip gauges and sine bar

**Engineering Materials**

Classification of materials, Ferrous and nonferrous metals, Composition of cast iron, carbon steel, alloy steel and their mechanical properties, Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. properties and its applications.

**UNIT-III** **(9)**

**Simple Stress and Strain**

Introduction, Normal and shear stresses, Poisson's ratio, Elastic constants and their relationships, Hooke's law, Deflection of bars of uniform and varying cross-sections, Strain energy in due to static loading, Stress-strain diagrams for ductile and brittle materials

**Mechanical Properties and Testing**

Introduction to Toughness, Hardness, Fracture, Fatigue, Strength and deformation, Tensile, compression, Hardness, Impact, Fatigue, spring stiffness tests.

**UNIT-IV** **(9)**

**Beams**

Introduction, Beams classification, types of loading, Free body diagram, Shear force and bending moment, Analysis of beams, Shear force and bending moment diagrams for statically determinate beams, Simple bending theory, Stress of beams of different cross sections

**Torsion of Circular shafts**

Introduction, Torsion of circular shafts, Shear stress due to torsion, Polar modulus, Power transmission

**EXPERIMENTS**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Tensile strength test on universal testing machine.
2. Compressive strength test on universal testing machine.
3. Bend/rebend test on Izod.
4. Impact test on Impact testing machine.
5. Hardness testing on Vicker/Brinell hardness testing machine.
6. Torsion test of a rod on torsion testing machine.
7. Stiffness test on spring testing machine.
8. Study of two stroke and four stroke engine model.
9. Fatigue test on fatigue testing machine.
10. Deflection on bending of simple supported and cantilever beams.
11. Determination of COP of vapour absorption system.
12. Determination of COP of vapour compression refrigeration system.
13. Study of steam boilers model.
14. Study of domestic refrigerator

**Books & References**


1. Basic and Applied Thermodynamics-P. K. Nag (Tata McGraw Hill)
2. Basic Thermodynamics- Cengel(Tata McGraw Hill).
3. Applied Thermodynamics-Onkar Singh (New Age International)
4. Elements of Materials science and Engineering-Van Vlash (Jhon Wiley & Sons)
5. Material Science-V. Raghvan (Prentice Hall India Limited)
6. Mechanical Measurement-G. Beckwith Thomas (Narosa Publishing House)
7. Mechanical Measurement – Sirohi (New Age Publications)
8. Strength of Materials-S. Ramamurtham (Dhanpat rai Publishing Co.)
9. Strength of Materials-R. K. Rajput (S. Chand)
10. Strength of Materials–R. K. Bansal (Lakshmi Publications)


**BHM-101/151 PROFESSIONAL COMMUNICATION**

| | | |
|---|---|---|
| **Course category** | : | HSS |
| Pre-requisite Subject | : | None |
| Contact hours/week | : | Lecture: 2, Tutorial: 0, Practical: 0 |
| Number of Credits | : | 02 |
| Course Assessment methods | : | Continuous assessment through attendance, home assignments, two minor tests and one major theory examination. |

**Course Objectives** : To sensitize the students to understand the role & importance of communication for personal & professional success and enable learners to exhibit knowledge, skills, and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Use of various facets of communication skills, such as, Reading, Writing, Listening and speaking skills.
2. To identify, formulate and solve the real-life problems with positive attitude.
3. To inculcate the habit of learning and developing the communication and soft skills by practice.
4. To create an amicable ambience to make them learn the different part of English language with the correction of the language.
5. Enhancing word power by counselling scientific literature.
6. Focusing on effortless speaking and writing.

**Topics Covered**

UNIT-I 6

**VERBAL COMMUNICATION:**

Received Pronunciation; how to activate passive vocabulary; Technical/non-technical and Business Presentations; questioning and answer skills; soft skills for professionals; role of body postures, movements, gestures, facial expressions, dress in effective communication; Information/ Desk/ Front Office/ Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

**UNIT-II**

**READING COMPREHENSION** 6

Skimming and Scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

**UNIT-III**

**WRITTEN COMMUNICATION:** 6

Note Making and Note Taking; summarizing; invitation, advertisement, agenda, notice and memos; official and commercial letters; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General – Specific, Problem – Solution, Process – Description, Data – Comment.

**UNIT-IV**

**SHORT ESSAYS:** 6

Description and Argument; comparison and contrast; illustration; using graphics in writing: tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

**Text and Reference Books**


1. Bansal, R.K. & Harrison J.B., (1972) *Spoken English*, Orient Longman, India.
2. Chauhan, Narender Kr. & Singh, Sudhir N., (2013) *Formal Letters*, Pankaj Publication International, New Delhi.
3. Chhabra T.N., (2019) *Business Communication*, Sun India Publication, New Delhi.
4. Dixon Robert J., (1986) *Complete Course in English*, Prentice Hall of India, New Delhi.
5. Jones, Daniel., (2012) *Cambridge English Pronouncing Dictionary*, 18th Edition, Paperback, CUP, India.
6. Lewis, Norman, (2015) *Word Power Made Easy*, Penguin India.


**BSM-201/ BSM-153 Complex Analysis and Numerical Methods**

| | | |
|---|---|---|
| **Course category** | : | Basic Sciences & Maths (BSM) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 0 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, and two minor tests and One Major Theory Examination. |
| **Course Objectives** | : | The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Prove basic results in complex analysis.
2. Establish the capacity for mathematical reasoning through analysing, proving, and explaining concepts from complex analysis.
3. Solve the problems using complex analysis techniques applied to different situations in engineering contexts.
4. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions.
5. To study numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations, and the solution of differential equations.
6. Demonstrate the concepts of numerical methods used for different applications.

**Topics Covered**

**UNIT-I** 9

**Functions of Complex Variable I:** Complex differentiability, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Harmonic conjugates, Cauchy-Integral Theorem, Cauchy-Integral formula, Cauchy's integral formula for higher derivatives.

**UNIT-II** 9

**Functions of Complex Variable II:** Taylor's Series and Laurent Series, Zero's and Singularities of functions, Removable singularity, Poles and essential singularities, Residues,

Cauchy's residue theorem., Residue theorem, Evaluation of the real integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ *and* $\int_{-\infty}^{+\infty} f(x)dx$.

**UNIT-III** 9

**Numerical Methods I:** Solution of algebraic and transcendental equations by Bisection, Regula-Falsi, secant Method and Newton-Raphson methods. Newton's Gregory forward and backward interpolation, Lagrange's and Newton's divided difference method.

**UNIT-IV** 9

**Numerical Methods II:** Solution of system of linear equations by Jacobi, Guass-Siedel method and Crout's method. Trapezoidal Rule, Simpson's one-third and three-eight rules. Solution of differential equations by Taylor, Picard, Euler, Modified Euler's Method, Runge-Kutta Fourth Order Methods, Milne's and Adam's predictor and corrector methods.

**Books & References**


1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers.
2. Jain, Iyenger and Jain: Advanced Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. James W. Brown & R. V. Churchill: Complex variables and applications, Mcgraw-Hill Asia
4. R. K. Jain and Iyenger: Numerical Methods, Narosa Publications.
5. A. Greenbaum & T. P. Chartier, Numerical methods, Princeton University Press, 2012.


**BEC-206** **Digital Electronics & Circuits**

| | | |
|---|---|---|
| **Course category** | : | Engineering Fundamental (EF) |
| **Pre-requisite Subject** | : | NA |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 0, Practical: 2 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, assignments, quizzes, practical work, record, viva voce, two minors, major theory & practical Examination |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course. |

1. Acquired knowledge about basics of digital electronics and solving problems related to number systems and Boolean algebra.
2. Ability to identify, analyze and design combinational circuits.
3. Ability to identify, analyze and design sequential circuits.
4. To design, implement and evaluate various synchronous and asynchronous sequential circuits and applications.
5. Acquired knowledge about internal circuitry and logic behind digital systems.
6. Able to understand State machine design procedure with sequential PLDs.

**Topics Covered**

**UNIT-I**

Digital system and Binary numbers: Signed binary numbers, Floating point number, Binary Codes, Cyclic codes, Error detecting and correcting codes, Hamming codes. NAND and NOR implementation, Minimization of circuit using K-map and Tabular method up to five variables, POS and SOP simplification, Logic family- TTL, DTL, ECL, CMOS, HMOS **9**

**UNIT-II**

Combinational Logic: Analysis and Design procedure for Combinational circuits, Binary adder/subtractor, Binary multiplier, Booth Algorithm, Magnitude comparator, Encoder/ Multiplexer, Decoder/Demultiplexer. **9**

**UNIT-III**

Sequential logic: Sequential circuits, Latches, Flip-flops, Conversion of flip-flops, Analysis of clocked sequential circuits, State reduction and assignments. Registers and counters: Shift registers, Asynchronous counter, Synchronous counter, Sequential circuit analysis and design procedure, Circuit with latches, Hazards. **9**

**UNIT-IV** **9**

Memory and programmable logic: Read only Memory, Read/Write Memory-SRAM and DRAM. Programmable Logic Devices,-PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs: Introduction, to field programmable gate arrays (FPGAs).

**LIST OF EXPERIMENTS**

**A. Compulsory Experiments**

1. Design and verification of following arithmetic circuits using 74xx family ICs.
   a. Half adder and Full adder
   b. Half subtractor and full subtractor
2. To perform the code conversion- binary to gray and gray to binary and its truth table verification.
3. To design a combinational logic circuit using 74xx family ICs and its truth table verification in both SOP and POS forms.
4. Realization of 2:4 decoders and 4:2 encoder circuit and verification of its truth table.
5. To design and verify the truth table of multiplexer and demultiplexer circuits.
6. To design a 1-bit comparator using 74xx family ICs and to study the performance of4-bit comparator IC7485.
7. Design and verification of basic Flip-Flops using 74xx family ICs and master-slave

JK flip-flop using IC7476.

**B. Optional Experiments**

8. To realize and verify the truth table of shift register-SIPO/SISO and PISO/PIPO.
9. Design and verification of asynchronous counter design and Mod-n counter.
10. To realize and verify the truth table of synchronous counter design.

**Text/Reference Books**


1. Hill & Peterson, "Switching Circuit & Logic Design",Wiley
2. Mano, M. Morris. Digital design. Pearson Educación, 2002.
3. Digital principle and applications Malvino and Leach-(TMH)


| | | |
|---|---|---|
| **BHM-201** | | **SCIENTIFIC AND TECHNICAL WRITING** |
| **Course category** | : | HSS |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | : | 2 |
| **Course Assessment methods** | : | Continuous assessment through attendance, home assignments, quizzes, two Minor Tests and one Major Theory Examination. |
| **Course Objectives** | : | To Prepare Professionals with a view to developing the power of know-how of the subject and enhance them face challenges in English language. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

1. Overcome the problems he/she faces in oral and written communication.
2. Acquire knowledge of and methods for using technical communication, such as, reports, proposals and business letters etc.
3. Use and practice compositions correctly.
4. Enhancing word power by counselling scientific literature.
5. Focusing on effortless speaking and writing.
6. Give Presentations in different sessions and make self-appraisal

**Topics Covered**

**UNIT-I** **6**

**Language Vs communication:** Communication as coding and decoding – signs, symbols & pictograph – verbal and non –verbal symbols – Language & communication; Types of Communication- functional, situational, verbal, and non-verbal, interpersonal, group, interactive, public, Mass Communication. Thinking and Articulation – cognitive, affect, critical, creative aspects of articulation.

**Skills of Language Acquisition:** Natural Language Acquisition Skills: Listening, Speaking, Reading & Writing {LSRW}; Language Acquisition Through Training: Listening, Speaking, Reading, Writing, Grammar & Vocabulary {LSRWGV}

**Phrase, Clause & Sentence: Professional Drafting**-Simplicity, Clarity and Conciseness of a Presentation, Differentiating between Professional & Creative Writing, Blending of Artistic/Professional Writing, Avoiding gender, racial and other forms of bias in Professional Writing. Pre Writing, Drafting and Re-writing.

**Processing Professional Data:** Data Collection, Literature Review, Data Analysis, Drafting Data & Deriving Inferences.

**UNIT-II** **6**

**Technical Paper Writing:** Professional Paper Elements-Front Matter of a Paper, Main Text of a Paper, End Matter of a Paper: Organising References and Bibliography, Order of a thesis and Paper Elements, Concluding Remarks. **Methods of Research Paper Writing:** Identification of Author and His Writing-Author's name and Affiliation, Joint Authorship of a Paper, Identification of Writing-Title, Keywords, Synopsis, Preface and abstract. Drafting Research Article & Methodology.

**Thesis/Dissertation Writing:** Thesis Elements-Front Matter of a Thesis, Main Text of a Thesis, End Matter of a Thesis, Specimen—Thesis and Research Paper, Chapters and Sections-Introductory Chapters and Sections, Statement of the Problems, Plan and Scope, Core Chapters and Sections-Theoretical Analysis and Synthesis, Basic Assumption and Hypothesis.

**Professional Presentation & Seminar Delivery Tools**: Designing the Presentation; Establishing the Objectives. Making Professional Power Point Presentations, Signalling Structure of Presentation through Sentences and Crisp Phrases, Preparing Notes for Professional/Technical Presentation, Text Animation, White Board, Flip Charts, Diagrams, Preparing Cards. Seminar Presentations: Purpose modes and methods. Nascent Emerging Platforms for On-line Presentations viz. Zoom, Webex, Team & Meet etc.

**UNIT-III** **6**

**Introduction to Generation–Z, Cyber Identity & Professional Netiquettes for Netizens:** Drafting E-mails, Blogs on social media, Videoconferencing. Managing Profiles on social media. What to Write and Share on social media.

**Professional Drafting:** Letters Vs E-mails, Formal and Informal mails, Parts of e-mails, Types of e-mails, Managing tone of E-mails & Business Letters, Examples of Letters & E-mail, Professional Correspondence through E-mail, Job Applications & Covering Letters. Introduction to DOs (Demi-Official Letters)

**Conducting Professional Meeting:** Pre-meeting Preparation, During Meeting: Action Taken Report (ATR) & New Agenda Points, Post Meeting Follow ups. Notice, Circular, Agenda & Minutes.

**Career & Correspondence:** Developing a Professional C.V, Bio Data & Resume Building. Report Writing, Kinds of Reports, Length of Report, Parts of a Report, Terms of Reference, Collection of Facts, Outlines of Report, Examples of Report, Technical Proposal, Elements of Proposal, Examples of Proposal, drafting of proposal.

**UNIT-IV** **6**

**Professional Interviews**- Interview skills-body language, gesture, posture, tips, and tactics of interview. Professional interview of an expert. Questioning & Answering Skills.

**Case study**- objectives, methods, examples of various case-study.

**Audience Analysis in Technical Writing**: Industrial vs. non-industrial users; Exploring primary, secondary, tertiary users in contexts of production and use; Creating personas; Multicultural issues; Analysing real-world examples. Estimating, tracking, and managing tech writing projects. Determine the project scope, Estimates and schedules, Assemble the team, provide resources and leadership, Evaluate the project, Appendixes and Annexure, References, Peripherals—Official Formalities, Rights and Permission, Certificate and Copyright, Dedication, Acknowledgement, Correspondences. Managing Tone in Writing.

**Project Writing:** Elements of a Professional Project Making: Making a final Project on topics, given by the instructor, Result & Discussion.

**Text and Reference Books**


1. Acharya Anita. (2012) *Interview Skills- Tips & Techniques*. Yking Books, Jaipur.
2. Basu, B. N., (2008) *Technical Writing*. PHI Learning Pvt. Ltd.., New Delhi.
3. Chauhan, N. K & Singh, S. N. (2013) *Formal Letters*, Pankaj Publication International, New Delhi.
4. Chhabra T.N. (2018) *Business Communication. Sun* India Publication New Delhi.
5. Dubey Arjun et.al. (2016) *Communication for Professionals. Alfa* Publications, Delhi.


**BEE-201 ELECTRICAL MACHINES-I**

**Course category** : Program Core (PC)
**Contact hours/week** **:** Lecture: 3, Tutorial: 1,Practical: 2
**Number of Credits** : 5
**Course Assessment Methods** **:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.
**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire knowledge about the fundamental principles and classification of electromagnetic machines.
2. Ability to understand electro-mechanical energy conversion process of rotating electrical machines in singly exited & doubly excited magnetic system.
3. Ability to learn basic concept of design, working & performances of DC Machines as Generator.
4. Ability to solve theoretical & numerical problems related with DC Machines as Generator.
5. Ability to learn basic concept of design, working & performances of DC Machines as Motors and solve theoretical & numerical problems.
6. Ability to know constructional details, working principle & Performances of single Phase & three phase transformer.

**Topic Covered**

**UNIT -I** **9**

**Principles of Electro-mechanical Energy Conversion –**

Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems, singly Excited Systems; Doubly excited Systems; derivation of mechanical force, mechanical energy and torque in magnetic field system, generated EMF in electrical machines

**UNIT II** **9**

**D.C. Machines-I**

Construction of DC Machines, parts of dc machine, armature winding, types of dc generators, Emf and torque equation, Armature Reaction, Commutation process, inter pole and Compensating Windings, Performance Characteristics of D.C. generators under no load and loaded conditions.

**UNIT III** **9**

**D.C. Machine-II**

DC motors, operating characteristics of D.C. motors, back EMF and torque equation, necessity of starters, types of starters, Speed control of D.C. motors, Field Control, armature control and voltage control, losses, Efficiency, and various Testing on D.C. motors.

**UNIT IV** **9**

**Transformer:**

Construction& working of single-phase transformer, types of transformers, equivalent circuit models, efficiency, voltage regulation, various testing methods, Single phase auto transformers, efficiency, merits & demerits, and applications of auto transformer. Construction & various connection diagrams of three phase transformers, phasor groups, parallel operation of three phase transformers, three winding transformers.

**Textbooks:**


1. I. J. Nagrath & D. P. Kothari," Electrical Machines", Tata McGraw Hill
2. Ashfaq Husain," Electrical Machines", Dhanpat Rai & Sons
3. U.A Bakshi and M.V Bakshi, "Electromechanical Energy Conversion-I", Technical Publication Pune,
4. B.R. Gupta & Vandana Singhal, "Fundamentals of Electrical Machines, New International.
5. Fitzerald, A.E., Kingsley and S. D. Umans "Electric Machinery", MC Graw Hill.


**Reference Books:**


1. Irving L. Kosow, "Electric Machine and Tranformers", Prentice Hall of India.
2. M.G. Say, "The Performance and Design of AC machines", Pit man & Sons.
3. P. S. Bimbhra, "Electrical Machinery", Khanna Publisher


**BEE-202 BASIC SYSTEM ANALYSIS**

| | | |
|---|---|---|
| **Course category** | **:** | Program Core (PC) |
| **Contact hours/week** | **:** | Lecture: 3, Tutorial: 1,Practical :0 |
| **Number of Credits** | **:** | 4 |
| **Course Assessment Methods** | **:** | Continuous assessment through tutorials, attendance, home assignments, quizzes, and two minor tests and One Major Theory Examination. |

**Course Outcome :** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze as well as synthesize Continuous and discrete signals, classification & identification of different signals/ models.
2. Acquire the knowledge of analogous electrical systems of different non- electrical systems.
3. Application of Fourier-series and Fourier Transform for the analysis of periodic & aperiodic signals.
4. Application of Laplace Transform for the analysis of continuous-time systems.
5. Modelling and system analysis through State variable.
6. Application of Z-Transform for the analysis of discrete-time systems.

**Topic Covered**

**UNIT I** **9**

**Introduction to continuous time signals and systems:**

Basic continuous time signals, unit step, unit ramp, unit impulse and periodic signals with their mathematical representation and characteristics. Introduction to various types of systems.

**Analogous System:**

Linear mechanical elements, force-voltage and force-current analogy, modelling of mechanical and electro-mechanical systems: Analysis of first and second order linear systems by classical method.

**UNIT II** **9**

**Fourier Transform Analysis:**

Exponential form and Trigonometric form of Fourier series, Fourier symmetry, Fourier Integral and Fourier Transform. Transform of common functions and periodic wave forms: Applications of Fourier Transform to network analysis.

**Laplace Transform Analysis:**

Review of Laplace Transform, Laplace Transform of periodic functions, Initial and Final Value Theorems, Inverse Laplace Transform, Convolution Theorem, Superposition Integral, Application of Laplace Transform to analysis of networks, waveform synthesis and Laplace Transform of complex waveforms

**UNIT III** **9**

**State Variable Analysis:**

Introduction, State Space representation of linear systems, Transfer Function and state Variables, State Transition Matrix, Solution of state equations for homogeneous and non-homogeneous systems, Applications of State-Variable technique to the analysis of linear systems.

**UNIT IV** **9**

**Z-Transform Analysis:**

Concept of Z-Transform, Z-Transform of common functions, Inverse Z-Transform, Initial and Final Value theorems, Applications to solution of difference equations, Pulse Transfer Function

**Textbooks:**

1. David K. Cheng; “Analysis of Linear System”, Narosa Publishing Co.

2. ME Van-Valkenberg; “Network Analysis”, Prentice Hall of India
3. C. L. Wadhwa, “Network Analysis and Synthesis”, New Age International Publishers,2007.
4. Samarajit Ghosh, “Network Theory: Analysis and Synthesis” Prentice Hall of India, 2008

**Reference Books:**

1. Choudhary D. Roy, “Network & Systems”, Wiley Eastern Ltd.
2. Donald E. Scott, “Introduction to circuit Analysis” Mc. Graw Hill
3. B.P. Lathi, “Linear Systems & Signals” Oxford University Press, 2008.
4. I.J. Nagrath, S.N. Saran, R. Ranjan and S. Kumar, “Signals and Systems, “Tata Mc. Graw Hill, 2001.
5. Taan S. Elali & Mohd. A. Karim, “Continuous Signals and Systems with MATLAB” 2nd Edition, CRC Press.

| | |
|---|---|
| **BSM-241** | **ENVIRONMENTAL CHEMISTRY** |
| **Course category** | Program link basic science and engineering courses (PLBSE) |
| **Pre-requisite Subject** | NIL |
| **Contact hours/week** | Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | 2 |
| **Course Assessment methods** | Continuous assessment through attendance, home assignments, quizzes, Two Minor Test and One Major Theory Examination. |

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

**Course Outcomes**

1. Students will acquire basic knowledge about Environment, which allows students to gain qualitative and quantitative skills.
2. Students will be aware of environmental pollution and control methods along with quality standards of air, water etc along with waste management.
3. Students will be able to give systematic account of natural resources their use and environmental problems due to overexploitation.
4. Students will acquire basic knowledge about the chemical reactions taking place in the environment.
5. To acquire awareness for ethical principle of environment.
6. To gain knowledge as a leader in multidisciplinary areas.

**Topics Covered**

**UNIT-I** **6**

Basic concept of Environmental chemistry, Introduction to atmospheric chemistry, Layers of the atmosphere and their chemical composition, chemistry of gaseous and particulate pollutants, Ozone and its control, Green House Effect.

**UNIT-II** **6**

The Chemistry of Natural Waters, Oxidation-Reduction Chemistry in Natural Waters, Ion Concentrations in Natural and potable Water, Water Pollution and Purification of Water, Water

Disinfection, Ground water: Its Supply, Chemical Contamination, and Remediation the Chemical Contamination and Treatment of Wastewater and Sewage.

**UNIT-III** **6**

Toxic Heavy Metals, Mercury, Lead, Arsenic, and cadmium. Soil pollution, Domestic and Commercial Garbage: solid waste management. The Recycling of Household and Commercial Waste, Hazardous Wastes, and methods of disposal

**UNIT-IV** **6**

Toxic Organic Compounds, Pesticides, Insecticides, Herbicides, Dioxins, Furans, and PCBs, Polynuclear Aromatic Hydrocarbons Chemistry of food additives, dyes, detergents, and bleaching agents

**Books & References**


1. Environmental Chemistry - Colin Baird and Michael Cann, W. H. Freeman
2. Environmental Chemistry - Stanley E. Manahan, CRC Press; 9th edition.
3. Sonja Krause, Herbert M. Clark, James P. Ferris, Robert L. Strong Chemistry of the Environment, Elsevier Science & Technology Books.
4. Eugene R. Weiner Applications of Environmental Chemistry, CRC Press, LLC.
5. By Clair N. Sawyer, Perry L. McCarty, Gene F. Parkin Chemistry for environmental engineering and science (5th edition), McGraw-Hill Professional.


**BSM-251 INTEGRAL TRANSFORMS AND STATISTICAL METHODS**

| | | |
|---|---|---|
| **Course category** | : | Basic Sciences & Maths (BSM) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial: 1, Practical: 0 |
| **Number of Credits** | : | 4 |
| **Course Assessment methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination |
| **Course Objectives** | : | The course is aimed to understand and implement various concepts of numerical analysis and statistics to solve real life problems. |
| **Course Outcomes** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course |

1. Use of Laplace Transform to solve the differential equation.
2. Use of Fourier transforms, and Z transforms to solve the differential equation.
3. Provide knowledge of various significant and fundamental concepts of Statistical Methods.
4. Demonstrate understanding of the probability and statistical foundations of data analysis.
5. Demonstrate understanding of the importance of assumption checking for valid statistical analysis and be able to perform assumption checking.
6. To inculcate the habit of mathematical thinking and lifelong learning.

**Topics Covered**

**UNIT-I** 9

**Integral Transform I:** Laplace Transform Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function. Laplace transform of periodic function, Impulse function.

Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

**UNIT-II** 9

**Integral Transform II:** Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one-dimensional heat transfer equation, wave equation. Z- transform and its application to solve difference equations

**UNIT-III** 9

**Statistical Methods I:** Frequency distribution, Mean, Median, Mode and Standard Deviation, Moments, generating function for moments, Skewness, Kurtosis, Curve fitting: Method of Least Squares, Fitting of Straight lines and Parabola, Correlation and Regression.

**UNIT-IV**

**Statistical Methos II:** Probability, conditional probability, Bayes theorem, random variables, Discrete and Continuous probability distributions: Binomial, Poisson, Uniform, Normal, and Exponential distribution. Tests of Significance, Chi-square test, t-test, and Application to Engineering problems 9

**Books & References**


1. Debanth L. and Bhatta D., "Integral Transforms and Their Applications", 2nd edition, Taylor and Francis Group, 2007.
2. Sneddon I. N. Fourier Transforms, Dover Publication, 2010.
3. D. C. Montgomery and G. C. Runger, Applied Statistics and Probability for Engineers, Wiley.
4. S.M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, Academic Press; 5th edition
5. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons Publisher


## BEE-251 ELECTRICAL MEASUREMENT & MEASURING INSTRUMENTS

**Course category** : Program Core (PC)
**Contact hours/week** : Lecture: 3, Tutorial: 0, Practical: 2
**Number of Credits** : 4
**Course Assessment** : Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Methods**

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Basic concept of measurement, instrumentation, working & performances of different kind of measuring instruments

2. Ability to analyze performance characteristics of measuring instruments.
3. Ability to know, working principle & Performances of AC Bridges.
4. Ability to understand construction, principle of operation, working and applications of waveform analyzers and spectrum analyzers.
5. Ability to understand construction, principle of operation, working and applications of harmonic distortion analyzers.
6. Ability to understand construction, principle of operation, working and measurements of Cathode Ray Oscilloscope (CRO).

**Topic Covered**

**UNIT-I** **9**

**Fundamentals of Measurement Systems**

Philosophy of measurement, methods of measurements, classification of measurement system, functional elements of measurement, units, dimensions & standards, static performance characteristics, errors analysis, loading effect of instrument, uncertainty in compound quantity, histogram, deviation, dispersion, standard deviations, variance, Gaussian's distribution curve analysis.

**UNIT II** **9**

**Analog Measurement of Electrical Quantities**

Types of measuring instruments, secondary instruments, essentials components of instruments, design of sprigs, pivot & jewels, Ammeters & Voltmeters; moving coil, moving iron, electrodynamic, electrostatic, rectifier & thermocouple type, Measurement of power, wattmeter, Measurement of energy, induction type energy meter, errors & remedies in wattmeter and energy meter, frequency meters.

**UNIT III** **9**

**Instrument Transformers & A.C. Bridges**

Instrument Transformer (CT &PT) and their applications in the extension of instrument range, Different methods of measuring low, medium and high resistances**,** measurement of inductance & capacitance with the help of AC Bridges.

**UNIT IV** **9**

**Magnetic Measurement & Digital Measurement of Electrical Quantities**

Flux meter**,** determination of hysteresis loop, measurement of iron losses**.** Concept of digital measurement, block diagram study of digital voltmeters (DVM), Spectrum analyzers, Wave Analyzer and Harmonics distortion analyzer; Basic CRO circuit (Block Diagram), Cathode ray tube (CRT) & its components**,** application of CRO in measurement, Lissajous Pattern.

**List of Experiments**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Calibration of ac voltmeter and ac ammeter.
2. Calibration of single of induction type energy meter with the help of wattmeter.
3. Extension of range instruments using CT & PT.
4. Determination of iron loss using Lloyd Fisher's square method.
5. Measurement of phase difference and frequency of a sinusoidal ac voltage using C.R.O.
6. Measurement of power and power factor of a load using three voltmeter methods.
7. Measurement of low resistance by Kelvin’s double bridge.

8. Study of Maxwell's inductance bridge.
9. Study of Schering bridge.
10. Study of Hay's bridge.
11. Study of Anderson's bridge.
12. Study of Owen's bridge.

**Textbooks:**


1. E.W. Golding & F.C. Widdis, "Electrical Measurement &Measuring Instrument", A.W. Wheeler& Co. Pvt. Ltd. India.
2. A.K. Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai& Sons India.


**Reference Books:**


1. E.O. Decblin, "Measurement System – Application & design", McGraw Hill.
2. Forest K. Harries, "Electrical Measurement", Willey Eastern Pvt. Ltd. India.
3. M.B. Stout,"Basic Electrical Measurement" Prentice hall of India.
4. W. D. Cooper," Electronic Instrument & Measurement Technique "Prentice Hall International.
5. B.C. Nakra & K. Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
6. J.B. Gupta, "Electrical Measurements and Measuring Instruments", S.K. Kataria & Sons


## BEE-252 NETWORK ANALYSIS AND SYNTHESIS

**Course category** : Program Core (PC)
**Contact hours/week** : Lecture: 3, Tutorial: 1, Practical: 2
**Number of Credits** : 5
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination
**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to apply the network theorems for A.C. and D.C. networks.
2. Able to analyse two-port networks.
3. Able to understand the concept of graph theory and its applications.
4. Able to understand the concept of network functions and their characteristics.
5. Able to synthesize two elements (R-L, R-C and L-C) networks.
6. Able to understand the basic concepts of filters and their applications.

**UNIT I** **9**

**Network Theorems**

Fundamentals to Network Analysis, Thevenin's and Norton's theorem, Superposition theorem, Maximum Power Transfer theorem, Millman's theorem, Compensation theorem and Reciprocity theorem. Problems with ac and dependent sources.

**UNIT II:** **9**

**Two Port Networks**:

Characterization of LTI two port networks Z, Y, ABCD and h parameters, reciprocity, and symmetry. Inter-relationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks & Π Representation.

**UNIT III** **9**

**Introduction to Graph Theory:**

Graph of a Network, definitions, tree, co tree, link, basic loop and basic cut set, Incidence matrix, cut set matrix, Tie set matrix Duality, Loop and Nodal methods of analysis.

**Network Functions:**

Concept of Complex frequency, Transform Impedances Network functions of one port and two port networks, concept of poles and zeros, properties of driving point and transfer functions, time response and stability from pole zero plot.

**UNIT IV** **9**

**Network Synthesis:**

Positive real function; definition and properties; properties of LC, RC and RL driving point functions, synthesis of LC, RC and RL driving point immittance functions using Foster and Cauer first and second forms.

**Introduction to Filters.**

**List of Experiments:**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Verification of Superposition Theorem.
2. Verification of Thevenin's Theorem.
3. Verification of Norton's theorem.
4. Verification of Maximum power transfer theorem.
5. Verification of Reciprocity Theorem.
6. Star Delta Transformation
7. Power Factor Improvement
8. To plot frequency response of a series resonant circuit.
9. To plot frequency response of a parallel resonant circuit.
10. To measure input impedance and output impedance of a given two port networks.
11. To design a Π attenuator which attenuate given signal to the desired level.

**Textbooks:**


1. M.E. Van Valkenburg, "Network Analysis", Prentice Hall of India
2. A. Chakrabarti, "Circuit Theory" Dhanpat Rai& Co.
3. C.L Wadhwa, "Network Analysis and Synthesis" New Age International Publishers, 2007.
4. D.Roy Choudhary, "Networks and Systems" Wiley Eastern Ltd.
5. Donald E. Scott: "An Introduction to Circuit analysis: A System Approach" McGraw Hill


**Reference Books:**


6. M.E. Van Valkenburg, "An Introduction to Modern Network Synthesis", Wiley Eastern Ltd.
7. N.C. Jagan and C. Lakshminarayana, "Network Analysis" B.S. Publications, 2008.
8. K.S. Suresh Kumar, "Electric Circuits and Networks" Pearson Education, 2009.
9. A Ramakalyan, "Linear Circuits: Analysis and Synthesis" Oxford University Press, 2005.


## BEE-253 ELECTRICAL MACHINES-II

**Course category** : Program Core (PC)
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :2
**Number of Credits** **:** 5

**Course Assessment Methods** : Continuous assessment through tutorials, assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to learn basic concept of design, working & performances of three phase AC Machines as Generator.
2. Ability to solve theoretical & numerical problems related with three phase AC Machines as Generator.
3. Ability to learn basic concept of design, working & performances of three phase AC Machines as Motors.
4. Ability to solve theoretical & numerical problems related with three phase AC Machines as Motors.
5. Ability to know constructional details, working principle & Performances of Single-Phase AC Machines
6. Ability to understand working, characteristics & applications of Special Electrical Machines (Universal Motor, AC series motor, Hysteresis Motor, Reluctance Motor)

**Topic Covered**

**UNIT-I** **9**

**Synchronous Generators:**

Constructional features, types and working of AC generator, EMF Equation, Armature reaction, O. C. & S. C. tests, Voltage Regulation, and calculations of voltage regulation by different methods, Parallel Operation of synchronous generators, synchronization of ac generators, synchronizing power, concept of $X_d$, and $X_q$.

**UNIT-II** **9**

**Synchronous Motors:**

Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating Characteristics, Synchronous Motor**,** power flow and torque equation, Effect of varying field current at different loads, V- Curves, Hunting, damper windings, synchronous condenser, and application of synchronous motor

**UNIT-III** **9**

**Three phase Induction Machine:**

Constructional features, rotating magnetic field, working principle, Phasor diagrams, equivalent circuits, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, losses, efficiency, starting methods, various speed control techniques, Deep bar and double cage type rotors, Cogging & Crawling effects, Induction generator, applications.

**UNIT-IV** **9**

**Single phase Induction Motor:**

Double revolving field theory, Equivalent circuits, no load and blocked rotor tests, Starting methods, types of single-phase induction motors, Repulsion motor, Universal motor, A.C. series motor, hysteresis motor

**List of Experiments**

**(Note:** Minimum 8 experiments are to be performed**)**

1. To perform no load and blocked rotor tests on a three-phase squirrel cage induction motor and determine equivalent circuit.
2. To perform load test on a three-phase induction motor and draw: Torque -speed characteristics
3. To perform no load and blocked rotor tests on a single-phase induction motor and determine equivalent circuit parameters and efficiency.
6. To study of speed control of three phase induction motor by (i) pole changing (ii) Supply voltage and (iii) frequency control method
7. To study speed control of three phase slip ring induction motor by rotor emf injected method.
8. To perform open circuit and short circuit tests on a three-phase alternator and determine voltage regulation at full load and at unity, 0.8 lagging by (i) Synchronous Impedance method and (ii) MMF method.
9. To perform V-curves and inverted V-curves of a three-phase synchronous motor.
10. To determine $X_d$ and $X_q$ of a three-phase salient pole synchronous machine using the slip test and draw the power-angle characteristics.
11. To study synchronization of an alternator with the infinite bus by using: dark lamp method (ii) two bright and one dark lamp method.
13. To study speed-torque characteristics of three phase slip ring induction motor and effects of additional resistance, or capacitance in the rotor circuit.
14. To study VSI based slip power recovery scheme of three phase induction motor
15. To study performances of three phase Induction Generator.

**Textbooks:**

1. D. P. Kothari & I. J. Nagrath, "Electric Machines", Tata McGraw Hill
2. Ashfaq Hussain "Electric Machines" Dhanpat Rai & Company
3. Fitzerald, A.E., Kingsley and S. D. Umans "Electric Machinery", MC Graw Hill.

**Reference Books:**

4. P. S. Bimbhra, "Electrical Machinery", Khanna Publisher
5. P.S. Bimbhra, "Generalized Theory of Electrical Machines", Khanna Publishers
6. M. G. Say, "Alternating Current Machines", Pitman& Sons

## BEE-254 POWER SYSTEM-1

**Course category** : Program Core (PC)
**Pre- requisites** : NIL
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.
**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course
The student will be able to demonstrate:

1. Basic Layout of power system.
2. The concept of supply system.
3. The analysis of O/H Transmission lines
4. The understanding of EHVAC & HVDC Transmission lines.
5. The Corona, insulator, neutral grounding & mechanical design of Transmission line.
6. Able to design mechanical & electrical aspects of transmission lines.

**Topic Covered**

**UNIT I** **9**

**Power System Components:**

Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator

**Supply System:**

Different kinds of supply system and their comparison, choice of transmission voltage

**Transmission Lines:**

Configurations, types of conductors, resistance of line, skin effect, Kelvin's law. Proximity effect

**UNIT II** **9**

**Over Head Transmission Lines:**

Calculation of inductance and capacitance of single phase, three phase, single circuit and double circuit transmission lines, Representation and performance of short, medium and long transmission lines, Ferranti effect. Surge impedance loading

**EHV AC and HVDC Transmission:**

Introduction to EHV AC and HVDC transmission and their comparison, use of bundle conductors, kinds of DC links, and incorporation of HVDC into AC system

**UNIT III** **9**

**Corona and Interference:**

Phenomenon of corona, corona formation, calculation of potential gradient, corona loss, factors affecting corona, methods of reducing corona and interference. Electrostatic and electromagnetic interference with communication lines

**Overhead line Insulators:**

Type of insulators and their applications, potential distribution over a string of insulators, methods of equalizing the potential, string efficiency

**Insulated cables:**

Type of cables and their construction, dielectric stress, grading of cables, insulation resistance, capacitance of single phase and three phase cables, dielectric loss, heating of cables

**UNIT IV** **9**

**Mechanical Design of transmission line:**

Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration, Dampers

**Electrical Design of Transmission Line:**

Design consideration of EHV transmission lines, choice of voltage, number of circuits, conductor configuration, insulation design, selection of ground wires.

**Neutral grounding:**

Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices

**Textbooks**

1.W. D. Stevenson, "Element of Power System Analysis", McGraw Hill,

2.C. L. Wadhwa, "Electrical Power Systems" New age international Ltd. Third Edition

3.AsfaqHussain, "'Power System", CBS Publishers and Distributors,

4.B. R. Gupta, “Power System Analysis and Design” Third Edition, S. Chand & Co.
5.M. V. Deshpande, “Electrical Power System Design” Tata McGraw Hill.

**Reference Books**

6.M. V. Deshpandey, “Elements of Power System Design”, Tata McGraw Hill,
7.Soni, Gupta &Bhatnagar, “A Course in Electrical Power”, Dhanpat Rai& Sons,
8.S. L. Uppal, “Electric Power”, Khanna Publishers
9. S.N. Singh, “Electric Power Generation, Transmission& distribution.” PHI Learning

## BEE-255 SIMULATION TECHNIQUES

| | |
|---|---|
| **Course category** | Program link basic science and engineering courses (PLBSE) |
| **Contact hours/week** | Lecture: 0, Tutorial: 0, Practical: 4 |
| **Number of Credits** | 2 |
| **Course Assessment Methods** | Continuous assessment through attendance, two Viva-voce, Practical work/record, and Major Practical Examination. |
| **Course Outcome** | The students are expected to be able to demonstrate the following knowledge, skills and attributes after completing this course. |

1. To gain knowledge on MATLAB software and its basic functions.
2. To acquire the knowledge & application of numerical technique in MATLAB functions.
3. To develop the MATLAB programming skill.
4. With the above knowledge/skill, students will be able to solve simultaneous linear equations, differential equations etc., applied in the electrical circuit solutions.
5. To develop and verify the concepts of various complex electrical engineering problems using MATLAB software.
6. Able to design simulation models in SIMULINK for electrical circuits.

**(Note:** Minimum 8 experiments are to be performed**)**

**MATLAB Based Experiments**

1. Solution of linear equations for under damped and over damped cases.
2. To study the usefulness of MATLAB toolboxes.
3. To study the usefulness of Simulink Models.
4. To study the Optimization based toolboxes.
5. Determination of Eigen values and eigenvectors of a square matrix.
6. Determination of roots of a polynomial.
7. Determination of polynomial using method of least square curve fitting.
8. Determination of polynomial fit, analyzing residuals, exponential fit and error bounds from the given data.
9. Solution of differential equations using 4th order Runge-Kutta method.
10. Solution of differential equation using revised Euler method.
11. Solution of difference equations.
12. Determination of time response of an R-L-C circuit.
13. Demonstration of feedback system using Simulink Models.

14. Design the Simulink model for DC motor.
15. Design the Simulink model of electrical circuits.

**Text/Reference Books:**

**1.** Amos Gilat, "MATLAB: An Introduction with Applications" Wiley India Ltd., 2004.
**2.** R. P. Singh, "Getting Started with MATLAB" Oxford University Press, 2002.

| **SEE-211** | **SCIENTIFIC COMPUTING USING MATLAB** |
|---|---|
| **Course Category** | : Departmental Minor-1 (DM1) |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : 4 |
| **Course Assessment Methods** | : Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : This course provides the knowledge and understanding to handle research projects using numerical techniques and able to solve differential equations using MATLAB. |
| **Course Outcome** | : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

1. Understand the need for simulation/implementation for the verification of mathematical functions.
2. Understand the main features of the MATLAB environment to enable their usage in the higher learning.
3. Implement simple mathematical functions/equations in numerical computing environment such as MATLAB.
4. Interpret and visualize simple mathematical functions and operations thereon using plots/display.
5. Analyze the program for correctness and determine/estimate/predict the output and verify it under simulation environment using MATLAB tools.
6. Able to solve ordinary differential equations.

**Topics Covered**

**Unit I** **9**

Introduction to MATLAB, Error estimation and methods of roots finding, Order of convergence of various methods.

**Unit II** **9**

Solving System of Linear Algebraic equations, Continuing Solving System of Linear Algebraic equations, Curve fitting and Interpolation.

**Unit III** **9**

Continuing Curve fitting and Interpolation, Continuing Curve fitting and Interpolation, Numerical differentiation.

**Unit IV** **9**

Numerical Integration, Numerical solution to ordinary differential equations (ODE's), Continuing with numerical solution to ODE's.

**Textbooks:**

1. Programming with MATLAB for Scientists: A Beginner's Introduction, E. Mikhailov Eugeniy, CRC Press; 1st edition, February 2, 2018.
2. MATLAB An Introduction with Applications, Rao V. Dukkipati, New Age International Publisher.

**SEE-221 ENERGY MANAGEMENT**

**Course Category** : Department Minor-2 (DM2)
**Pre-requisite Subject** : NIL
**Contact hours/week** : Lecture: 3, Tutorial:1, Practical: 0
**No of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination.
**Course Objectives** : To learn & apply energy engineering management skills in practical problems for efficient energy management.
**Course Outcome** : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. General Principles of Energy Management, Skills, Strategy& Energy Conservation Technology.
2. Energy system economics, policies & laws.
3. Students will be able to apply the knowledge of the subject to calculate the efficiency of various thermal utilities.
4. Students will be able to design suitable energy monitoring system to analyze and optimize the energy consumption in an organization.
5. Students will be able to improve the thermal efficiency by designing suitable systems for heat recovery and co-generation.
6. Students will be able to use the energy audit methods learnt to identify the areas deserving tighter control to save energy expenditure.

**Topic Covered**

**Unit I** **9**

Introduction, Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Conservation Technology, General principles of Energy Auditing and Survey Instrument, Energy System Economics, Policies and Laws.

**Unit II** **9**

Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

**Unit III:** **9**

Energy & Power supply technology and systems in residential and tertiary sector, transport and, industrial sectors.

**Unit IV:** **9**

Electrical utilities technology and operation, Total Energy Systems, Energy efficiency, energy efficient devices etc.

**Textbooks:**


3. "Energy Engineering and Management," Amlan Chakrabarti, Printice Hall of India, 2011.
4. "Indian Industry: Energy Management," R. M. Gedam, Anmol Publication, 1999.


**SEE-231** **Introduction to Power Electronics**

| | | |
|---|---|---|
| **Course Category** | : | Department Minor-3 (DM3) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 2 |
| **No of Credits** | : | 5 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | To learn & apply energy engineering management skills in practical problems for efficient energy management. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

CO1: Competency in function of various power Semiconductor devices
CO2: To Analysis the operation and construction of Thyristor
CO3: The concept and working principle of Controlled DC-DC Supply
CO4: The analysis of Controlled AC-AC regulated Supply.
CO5: The concept and working principle of Controlled AC-DC Supply
CO6: The analysis of Controlled DC-AC Inverter.

**UNIT 1:**

**Introduction of Power Electronics:** (Lecture 9)

Concept of Power Electronics, Application of power electronics, Advantage and Disadvantage of Power Electronics Converter, Power Electronics System, Power Semiconductor Devices, Their Symbols, Rating, application and static characteristics, Types of power electronics converters.

**UNIT 2.**

**Introduction of Thyristor:** (Lecture 9)

Operation and construction of Thyristor, Static V-I characteristics of Thyristor, Thyristor gate characteristics, Thyristor rating, Thyristors Protection, Heating, cooling and mounting of Thyristor, Improvement of Thyristor characteristics, Types of Thyristors, and its symbol, Thyristor turn-on method, Firing Circuit.

**UNIT 3.** (Lecture 9)

**Controlled DC Supply:**

Principle of Phase control: Principle of Single phase-Half Wave Rectifier, Application, Circuit diagram, voltage, and current waveform, Voltage and phase angle relationship, Principle of Single Phase-Full-Wave Rectifier, application, Circuit diagram, voltage, and current waveform, voltage and phase angle relationship. Principle of Chopper operation, Control Strategies.

**UNIT 4.** (Lecture 9)

**Controlled AC Supply:**
Principle of Single-phase Full Bridge voltage source inverters, application, Circuit diagram, voltage, and current waveform, External Control of AC Output Voltage, External Control of DC Output Voltage, Internal voltage control of inverter, Operation of single-phase AC Voltage Controller, Circuit diagram, voltage, and current waveform, Principal operation single phase to single phase cyclo-converters, Circuit diagram, voltage, and current waveform, application of AC-AC Converter.

**Lists of Experiment**

1. To draw the V-I characteristics of SCR
2. To draw latching and holding currents of SCR.
3. To draw the relevant waveform for triggering Waveform of MOSFET.
4. To draw the relevant waveform for triggering Waveform of IGBT.
5. To draw the relevant waveform for triggering Waveform of Power transistor.
6. To draw the relevant waveform for single phase fully controlled bridge rectifiers with resistive Load.
7. To draw the relevant waveform for single phase ac voltage regulator with resistive load.
8. To draw the relevant waveform for single phase ac voltage regulator with resistive loads.
9. To draw the relevant waveform for operation of MOSFET based chopper circuit.
10. To draw the relevant waveform for MOSFET based single phase bridge inverter.

**References**


1. Ned Mohan, Tore M, Undeland, William P, Robbins (3 Edition), "Power Electronics: Converters, Applications and Design," Wiley 2002.
2. M H Rashid, Power Electronics -Circuits, Devices and Applications; PHI, New Delhi.
3. M.D. Singh and K.B. Khanchandani "Power Electronics" Tata McGraw Hill,2005
4. P.S. Bimbhra "Power Electronics" Khanna Publisher, New Delhi, 2010.
5. Chakrabarti & Rai "Fundamental of Power Electronics & Drives" Dhanpat Rai & sons.


| **BHM-302/352** | **INDUSTRIAL MANAGEMENT** |
|---|---|
| **Course category** | : BHM |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | : 2 |
| **Course Assessment methods** | : Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination |
| **Course Objectives** | The course is aimed to develop the mathematical skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints. |

**Course Outcomes** : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will become efficient and acquire acumen for more profitable business practices.
2. Students will understand the importance of better customer service and product quality.
3. Able to make work safer, faster, easier, and more rewarding.
4. Able to help the industry in the production of more products that possess all utility factors
5. Reducing costs associated with new technologies.
6. Able to understand different principle of Industrial Management.

**Topics Covered**

**UNIT-I** 6

**Introduction of Modern Management:** Definition, Nature and Scope of Management, Process of Management, Elements of Management, Definition of Industrial Management, Scope and Application of Industrial Management.

**Plant Location and Layout**: Factors affecting Plant Location, Objectives and Principles of Plant Layout, Types of Plant-Layout

**UNIT-II** 6

**Work Analysis and Measurement**: Design of work Study, Steps involved in Work-study process, Definition and Concept of Method study, Procedure involved in Method Study, Objectives and techniques of Work Measurement, Work -sampling and its application, Selection of Personnel and wage payment plans.

**UNIT-III** 6

**Organizational Structures:** Types of organizations, Functions, and objectives of industrial organizations, Ownership of Industries; Proprietorship, Partnership, Joint-stock companies, Public and Private undertakings, Co-operative organizations. Sources of finance, Types of Bank accounts.

**UNIT-IV** 6

**Material Management**: Meaning of Inventory management, Economic Order Quantity (EOQ) Model, ABC analysis, Just-in-time (JIT), Minimum Safety Stock

**Industrial Safety:** Occupational safety, safety programs; Safety aspects in work system design

**Text & Reference books:**


1. P. Crowson. Economics for Managers, Macmillan, London.
2. J. Russell (Joseph Russell) Smith, "The Elements of Industrial Management", Hard Press
3. Rieske, David W., Asfahl and C. Ray, "Industrial Safety and Health Management", 6th Ed., Prentice Hall Professional Technical Ref.
4. Gavriel Salvendy, "Handbook of Industrial Engineering: Technology and Operations Management", John Wiley & Sons, Inc.
5. Herman B. Henderson, Albert E. Haas, "Industrial Organization and Management Fundamentals", Industrial Press, The University of California.


**BEE-301 POWER SYSTEM-II**

**Course category** **:** Program Core (PC)
**Pre- requisites** : Nil

**Contact hours/week** : Lecture: 3, Tutorial: 0 , Practical :2
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.
**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.
The student will be able to demonstrate:

1. The L and C expressions for various configurations and analyze different types of Transmission lines
2. The Traveling wave theory and derive expressions for reflection and refraction coefficients with various terminations of the lines
3. The analysis symmetrical as well as unsymmetrical faults.
4. Load flow analysis.
5. The concept of Power system stability.
6. Describe travelling wave and transients in power system.

**Topic Covered**

**UNIT-I**

**Representation of Power System Components**: **9**

Synchronous machines, Transformers, Transmission lines, One line diagram, Impedance and reactance diagram, per unit System

**Symmetrical components, Symmetrical & Unsymmetrical faults:**

Symmetrical Components of unbalanced phasors, power in terms of symmetrical components, sequence impedances and sequence networks. Transient in R-L series circuit, calculation of 3-phase short circuit current and reactance of synchronous machine, internal voltage of loaded machines under transient conditions

Analysis of single line to ground fault, line-to-line fault and Double Line to ground fault on an unloaded generators and power system network with and without fault impedance.

Formation of Zbus using singular transformation and algorithm, computer method for short circuit calculations

**Unit-II**

**Load Flows**: **9**

Introduction, bus classifications, nodal admittance matrix ( BUS Y ), development of load flow equations, load flow solution using Gauss Siedel and Newton-Raphson method, approximation to N-R method, line flow equations and fast decoupled method

**Unit-III**

**Power System Stability**: **9**

Stability and Stability limit, Steady state stability study, derivation of Swing equation, transient stability studies by equal area criterion and step-by-step method. Factors affecting steady state and transient stability and methods of improvement

**Unit-IV**

**Traveling Waves**: **9**

Wave equation for uniform Transmission lines, velocity of propagation, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewlay's lattice diagram, protection of equipments and line against traveling waves

**List of Experiments**

**(A) Hardware Based:**

1. To determine direct axis reactance (xd) and quadrature axis reactance (xq) of a salient pole alternator.
2. To determine fault current for L-G, L-L, L-L-G and L-L-L faults at the terminals of an alternator at very low excitation
3. To study the IDMT over current relay and determine the time current characteristics
4. To study percentage differential relay
5. To study Impedance, MHO and Reactance type distance relays
6. To determine location of fault in a cable using cable fault locator
7. To study ferranty effect and voltage distribution in H.V. long transmission line using transmission line model.
8. To study operation of oil testing set.

**Simulation Based Experiments (using MATLAB or any other software)**

9. To determine transmission line performance.
10. To obtain steady state, transient and sub-transient short circuit currents in an alternator
11. To obtain formation of Y-bus and perform load flow analysis
12. To perform symmetrical fault analysis in a power system
13. To perform unsymmetrical fault analysis in a power system

**Textbooks:**

1. W.D. Stevenson, Jr. "Elements of Power System Analysis", McGraw Hill.
2. C.L. Wadhwa, "Electrical Power System", New Age International.
3. Chakraborthy, Soni,Gupta & Bhatnagar, "Power System Engineering", Dhanpat Rai& Co.
4. T.K Nagsarkar & M.S. Sukhija, "Power System Analysis" Oxford University Press,2007.

**Reference Books**:

5. L. P. Singh; "Advanced Power System Analysis & Dynamics", New Age International
6. Hadi Sadat; "Power System Analysis", Tata McGraw Hill.
7. D. Das, "Electrical Power Systems" New Age International, 2006.
8. J.D. Glover, M.S. Sharma & T.J.Overbye, "Power System Analysis and Design" Thomson, 2008.
9. P.S.R. Murthy "Power System Analysis" B.S. Publications,2007.
10. Stagg and El-Abiad, "Computer Methods in Power System Analysis" Tata McGraw Hill
11. Kothari & Nagrath, "Modern Power System Analysis" Tata Mc. Graw Hill.

**BEE-302 CONTROL SYSTEM ENGINEERING**

**Course category** **:** Program Core(PC)
**Pre- requisites** **:** Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :2
**Number of Credits** **:** 5
**Course Assessment** **:** Continuous assessment through tutorials, assignments,

**Methods** attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

The student will be able to demonstrate:

1. Apply the basic control systems engineering principles of modelling, analysis, and design to simple control systems.
2. Identify the various control system components and their representations.
3. Apply the concepts of various system stability criterions.
4. Analyze the various time domain parameters.
5. Apply the concepts of various system stability criterions.
6. Able to design compensators.

**Topic Covered**

**UNIT I**

**Control System Introduction and Mathematical Modelling: 9**

Open loop & closed control; servomechanism; Mathematical modelling of physical systems; Transfer functions, Block diagram algebra, Signal flow graph, Mason's gain formula, Reduction of parameter variation and effects of disturbance by using negative feedback.

**UNIT II**

**Control System Components: 9**

Constructional and working principles of AC & DC servomotors, stepper motor, and synchros, error detectors. Basic control actions: proportional (P), integral (I), derivative (D), and PID controllers.
Concept of Stability: Stability concepts, algebraic criteria, and necessary conditions, Routh-Hurwitz criteria and limitations.

**UNITIII**

**Time Response analysis: 9**

Standard test signals, time response of first and second order systems, time response specifications, steady state errors and error constants.
Design specifications of second order systems: Derivative error, derivative output, integral error and PID compensations, design considerations for higher order systems, performance indices. Root Locus Technique: The root locus concepts, construction of root loci.

**UNIT-IV**

**Frequency response Analysis: 9**

Frequency response, correlation between time and frequency responses, polar and inverse polar plots, Bode plots.
Stability in Frequency Domain: Nyquist stability criterion, assessment of relative stability, gain margin and phase margin, constant M&N circles

**List of Experiments**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Study Metaldyne cross-field generator. Determine its transfer function.
2. Determine transfer function of dc generator. Study behavior of dc generator in open loop and closed loop conditions at various loads.
3. Determine transfer function of dc motor. Study behavior of dc motor in open loop and closed loop conditions at various loads.

4. Study DC position control system and determine speed-torque characteristics of ac servomotor.
5. Study AC position control system and determine speed-torque characteristics of ac servomotor.
6. Study PID control using linear simulator unit and determine step input response of first order and second order systems.
7. Study synchros. Determine synchros-transmitter characteristics. Configure synchro-transmitter and synchro-control transformer unit as error detector and obtain output vs input characteristics.
8. Study stepper motor from its characteristics and applications point of view.

**References:**


1. I. J. Nagrath and M. Gopal, "Control System Engineering", 4th Edition, New age International.
2. M. Gopal, "Control Systems: Principles and Design", Tata McGraw-Hill Education, 2002.
3. K. Ogata, "Modern Control Engineering", Pearson Education, 4th Indian reprint.
4. B.C. Kuo and Farid Golnaraghi, "Automatic Control System" Wiley India Ltd, 2008.
5. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
6. Ajit K. Mandal, "Introduction to Control Engineering" New Age International, 2006.


**BEE-303 Power Electronics**

**Course category** **:** Program Core (PC)
**Pre- requisites** **:** Nil
**Contact hours/week** : Lecture : 3, Tutorial :1, Practical :2
**Number of Credits** **:** 5
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcomes:** The students are expected to be able to demonstrate the following knowledge, skills and attitude after completing this course.

1 The working principle of various Power semiconductor devices.
2 The concept of phase-controlled converters.
3 The analysis of inverters in various configuration and elimination of harmonics.
4 The concepts of DC choppers, for various applications.
5 The concepts of AC voltage controllers for various applications.
6 The concepts of Cyclo converters for various applications

**Topics Covered**

**Unit-I** **9**

**Power Semiconductor Devices:**

Power semiconductor Devices, their symbols, rating and static characteristics, Operation of Power Diode, Power MOSFET, IGBT, GTO, and TRIAC, Thyristor operation, V-I characteristics of Thyristor, Switching characteristics of Thyristor, Two transistor model of thyristor, Thyristor turn-on method, Thyristors Protection, Series, and parallel operation of thyristors.

**Unit-II** **9**

**Modelling of DC-DC supply:**

DC-DC Converters: Operation of Buck Converter, Voltage and Current relationship, Output Voltage Ripple equation, Design considerations, Operation of Boost Converter, voltage and current relationship, Output Voltage Ripple, Impact of Inductor resistance on output voltage equation, Design considerations.

**Unit-III** **9**

**Modelling of AC-DC supply:**

Single phase half wave-controlled rectifier with resistive and inductive loads, effect of freewheeling diode, single phase fully controlled and half controlled bridge converters, performance parameters, three phase fully controlled bridge converters, effect of source impedance, single phase dual converters.

**Modelling of AC-AC supply:**

Principle operation of single phase to single phase cyclo-converters; Types and configuration of cyclo-converters, output voltage equation.

**Unit-IV** **9**

**Modelling of DC-AC supply:**

Operation Of Single-phase half and full Bridge Voltage Source inverters, Fourier Analysis of Single-phase inverter output voltage, Voltage control in single phase inverter, Pulse width modulated inverters, harmonics reduction techniques in inverter output voltage, Operation of Three Phase Bridge 120- and 180-degree mode operation.

**Modelling of AC-AC Voltage Controllers:**

Principle of on-off and phase control, Operation of single-phase AC Voltage Controller for Resistive load and Resistive with inductive loads, Sequence Control of AC voltage controller.

## Experiments:

**(Note:** Minimum 8 experiments are to be performed**)**

1. To study V-I characteristics of SCR and measure latching and holding currents.
    a. 2 To study UJT trigger circuit for half wave and full wave control.
    b. 3 To study single phase half wave-controlled rectifier with (i) resistive load, (ii) inductive load with and without freewheeling diode.
2. To study single phase (i) fully controlled (ii) half-controlled bridge rectifiers with resistive and inductive loads
3. To study three phases fully /half-controlled bridge rectifier with resistive and inductive loads.
4. To study single phase ac voltage regulator with resistive and inductive loads.
5. To study single phase cyclo converter
6. To study triggering of (i) IGBT, (ii) MOSFET, & (iii) Power transistor
7. To study operation of IGBT/MOSFET chopper circuit.
8. To study MOSFET/IGBT based single phase series resonant inverter
9. To study MOSFET/IGBT based single phase bridge inverter.

## BOOKS &REFERENCES


1. M. H. Rashid, “Power Electronics Circuits, Devices & Application” Prentice Hall of India Ltd. 4th Edition 2018.
2. M.D. Singh and K.B. Khanchandani, “Power Electronics” Tata McGraw Hill,2005
3. V.R. Moorthy “Power Electronic Devices circuits and Industrial Applications” Oxford University Press, 2007
4. P.S. Bimbhra “Power Electronics” Khanna Publisher, New Delhi, 2010.

5. Chakrabarti & Rai "Fundamental of Power Electronics & Drives" Dhanpat Rai & sons.

**BEE-326 POWER PLANT ENGINEERING**

**Course category** **:** Program Elective (PE1)
**Pre- requisites** : Nil
**Contact hours/week** **:** Lecture: 3, Tutorial: 1, Practical: 0
**Number of Credits** : 4
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Discuss and analyze the mathematical and working principles of different electrical equipments involved in the generation of power.
2. The concept of conventional & non-conventional source of energy.
3. The general layout, principle, working & performance of a steam power plant.
4. Analyze the working of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.
5. The general layout, principle, working & performance of a Hydro-electric power plant.
6. The general layout, principle, working & performance of a Diesel power plant.

**Topic Covered**

**UNIT I**

**Introduction:** **9**

Power and energy, sources of energy, fuels, energy stored in water, nuclear energy, wind energy, solar energy, tidal power, thermo-electric power, Geothermal energy Load estimation, load curves, Selection of power plant units, Power plant economics, Effect of plant type on costs, rates

**UNIT II**

**Steam Power Plant:** **9**

Classification of steam power plant, general layout of steam power plant, Power plant boilers, Coal handling system, pulverisers and coal burners, combustion system, ash handling system, Steam turbines, steam condensers, dust collection system, Feed water treatment, Steam turbines, auxiliary systems, governing, reheating, Operation and maintenance of steam power plant, Site selection of a steam power plant.

**UNIT III**

**Hydro-Electric Power Plant:** **9**

General layout, site selection for hydro-electric plant, classifications of hydro-electric power plants, hydro plant auxiliaries, Hydraulic turbines, types of turbines, performance of hydraulic turbines, governing operation, hydro plant control, combined hydro and steam power plants, safety measures and preventive maintenance of hydro-plant, hydro-power development in India

**UNIT IV**

**Diesel Power Plant:** **9**

General layout, Components of Diesel power plant, site selection, heat engines, classifications of I.C engines, Performance of diesel power plant, fuel system, lubrication system, air intake system,

exhaust system, Comparative study of diesel engine and petrol engine, merits and demerits of diesel power plants, applications of diesel power plant

**References**

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. "Power System Engineering" R.K Rajput, Laxmi Publication Ltd. New Delhi
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill. New Delhi

## BEE-327 HIGH VOLTAGE ENGINEERING

**Course category** : Program Elective (PE1)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The concepts of break down in gases, solids & liquids with numerical calculation.
2. Understand the phenomena involved in non-destructive insulation and testing as well as over voltages in power systems.
3. The concept of generation & measurement of high voltages & currents.
4. Understand electric fields and field stress control around high voltage systems
5. The concept of various high voltage testing.
6. Understand the generation and measurement of high voltages

**Topic Covered**

**UNIT I**

**Break Down In Gases: 9**

Ionization processes, Townsend's criterion, breakdown in electronegative gases, time lags for breakdown, streamer theory, Paschen's law, break down in non-uniform field, breakdown in vacuum.

**Break Down In Solid & Liquid Dielectrics:**

Classification of liquid dielectric, characteristic of liquid dielectric, breakdown in pure liquid and commercial liquid. Intrinsic breakdown, electromechanical breakdown, breakdown of solid, dielectric in practice, breakdown in composite dielectrics.

**UNIT II**

**Generation of High Voltages and Currents: 9**

Generation of high direct current voltages, generation of high alternating voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

**UNIT III**

**Measurement of High Voltages and Currents: 9**

Measurement of high direct current voltages, measurement of high alternating and impulse voltages, measurement of high direct, alternating and impulse currents, Cathode Ray Oscillographs for impulse voltage and current measurements.

**UNIT IV**

**Non-Destructive Testing: 9**

Measurement of direct current resistively, measurement of dielectric constant and loss factor, partial discharge measurements

**High Voltage Testing:**

Testing of insulators and bushings, testing of isolators and circuit breakers, testing of cables, testing of transformers, testing of surge arresters, radio interference measurements.

**Textbook:**

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering, Tata Mc-Graw Hill.

**Reference Books:**

2. E. Kuffel and W. S. Zacngal, High Voltage Engineering", Pergamon Press.
3. M. P. Chaurasia , "High Voltage Engineering", Khanna Publishers
4. R. S. Jha, "High Voltage Engineering", Dhanpat Rai& sons
5. C. L. Wadhwa, "High Voltage Engineering", Wiley Eastern Ltd.
6. M. Khalifa,' High Voltage Engineering Theory and Practice,' Marcel Dekker.
7. Subir Ray,' An Introduction to High Voltage Engineering' Prentice Hall of India

## BEE-328 INTELLIGENT INSTRUMENTATION

**Course category** **:** Program Elective (PE1)
**Pre- requisites** : Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The concepts of intelligent instrumentation system.
2. The concept of signal processing, manipulation & transmission.
3. The concept of Smart Sensors, Interfacing Instruments & Computers.
4. Recognize the type of the control system and to express the transfer function of the system.
5. Analyse the time response of various order of the system.
6. Recent trends in sensor technology.

**Topic Covered**

**UNIT I**

**Introduction: 9**

Intelligence features characterizing intelligence, intelligent instrumentation system; features of intelligent instrumentation; components of intelligent instrumentation system; Block diagram of an intelligent instrumentation system.

**UNIT II**

**Signal Processing, Manipulation and Transmission: 9**

Signal amplification & attenuation (OP-AMP based); Instrumentation Amplifier (circuit diagram, high CMRR & other features); Signal Linearization (different types such as Diode-resistor combination, OP-AMP based, etc); Bias Removal, Signal filtering (outputs from ideal filters, outputs from constant-k filters, matching of filter sections active analog filters); OP-AMP based Voltage-to-current converter, Current-to-voltage conversion, Signal integration, Voltage follower (pre-amplifier), voltage comparator Phase locked loop, Signal addition, Signal multiplication, Signal Transmission (Signal amplification, Shielding, Current loop transmission, Voltage-to-frequency conversion, Fiber optic transmission).

**UNIT III**

**Smart Sensors, Interfacing Instruments & Computers**: **9**

Nonlinearity: took up table method, polygon interpolation, polynomial interpolation, cubic spline interpolation, Approximation & regression; Noise & interference; Response time; Drift; Cross-sensitivity; Basic issues of interfacing; Address decoding; Data transfer Control; A/D converter; D/A converter, Sample & hold circuit; Other interface considerations.

**UNIT IV**

**Recent Trends in Sensor Technologies: 9**

Introduction; Film sensors (Thick film sensors, thin film sensors); Semiconductor IC technology-standard methods; microelectro-mechanical systems (Micro-machining, some application examples); Nano-sensors.

**Textbook:**

1. Barney, G.C. Intelligent Instruments. Hemel Hempstead: Prentice Hall, 1985.
2. Alan S. Morris, Principles of Measurement& instrumentation. N. Delhi; PHI Pvt. Ltd., 1999.

**Reference Book:**

1. D. Patranabis, Sensors & Transducers N. Delhi: 2003.
2. Roman Kuo, Introduction to Digital Signal Processing. N. York: McGraw-Hill Pub, Co.

## BEE-304 MICROPROCESSOR: ARCHITECTURE, PROGRAMMING AND INTERFACING

**Course Category** : Program link basic science and engineering courses (PLBSE)
**Pre requisite Subject** : NIL
**Contact hours/week** : Lecture: 3 Tutorial: 0 Practical: 2
**Number of credits** : 4

**Course Assessment methods:** Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Objective:** The students should be able to use and apply

1. The hardware knowledge of 8085 microprocessor

2. The programming skill on 8085 microprocessor-based applications along with peripheral interfaces
3. The knowledge on intel 8086 microprocessor architecture and operation.

**Course Outcomes:** The students are expected to be able to demonstrate the following knowledge, skills, and attitude after completing this course.

1. Microcomputer systems and its associated hardware
2. Detailed architecture of the Intel 8085microprocessor.
3. Operation and control, instruction set and interrupts of the microprocessor
4. Assembly language programming with the 8085 microprocessors
5. Intel 8255 and 8254 peripheral interfaces
6. Architecture and operation of the intel 8086 microprocessor.

**Unit-I** **9**

**Introduction to Microcomputer Systems and Hardware:** History of Computers, Computer Languages, Large computers to Single-Chip-Microcomputers, Evolution of Microprocessors, Microprocessor Architecture and Its operations, memory, Input/Output, Interfacing Devices.
**8085 Microprocessor:** Pin configuration, internal architecture, control and status signals, interrupts, bus timings, de-multiplexing of address bus, generating control signals, ALU, Flag register.

**Unit-II** **9**

**Operation and Control of Microprocessor:** Decoding and executing an instruction-code fetch machine cycle, memory read/write machine cycles, I/O read/write machine cycles, interrupt acknowledge machine cycle, state-transition diagram.
**Instruction Set:** Addressing modes; Data transfer, arithmetic, logical, branch, stack and machine control groups of instruction set, macro-RTL and micro-RTL flow chart of few typical instructions; unspecified flags and instructions.
**Interrupts:** Interrupt structure of 8085 microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; handling multiple interrupts.

**Unit-III** **9**

**Assembly Language Programming for 8085 microprocessors:** Assembler directives, simple examples; Subroutines, parameter passing to subroutines, programming techniques with looping, counting, and indexing, counter and timing delays.
**Serial and Parallel Input and Output:** memory mapped I/O, I/O mapped I/O, Programmed I/O, Interrupt Driven I/O, DMA I/O.
**Programmable Peripheral Interface:** Intel 8255, pin configuration, internal structure of a port bit, modes of operation, bit SET/RESET feature.
**Programmable Interval Timer:** Intel 8253, pin configuration, internal block diagram of counter and modes of operation, counter read methods.

**Unit-IV** **9**

**16-bit Microprocessor:** Architecture of Intel 8086 (Bus Interface Unit, Execution Unit), register organization, memory addressing, memory segmentation, operating modes, addressing modes, instruction set, hardware and software interrupts, responses and types.

**Experiments**

| Course Learning Objective | Course outcomes |
|---|---|

| | |
|---|---|
| This subject helps student to learn the<br>• To become familiar with 8085 microprocessor training kit.<br>• To be able to write Intel 8085 microprocessor-based assembly language program.<br>• To become familiar with 8085 microprocessor software simulators | The students should be able to use and apply<br>• The Intel 8085 based microcomputer training kits/software simulator.<br>• The knowledge of the 8085 microprocessors to write typical assembly language programs<br>• The programming to the peripheral devices interfaced with the Intel 8085 based microcomputer. |

**Perform at least any ten experiments from the following:**

1.To become familiar with 8085 microprocessor training kit/software simulator and execute following programs.

- Add two 8 bit numbers stored in register B&C store result in register D.
- Subtract 8 bit data stored at memory location 402th ROM data stored at memory location 4020h .store result at memory location 4022h.
- To perform OR operation between accumulator and register B store result in register C.

2 To become familiar with 8085 microprocessor simulator and simulate following programs using simulator

- Write a program to interchange content of register B and C
- Subtract content of register E from register B.
- Complement content of accumulator and display result on output port PORT2
- Perform logical OR operation between register B and C logical AND operation between

3 write a program to transfer set of data from memory location 2050 Fh to 2060-206Fh.

4 write a program to find smallest numbers from given set of data stored at location 2040h to 2051h.

5 write a program to find negative number in given set of data stored at the location 2050h to 2051h.

6 write a program to arrange an array of data in ascending order.

7 write a program to multiply two 8 bit numbers stored at the location 2100 and 2101 .store result at memory location 2102h.

8 write a program to divide 16 bit number stored at memory location 2100h a 2101h and 2111h. Remainder at memory location 2112h.

9 write a program to convert hexadecimal number into equivalent BCD number.

10 write a program to check parity of data stored at memory location 2100. Move content EEh to register B. if parity is even and 00h if parity is odd.

11 To interface Programmable peripheral interface (PPI) IC- Microprocessor in Mode 0.

12 To generate square wave on port pin PC7 of 8255 in BSR mode.

**Text Books:**

1. Gaonkar, Ramesh S, “Microprocessor Architecture, programming and applications with the 8085” Pen ram International Publishing 5th Ed.
2. Uffenbeck, John, “Microcomputers and Microprocessors” PHI/ 3rd Edition.
3. Ray, A.K. &Burchandi, K.M., “Advanced Microprocessors and Peripherals: Architecture, Programaming and Interfacing” Tata Mc. Graw Hill.
4. Krishna Kant, “Microprocessors and Microcontrollers” PHI Learning.

**Reference Books:**

5. Brey, Barry B. “INTEL Microprocessors” Prentice Hall (India)
6. Aditya P. Mathur, “Introduction to Microprocessor” Tata McGraw Hill
7. M. Rafiquzzaman, “Microprocessors- Theory and applications” PHI
8. B. Ram, “Advanced Microprocessor & Interfacing” Tata McGraw Hill
9. Renu Singh &B.P.Singh, “Microprocessor and Interfacing and applications” New Age International
10. Hall D.V., “Microprocessors Interfacing” Tata McGraw Hill
11. Liu and Gibson G.A., “Microcomputer Systems: The 8086/8088 Family” Prentice Hall (India)

| | | |
|---|---|---|
| **SEE-312** | | **FUZZY SETS, LOGIC AND SYSTEMS & APPLICATIONS** |
| **Course Category** | : | Departmental Minor-1 (DM1) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | The course is designed to give a solid grounding of fundamental concepts of fuzzy logic and its applications. The level of the course is chosen to be such that all students aspiring to be a part of computational intelligence directly or indirectly in near future. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

1. Understand the basic ideas of fuzzy sets, operations, and properties of fuzzy sets.
2. Know combining fuzzy set theory with probability to handle random and non-random uncertainty, and the decision-making process.
3. Understand the basic features of membership functions, fuzzification process and defuzzification process.
4. Analyze and demonstrate the difference between crips set and fuzzy set theory.
5. Recognize fuzzy logic membership function.
6. Make applications on Fuzzy logic membership function and fuzzy inference systems.

**Topics Covered**

**Unit I: Introduction to Fuzzy Sets** **9**

Fuzzy Sets, Logic and Systems & Applications, Fuzzy Sets, Logic and Systems & Applications, Real Life Applications of Fuzzy Systems, Fuzzy Sets and Fuzzy Logic Toolbox in MATLAB, Membership Functions, Nomenclatures used in Fuzzy Set Theory, Set Theoretic Operations on Fuzzy Sets.

**Unit II: Properties of Fuzzy Sets** **9**

Introduction, Properties of Fuzzy Sets, Distance between Fuzzy Sets, Arithmetic Operations on Fuzzy Numbers, Complement of Fuzzy Sets, T-norm & S-norm Operators, Parameterized T-Norm & S-norm Operators.

**Unit III: Fuzzy Relation** **9**

Introduction to Fuzzy Relation, Operations on Crisp and Fuzzy Relations, Projection of Fuzzy Relation Set, Cylindrical Extension of Fuzzy Set, Properties of Fuzzy Relation, Extension Principle, Composition of Fuzzy Relations, Properties of Composition of Fuzzy Relations, Fuzzy Tolerance and Equivalence Relations, Linguistic Hedges and Negation/ Complement and Connectives, Concentration and Dilation & Composite Linguistic Term, Dilation and Composite Linguistic Term, Contrast Intensification of Fuzzy Sets, Orthogonality of Fuzzy Sets.

**Unit IV: Fuzzy Rules and Fuzzy Reasoning** **9**

Introduction to Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference System, Mamdani Fuzzy Model, Larsen Fuzzy Model, Tsukamoto Fuzzy Model.

**Textbooks:**


1. Ross, T. J. (2005), "Fuzzy logic with engineering applications," John Wiley & Sons.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, "Neuro-Fuzzy and Soft Computing" Prentice Hall.


**SEE-322** **SOLAR ENERGY SYSTEMS**

| | | |
|---|---|---|
| **Course Category** | : | Department Minor-2 (DM2) |
| **Pre-requisite Subject** | : | Power System-I |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 2 |
| **No of Credits** | : | 5 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, viva-voce, record, two minor test, one major theory and practical examination. |
| **Course Objectives** | : | Objective of this course is to give knowledge and develop skill of students in Solar Energy being most valuable resource of renewable energy. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course: |

1. The students will be able to know the global scenario of solar energy.
2. The students will be able to analysis the Solar PV Generation Systems.
3. The students will be able to analysis the Solar Thermal Generation Systems.
4. The students will be able to design solar systems & its applications.
5. The students will be able to know the innovative applications of solar energy
6. The students will be able to design Solar Power Plants

**Topic Covered**

**Unit I: INTRODUCTION TO SOLAR ENERGY** **9**

World energy resources, Indian energy scenario, Environmental aspects of energy utilization, Growth of solar energy: Indian and global scenario, Solar potential in India, Merit and demerit of solar energy.

**Unit II: SOLAR PV GENERATION** **9**

Principles and operation of solar cells, Types of Solar cell, Solar cell energy conversion efficiency, I-V characteristics, Historic development of solar PV system, Fundamental of solar PV system and their component, Classification of solar PV systems, Maximum power point tracking of solar PV system.

**Unit III: SOLAR THERMAL POWER GENERATION** **9**

Layout of solar thermal power plant, Classification of solar thermal energy technology: Concentrating and non-concentrating solar thermal technology, Parabolic dish collector, Power generation cycle, Hybridization of concentrated solar power.

**Unit IV: SOLAR ENERGY APLLICATION AND PRICING** **9**

Off-Grid solar lighting testing and reliability, Phase change material (PCM), Floating solar PV system, Innovative application of solar energy.

**EXPERIMENTS**

**(Note:** Minimum 8 experiments are to be performed**)**

1. To plot the V-I Characteristics of the solar cell and hence determine the fill factor.
2. Study and Analysis of Solar Radiation, Wind Speed, Rain, Humidity and Azimuth of solar site location of Gorakhpur.
3. Simulation and performance analysis of 500kW Solar power plant.
4. Study of in-campus 100kW solar power plant of MMMUT, Gorakhpur.
5. Maximum Power point Tracking using PO technique in MATLAB.
6. Maximum Power point Tracking using incremental-Conductance technique in MATLAB and comparison with PO method.
7. Design & Analysis of 100kW grid connected PV plant using MATLAB.
8. Performance analysis of Series & Parallel configuration of PV Modules using MATLAB.
9. Study of Solar Tree.
10. Study of different types of Solar PV Cells.

**Textbooks:**

1. Handbook of Solar Energy: Theory, Analysis and Applications, by G N Tiwari, Arvind Tiwari and Shyam, Energy Systems in Electrical Engineering, Springer Nature Singapore, Pte Ltd, Publisher, 2018.

*2.* Solar Photovoltaic Technology and Systems by Chetan Singh Solanki, PHI Learning Pvt Ltd. Publishers, 2013.

| **BHM-301/351** | **Engineering & Managerial Economics** |
|---|---|
| **Course category** | : Management (M) |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : Lecture: 2, Tutorial: 0, Practical: 0 |
| **Number of Credits** | : 2 |
| **Course Assessment methods** | : Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination |
| **Course Objective** | Enable students to understand the fundamental economic concepts applicable to engineering. |
| **Course Outcomes** | : 1. Students will acquire basic knowledge in Engineering Economics, which allows students to gain theoretical and empirical skill of Economics.<br>2. To develop the basic understanding of Microeconomics and Macroeconomics and its application to decision making and Managerial Economics.<br>3. Become acquainted with basic economic concepts such as demand and supply and Elasticity of Demand.<br>4. To develop a significant understanding of various concepts of cost.<br>5. To develop the ability to understand the various kinds of market structure.<br>6. To develop the ability to acquire the knowledge of National Income and its measurement. |

**Topics Covered**

**UNIT-I** 6

Introduction: Meaning, Nature and Scope of Microeconomics, Macro Economics and Managerial Economics, Decision making Process with reference to Managerial economics, Managerial Economics and its application in engineering perspective.

**UNIT-II** 6

Concepts of Demand and Supply: Demand Analysis, Law of Demand, Determinants of Demand,Elasticity of Demand: Price, Income and cross Elasticity. Uses of concept of elasticity of demand in managerial decision, Law of Supply.

**UNIT-III** **6**

Production function, Overview of cost: fixed cost, variable cost, average cost, marginal cost, opportunity cost, An over-view of Short and long run cost curves.

**UNIT-IV** **6**

Market Structure: Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, Monopoly, National Income: Concept and Measurement of National Income.

**Books & References**


1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.
2. H L Ahuja, Managerial Economics, S Chand & Co. New Delhi
3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chand Sons, New Delhi.
4. Prof. D.N. Kakkar , Managerial Economics for Engineering, PHI publication, New Delhi
5. Varshney


**BEE-351 INSTRUMENTATION ENGINEERING**

**Course category** **:** Program Core (PC)
**Pre- requisites** **:** Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :2
**Number of Credits** **:** 4
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Basic concept of instrumentation and its industrial application and working & performances of different kind of measuring instruments.
2. Ability to analyze performance characteristics of measuring instruments.
3. Ability to know, working principle & Performances of different electrical transducers.
4. Ability to understand construction, principle of operation, working and applications of waveform analyzers and spectrum analyzers, CRO and other display devices.
5. Ability to understand principle of operation of telemetry system and data acquisition system.
6. Ability to understand principle of operation of different display device and Introduction of Bio-electric signals (ECG, EEG, EMG, EOG, ERG etc.)

**UNIT I**

**Fundamentals of Instrumentation Engineering** **9**

Fundamentals of instrumentation engineering, Performance characteristics of instruments, Static Performance Characteristics, Dynamic Performance Characteristics & Environmental Performance Characteristics, Generalized input-output configuration of instrumentation, order of systems, Response of zero, first, seconds order systems, Transfer functions,

**UNIT II**

**Transducers for Measurement of Non-Electrical Quantities** **9**

Advantages of electrical transducers, definition, description, classification, characteristics, factors affecting the choice of transducers, Sensors & pick-ups. Introduction to resistive, inductive & capacitive transducers. Transducers for measurement of displacement, velocity, acceleration, force, pressure, temperature, humidity, moisture, flow and liquid level monitoring & control. Piezoelectric, Piezo-resistive, Photo voltaic, Hall effect, and fiber optics.

**UNIT III**

**Telemetry, Data Acquisition System and Recorders 9**

General telemetry system, land line & radio frequency telemetering system, transmission channels and media, receiver & transmitter, TDM &, FDM. Analog data acquisition system, Digital data acquisition system, Modern digital data acquisition system. Display devices, storage oscilloscope, Strip chart & X-Y recorders, magnetic tape & digital tape recorders.

**UNIT IV**

**Display Devices and Introduction to Bio Electric Signals 9**

LED, LCD, seven segment Display, Nixie Display devices, CRT Display, Digital storage oscilloscope (DSO), Introduction of ECG, EEG, EMG, EOG, ERG and its relevance in bio medical engineering, Role of microprocessors and computer in instrumentation engineering.

**EXPERIMENTS**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Measurement of displacement using LVDT.
2. Measurement of displacement using strain gauge-based displacement transducer.
3. Measurement of displacement using LDR.
4. Measurement of speed of motor using magnetic pickup & photoelectric pickup.
5. Measurement of speed of motor using stroboscope.
6. Measurement of load using strain gauge-based load cell.
7. Measurement of temperature by RTD.
8. Measurement of temperature by thermocouple.
9. Measurement of weight of unknown sample using inductive transducers.
10. Study of ECG Data Acquisition System.
11. Recording of 12 lead ECG signals.
12. Study of storage oscilloscope and determination of transient response of RLC circuit.
13. Study of signal conditioning circuit for any transducer
14. Study of data acquisition system using "**Lab View**" software and test all signal points
15. Measurement of sine, triangular, square wave signal of function generator and verify its frequency at 100 Hz tap point using "**Lab View**" software.

**Textbooks:**


1. A.K.Sawhney, "Advanced Measurements & Instrumentation", Dhanpat Rai& Sons
2. B.C. Nakra & K.Chaudhry, "Instrumentation, Measurement and Analysis", Tata McGraw Hill 2nd Edition.
3. Cromwell & Weibell, "Bio Medical Instrumentation and Measurement", Prentice Hall


**Reference Books:**


4. E.O. Decblin, "Measurement System – Application & design", McGraw Hill.
5. W.D. Cooper and A.P. Beltried, "Electronics Instrumentation and Measurement Techniques" Prentice Hall International

6. Rajendra Prasad, Electronic Measurement and Instrumentation Khanna Publisher
7. M.M.S. Anand, "Electronic Instruments and Instrumentation Technology" PHI Learning.

## BEE-352 PROTECTION & SWITCHGEAR

**Course category** : Program Core (PC)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture: 3, Tutorial: 0, Practical: 2
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.
**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Student gains knowledge on different Protective Equipments of Power Systems
2. Know about various protective systems- how it works and where it works?
3. Student gains knowledge on different Protective Equipments of Power Systems
4. Different applications of the relays, circuit breakers, grounding and able to understand the Recovery and Restricting effects of power system.
5. Ability to express Oil circuit Breaker, Air Blast circuit Breakers, SF6 Circuit Breaker.
6. Ability to identify DMT, IDMT type relays**.**

**Topic Covered**

**UNIT-I**

**Protective Relaying Fundamentals & Relays** **9**

Introduction to protection system and its elements, Functional Characteristics of protective relaying, Protective zones, Primary and Backup protection, desirable qualities of protective relaying, basic terminology sealing/auxiliary relay. Electromagnetic, attracted and induction type relays, thermal relay, gas actuated relay.

**UNIT-II**

**Relay Applications/Characteristics & Static Relays:** **9**

Over current relays, directional relays, distance relays, differential relay**.** Amplitude and phase comparators. Comparison between electromagnetic & static relays, classification, and description of static relays.

**UNIT-III** **9**

**Protection of Transmission Line & Power Apparatus**

Over current protection, distance protection, pilot wire protection, carrier current protection, protection of bus bar, auto re-closing. Protection scheme for power transformers, generators, and motors.

**UNIT-IV** **9**

**Circuit Breaking Theories & Circuit Breakers:**

Properties of arc, arc extinction theories, re-striking voltage transient, current chopping, resistance switching, capacitive current interruption, operating modes, selection of circuit breakers. Constructional features and operation of Air, Bulk Oil, Minimum Oil, Air Blast, $SF_6$, and Vacuum Circuit breakers, Ratings & Testing of Circuit Breakers.

**List of Experiments**

**(Note:** Minimum 8 experiments are to be performed**)**

1. To study the IDMT over current relay and determine the time current characteristics.
2. To study percentage differential relay.
3. To study Impedance, MHO and Reactance type distance relays.
4. To study the working and principle of operation of Buchholz relay.
5. To understand the protection scheme of transformer through visit to local high voltage substation and to sketch labelled schematic diagram of various type of protection of transformer.
6. To understand the protection scheme using static relaying of nearby high voltage substation through visit and to sketch labelled schematic diagram.
7. To understand the protection scheme of alternator and to sketch labelled schematic diagram of various type of protection of alternator.
8. To understand various type of neutral earthling and specifications of earthling at different substations/locations and new trends in earthling schemes (information search).
9. To identify the components of different type of circuit breakers with their specifications (through/video/manuals)
10. To study operation of oil testing set and find out the break down strength of given oil sample.

**Textbooks:**

1. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
2. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
3. B.Bhalja, R.P. Maheshwari& N. G. Chothani, Protection & Switch Gear, Oxford University Press.

**Reference Books:**

3. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", Tata Mc. Graw Hill
4. Y. G. Paithankar and S R Bhide, "Fundamentals of Power System Protection", Prentice Hall of India.
5. T.S.M Rao,"Power System Protection: Static Relays with Microprocessor Applications" Tata Macgraw Hill".
6. A.R. Van C. Warringtaon , " Protective Relays- Their Theory and Practice, Vol. I & II" Jhon Willey & Sons.

## BEE-353 DIGITAL CONTROL SYSTEM

**Course category**: Program Core (PC)
**Pre- requisites**: Control System Engineering
**Contact hours/week** : Lecture: 3, Tutorial :1 , Practical :2
**Number of Credits** **:** 5
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Representation and solution of discrete time systems in z-domain.

2. Analyze transient response, and steady state behaviour of linear discrete-time systems, analytically and numerically using tools such as MATLAB and Simulink.
3. Analysis and Design of digital control systems using state-space methods.
4. Describe and test controllability and observability of linear systems.
5. Design of controller through state feedback
6. Stability analysis of discrete time systems

**Topic Covered**

**UNIT-I**

**Signal Processing in Digital Control: 9**

Basic digital control system, advantages of digital control and implementation problems, basic discrete time signals, z-transform and inverse z-transform, modelling of sample-hold circuit, pulse transfer function, solution of difference equation by z-transform method.

**UNIT-II**

**Time Domain and Frequency Domain Analysis: 9**

Time domain performance analysis of discrete time systems, Steady state accuracy, transient response and frequency response specifications, digital compensator design using frequency response plots and root locus plots.

**UNIT-III**

**State Space Analysis and Design: 9**

State space representation of digital control system, conversion of state variable models to transfer functions and vice-versa, solution of state difference equations, controllability and observability, design of digital control system with state feedback.

**UNIT-IV**

**Stability of Discrete System: 9**

Stability on the z-plane and Jury stability criterion, bilinear transformation, Routh stability criterion on $r^{th}$ plane.

**List of Experiments**

**(Note:** Minimum 8 experiments are to be performed**)**

1. Determination of Z – transform, inverse Z - transform and Pole-zero map of discrete-time system.
2. To obtain the s-domain transfer function of a given RLC circuit and convert it into z-domain pulse transfer function.
3. To study the effects in transient response and frequency response of different methods and sampling time used in z- Transfer function.
4. To test the stability of closed –loop discrete-time system in z-plane.
5. Digital control of DC servo motor using MATLAB.
6. Computer simulation of Digital control systems through Simulink and to obtain its response.
7. To obtain the Root Locus plot of a Digital control system and comment on its stability.
8. To test the controllability and observability of a discrete time system using MATLAB.
9. To obtain the different canonical forms of a given state space models.
10. To design of digital control system with state feedback.

11. To obtain the reduced order model of a given discrete-time system.

**References:**


1. K. Ogata, "Discrete-Time Control System", Pearson Education.
2. B.C. Kuo, "Digital Control System", Saunders College Publishing.
3. M. Gopal, "Digital Control and State Variable Methods", Tata McGraw Hill.
4. S. K. Nagar and S. K. Bhardwaj, "Modern Control Systems with Advanced Topics" New age international publishers.


## BEE-376 CONVENTIONAL & CAD OF ELECTRICAL MACHINES

**Course category** : Program Elective (PE2)
**Pre- requisites** **:** Nil
**Contact hours/week** : Lecture : 3, Tutorial :0 , Practical :2
**Number of Credits** : 4
**Course Assessment methods** **:** Continuous assessment through tutorials, assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.
**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The concepts of transformer design.
2. The concept of 3-phase synchronous machines.
3. To introduce the concepts of ideal synchronous machines and poly-phase induction machines.
4. Study of special machines.
5. Able to understand the concept of IM & computer aided design.
6. Applications which will be utilized in the electrical machines with its performance and theory of operation.

**Topic Covered**

**UNITI**

**Basic Considerations:** **9**

Basic concept of design, limitations in design, standardization, modern trends in design and manufacturing techniques, Classification of insulating materials. Heating and Cooling of electrical machines. Transformer Design: Output equation design of core, yoke and windings, overall dimensions, Computation of no-load current, voltage regulation, efficiency and cooling system designs

**UNIT II**

**Design of 3-phase synchronous machines:** **9**

Output equation, specific electric and magnetic loadings, factors affecting size of machines, separation of main dimensions, Stator design, losses in stator, damper winding design, rotor design of salient pole synchronous machines, determination of OCC by design data, stator leakage reactance, rotor design of cylindrical machines

**UNIT III**

**Design of 3-phase induction machines:** **9**

Output equation, specific electric and magnetic loadings, factors affecting size of machines, separation of main dimensions, Stator design, losses in stator, Rotor design, concept of flattened flux density, no load current, Estimation of performance, construction of circle diagram from design data, stator temperature rise.

**UNIT IV**

**Computer Aided Design: 9**

Philosophy of computer aided design, advantages, and limitations. Computer aided design approaches analysis, synthesis, and hybrid methods. Concept of optimization and its general procedure. Flow charts and 'c' based computer programs for the design of transformer, dc machine, three phase induction and synchronous machines.

Core and armature design of dc machines, design of field system of dc machine

**List of Experiments:**

1. CAD of 3-phase Synchronous Machines: Design of Core, Yoke, dimensions etc.
2. CAD of 3-phase Induction Motors: Design of main dimensions, Yoke dimensions etc.
3. CAD of Transformer: Design of Core, Yoke, dimensions etc.

**Textbooks:**

1. K. Sawhney, "A Course in Electrical Machine Design" Dhanpat Rai& Sons.
2. K.G. Upadhyay, "Design of Electrical Machines" New Age International Publishers, New Delhi.

**Reference Books:**

3. M.G. Say, "The Performance and Design of AC Machines" Pitman & Sons.
4. A.E. Clayton and N.N. Hancock, "The Performance and Design of D.C. Machines" Pitman & Sons.
5. S.K. Sen, "Principle of Electrical Machine Design with Computer Programming" Oxford and IBM Publications.

## BEE-377 EHV AC & DC TRANSMISSION

**Course category** : Program Elective (PE2)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, attendance, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the concept and performance of EHV transmission line.
2. Acquire the knowledge about the properties of bundled conductors.
3. The concept of Extra High Voltage Generation, Measurement and Testing.
4. Understand the concept of HVDC Transmission and about the various scheme of converter station.
5. Understand the concept of how to control the HVDC link.

6. Understand the comparison between AC and DC transmissions Applications of HVDC transmission.

**Topic covered**

**UNIT I**

**Introduction: 9**

Need of EHV transmission, standard transmission voltage, comparison of EHV ac & dc transmission systems and their applications & limitations, mechanical design considerations of transmission lines, modern trends in EHV AC and DC transmission systems

**UNIT II**

**EHV AC Transmission: 9**

Corona effects, Corona loss formulas, audible noise – generation and characteristics, corona Pulses, generation and properties, radio interference, over voltages in EHV system caused by switching operations, Concept of travelling waves and standing waves

**UNIT III**

**Extra High Voltage Generation, Measurement and Testing: 9**

Characteristics and generation of impulse voltage, Impulse current, generation of high AC and DC voltages, measurement of high voltages, general lay out of EHV Labs, Standard testing methods, EHV line insulation testing characteristics, protection of EHV lines.

**UNIT IV**

**HVDC Transmission: 9**

Types of dc links, converter station, choice of converter configuration and pulse number, effect of source inductance on operation of converters. Principle of dc link control, converter controls characteristics, firing angle control, excitation angle control, Converter faults, generation of harmonics, ac and dc filters, Multi Terminal DC systems (MTDC): Types, control, protection and applications.

**Textbooks:**


1. R. D. Begamudre, “Extra High Voltage AC Transmission Engineering” Wiley Eastern.
2. K. R. Padiyar, “HVDC Power Transmission Systems: Technology and System Reactions” New Age International.
3. J. Arrillaga, “High Voltage Direct Current Transmission” IFFE Power Engineering Series 6, Peter Peregrinus Ltd, London.
4. M. S. Naidu & V. Kamaraju, “High Voltage Engineering” Tata McGraw Hill.


**Reference Books:**


5. M. H. Rashid, “Power Electronics: Circuits, Devices and Applications” Prentice Hall of India.
6. S. Rao, “EHV AC and HVDC Transmission Engineering and Practice” Khanna Publisher.
7. “EPRI, Transmission Line Reference Book, 345 KV and above” Electric Power Research Institute. Palo Alto, California, 1982.


## BEE-378 ADVANCED MICROPROCESSOR AND MICRO CONTROLERS

**Course category** **:** Program Elective (PE2)
**Pre- requisites** **:** Nil
**Contact hours/week** : Lecture : 3, Tutorial :0 , Practical :2

**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through assignments, attendance, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Analyze the architectures of microprocessors and programming in ALP.
2. Understand the optimal usage of registers of processors in programming.
3. Understand the concepts of interfacing with processors and controllers.
4. Interfacing & Coprocessor 8087.
5. The concept of Micro-controller.
6. Understand the concept of High-end processor.

**Topic covered**

**UNIT I**
**Introduction to Architecture of Microprocessors: 9**
General definitions of minicomputers, microprocessors, micro controllers, and digital signal processors. Overview of 8085 microprocessor. Overview of 8086 microprocessor. Signals and pins of 8086 microprocessor.
**Assembly language of 8086:** Description of Instructions. Assembly directives. Assembly software programs with algorithms.

**UNIT II**
**Interfacing with 8086: 9**
Interfacing with RAMs, ROMs along with the explanation of timing diagrams. Interfacing with peripheral ICs like 8255, 8254, 8279, 8259, 8259 etc. Interfacing with keyboards, LEDs, LCDs, ADCs, and DACs etc.
**Coprocessor 8087:** Architecture of 8087, interfacing with 8086. Data types, instructions and programming

**UNIT III**
**Introduction to Micro controllers: 9**
Overview of the architecture of 8051 microcontroller. Overview of the architecture of 8096, 16-bit microcontroller.
**Assembly language of 8051:** Description of Instructions. Assembly directives. Assembly software programs with Algorithms.
**Interfacing with 8051:** Interfacing with keyboards, LEDs, 7 segment LEDs, LCDs, Interfacing with ADCs. Interfacing with DACs, etc.

**UNIT IV**
**High end processors: 9**
Introduction to 80386, 80486 and Pentium Processors.

**List of Experiments:**
**(Note:** Minimum 8 experiments are to be performed**)**

1. Description of 8086 Pin Diagram

2. Study of 8086 Instruction Set

**• 8086 Programs**

3. 16-bit addition using 8086 microprocessors
4. Move contents of array
5. Sum of 'n' consecutive numbers
6. Conversion of BCD number to decimal
7. Separating Odd and Even numbers
8. Description of 8051 Pin Diagram
9. Study of8051 Instruction Set

**• 8051 Programs**

10. Addition of 8-bit numbers using 8051
11. Subtraction of 8-bit numbers using 8051

**REFERENCES**


1. Ramesh S. Gaonkar "Microprocessor Architecture, Programming, and Applications with the 8085", Prentice Hall PTR, 2002.
2. A.K. Ray & K. M. Bhurchandi, "Advanced microprocessors and Peripherals", Tata McGraw Hill.
3. James L. Antonakos, "An Introduction to the Intel family of Microprocessors" Pearson Education 1999.
4. Barry.B.Breg," The Intel Microprocessors Architecture , Programming and Interfacing , PHI,2002.
5. James L. Antonakos , " The Pentium Microprocessor '' Pearson Education , 1997.


**BEE-370 PROJECT PART-1**

| | | |
|---|---|---|
| **Course category** | **:** | Project (P) |
| **Pre- requisites** | **:** | Nil |
| **Contact hours/week** | **:** | Lecture: 0, Tutorial :0, Practical :4 |
| **Number of Credits** | **:** | 2 |
| **Course Assessment Methods** | **:** | Continuous assessment through one viva voce/presentation, preliminary project report, effort and regularity and end semester presentation. |
| **Course Outcome** | **:** | The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course. |

1. Ability to learn, design & analysis of electrical engineering system modules.
2. Development of hardware based electrical engineering module.
3. Development of software-based simulation module.
4. Innovative tool-based research work in electrical engineering.
5. Communicate with engineers and the community at large in written an oral form.
6. Design engineering solutions to complex problems utilising a systems approach.

**BEE-380 SEMINAR**

| | |
|---|---|
| Course category: | Seminar (S) |
| Pre-requisite Subject: | NIL |
| Contact hours/week: | Lecture: 0, Tutorial: 0, Practical: 4 |
| Number of Credits: | 2 |
| Course Assessment methods: | Continuous assessment through quality of material, presentation, quality & extent of external response of question asked and participation in other seminars (attendance). |
| **Course Objectives** | a. To impart knowledge on technical topic of electrical engineering<br>b. To impart knowledge on technical writing skill<br>c. To identify electrical engineering problem from real life challenges |
| **Course Outcomes:** | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Engage students in the integrated activities of reading, research, discussion, and composition around a designated subject.
2. Identify, understand and discussion current, real-world issues.
3. Improve oral and written communication skills.
4. Explore an appreciation of the self in relation to its larger diverse social and academic contexts.
5. Apply principles of ethics and respect in interaction with others.
6. Communicate with engineers and the community at large in written an oral form.

**Syllabus:**

1 Seminar first part is a review of literature of specific phenomena/new process. Working model to demonstrate the principle, alternatively a small experimentation to investigate electrical engineering data/unit process/ unit operation.

2 Based review study from literature (from reference books, and international/national journals). It is expected that the student collects information and present the recent concepts and analytical techniques knowledge. The report submitted should reveal the student's internalization of the collected information.

Mere compilation from the net and other resources is discouraged.

Seminar report should be prepared based on guidelines provided by Department from time to time.

| | | |
|---|---|---|
| **SEE-313** | | **NONLINEAR SYSTEM ANALYSIS** |
| **Course Category** | : | Departmental Minor-1 (DM1) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |

**Course Assessment Methods** : Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination.

**Course Objectives** : This course deals with the analysis of nonlinear systems. The need for special tools to analyze nonlinear systems arises from the fact that the principle of superposition on which linear analysis is based, fails in the nonlinear case. The course exposes the students to various tools to analyze the behaviour of nonlinear systems, culminating in the stability analysis, which is of paramount importance in control systems.

**Course Outcome** : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. A thorough knowledge of theory and methods for nonlinear dynamical systems.
2. Ability to analyze nonlinear systems using Phase Plane, Describing functions; Lyapunov's direct stability method
3. Design and implement systems to improve nonlinear system performance in the presence of constraints.
4. Analyse the stability of nonlinear systems using various approaches.
5. Ability to apply nonlinear control design tools to derive feedback control of nonlinear dynamical systems.
6. Able to improve the learning capacity independently through the design of nonlinear control and able to use MATLAB/Simulink in designing of nonlinear control system.

**Topics Covered**

**Unit I** **9**

Why nonlinear systems? - Non-linear Models of Physical Systems, Mathematical Preliminaries: Finite dimensional normed spaces, Euclidean space and its topology, Infinite dimensional Banach spaces - Contraction mapping theorem.

**Unit II** **9**

Existence and Uniqueness results for solutions to nonlinear, ODEs as vector fields - One dimensional systems - Phase portrait of second order linear systems - Equilibrium points, linearization and their classification, Examples: Simple pendulum, Bead on a hoop, Lotka-Volterra models for predation and competition, biological transcriptional system, van der Pol oscillator and conservative systems, nonlinear circuits - Limit cycles.

**Unit III** **9**

Bifurcations of two-dimensional flows: Saddle-node, pitchfork, transcritical and Hopf - their normal forms, Notions of stability - Lyapunov and LaSalle's theorems, Finding Lyapunov functions: Linear systems, variable gradient method - Center Manifold Theorem.

**Unit IV:** **9**

Physical Non-linearities - Interconnections and feedback - Aizermann's conjecture – Passivity, PR systems - Dissipation equality - Passive filters, KYP Lemma - Popov and circle criterion

**Textbooks:**


1. P. Ioannou and J. Sun, Robust Adaptive Control, Upper Saddle River, NJ: Prentice Hall 1996
2. Miroslav Krstic, Ioannis Kanellakopoulos, Petar V. Kokotovic Nonlinear and Adaptive Control Design, Wiley Series, July 1995
3. S. Sastry and M. Bodson, Adaptive Control: Stability, Convergence and Robustness, Upper Saddle River, NJ: Prentice Hall 1989

4. K. S. Narendra and A. M. Annaswamy, Stable Adaptive Systems, Dover Publications, 2005
5. H. K. Khalil, Nonlinear Systems, Pearson Publications, Third Edition, 2002
6. M. Vidyasagar, Nonlinear Systems Analysis, Second Edition, SIAM, 2002

**SEE-323 FACTS CONTROLLERS & DEVICES**

| | | |
|---|---|---|
| **Course Category** | : | Department Minor-2 (DM2) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | To learn & apply FACTS Controller Devices as per requirement of AC Power Transmission in Simulation Models. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

7. Fundamentals of ac power transmission, transmission problems.
8. Able to analyze the needs, emergence of FACTS-FACTS control considerations, FACTS controllers.
9. Principles, types & characteristics of shunt compensation FACTS devices.
10. Principles, types & characteristics of static series compensation FACTS devices.
11. Principles of operation and characteristics of UPFC.
12. Generalized Unified Power Flow Controller (GUPFC), unified power flow conditioners.

**Topic Covered**

**Unit I** **9**

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

**Unit II** **9**

Principles of shunt compensation – Variable Impedance type & switching converter type-Static Synchronous Compensator (STATCOM) configuration, characteristics and control.

**Unit III** **9**

Principles of static series compensation, TCSC and TSSC, applications, Static Synchronous Series Compensator (SSSC), Interline power flow controller (IPFC).

**Unit IV** **9**

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters Generalized Unified Power Flow Controller (GUPFC), unified power flow conditioners.

**Textbooks:**

1. “FACTS: Controller in Power Transmission and Distribution,” K. R. Padiyar, Anshan Publication, 2009.

2. “Understanding FACTS: Concept and Technology of FACTS,” N. G. Hingorani and L. Gyuayi, Wiley, 2000.

**SEE-333 Power Electronics Controlled Electric DC-Drives**

**Course Category** : Department Minor-3 (DM3)
**Pre-requisite Subject** : NIL
**Contact hours/week** : Lecture: 3, Tutorial:1, Practical: 0
**No of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination.
**Course Objectives** : To learn & apply energy engineering management skills in practical problems for efficient energy management.
**Course Outcome** : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

CO1: Capability in designing of Power Electronics Controlled Electric DC-Drives.

CO2: Ability to design analysis of Chopper Controlled DC-Drives.

CO3: Ability to design analysis of Rectifier Controlled DC Drives.

CO4: Competency in operation and types of Closed Loop of DC Drives.

CO5: Ability to design analysis Microcontroller based DC drive.

CO6: To Study of application of DC drive for industrial application.

**Unit 1:** (Lecture 9)

**Introduction:**

Concept of Electric Drive, Advantage of Electric drives, Parts of electric Drive, Choice of electric Drives, Basic performance Equation of different type of DC motors, Modeling of electrical machines, Selection of motors for different applications, speed-torque characteristics, different control schemes like constant torque control, constant power control, Requirements of electric drives, Speed Torque convention and Multi Quadrant Operation,

**Unit 2:** (Lecture 9)

**Chopper Controlled DC-Drives:**

Basic principles of chopper drives, Power control or motoring control, regenerative braking control, Two Quadrant chopper drive, circuit diagram and application, Four Quadrant chopper drive, circuit diagram and application, closed loop speed and position control schemes, advantages, and disadvantages of Chopper Controlled Motor Drives.

**Unit 3:** (Lecture 9)

**Rectifier Controlled DC Drives:**

Phase controlled converter fed DC drives: Single phase half wave-controlled drives, Single phase Symmetrical and asymmetrical Semi controlled drives, Single phase full wave-controlled drives, active front end converters, Single phase Dual converter-controlled drives, three phase half and full wave-controlled drives, advantages, and disadvantages of Rectifier Controlled Motor Drives.

**UNIT 4:** (Lecture 9)

**Closed Loop Control of DC Drives:**

Various type of speed and current sensors, closed loop control of separately excited DC motor, Microcontroller based DC drive, application of DC drive for industrial application.

**References**


1. Paul C Krause, Oleg Wasynczuk, Scott D Sudhoff, Analysis of Electric Machinery and Drive System, Wiley Inter-science.
2. Leonhard W., Control of Electrical Drives, Springer-Verlag, 1985.
3. Mohan, Undeland and Robbins, Power Electronics: Converters, Application and Design, John Wiley and Sons, 1989.
4. Krishnan, R., Electric Motor drives: Modelling, Analysis and Control, Prentice Hall, March 2001.

**BEE-401 ELECTRIC DRIVES**

**Course category** **:** Program Core (PC)
**Pre- requisites** **:** Nil
**Contact hours/week** : Lecture: 3, Tutorial: 1,Practical: 2
**Number of Credits** **:** 5
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, quizzes, practical work, record, viva voce and two minor tests and One Major Theory & Practical Examination.

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Knowledge of electric drive and its parts, significance of power modulator, electric motors, sensing units, loads and control units in electric drives, advantages and classification of electric drive, multi quadrant operation of the drive
2. Knowledge of dynamic behaviour of motor, thermal motor of drives, concept of braking & energy loss.
3. Control of separately excited and dc series motor dc drive by single phase and three phase converter, dual converter control of dc drive, applications and limitations of various control, chopper control of dc series and servo motor.
4. Static control of dc motor by single phase, three phase and dual converters. chopper control of dc series and servomotor, idea, and effect of supply harmonics
5. Static control of three phase induction motor by CSI, VSI and Cycloconverter. static voltage and frequency control, static rotor resistance control and slip power recovery scheme, selection of motor for particular application.
6. Constructional features, working and of switched reluctance and brush less motor, selection of motor for particular services.

**Topic Covered**

**UNIT I**

**Introduction to Electric Drives:** **9**

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operation. Types of load torque components, nature and classification. Dynamics of motor-load combination; Steady state stability of Electric Drive; Transient stability of electric Drive, Thermal model of motor for heating and cooling, classes of motor duty, determination of motor power rating for continuous duty, short time duty and intermittent duty. Load equalization

**UNIT II**

**Braking of Electrical Machines:** **9**

Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors, Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors, methods of reducing energy loss during starting. Energy relations during braking, dynamics during braking.

**UNIT III**

**Power Electronics Control of DC Drives:** **9**

Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series

motor. Supply harmonics, power factor and ripples in motor current, Chopper control of separately excited dc motor and dc series motor**.**

**UNIT IV**

**Power Electronics Control of AC Drives & Special Machine: 9**

Static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo – converter based) static rotor resistance and slip power recovery control schemes. Self-controlled scheme of synchronous motor drive, Switched Reluctance motor, Brushless dc motor. Selection of motor for particular applications

**List of Experiments**

**Note: - Minimum 10 experiments are to be performed**

**Hardware Based Experiments**

1. To study speed control of separately excited dc motor by varying armature
2. Voltage using single-phase fully controlled bridge converter.
3. To study speed control of separately excited dc motor by varying armature
4. Voltage using single phase half-controlled bridge converter.
5. To study speed control of separately excited dc motor using single phase dual converter (Static Ward-Leonard Control).
6. To study speed control of separately excited dc motor using MOSFET/IGBT chopper.
7. To study closed loop control of separately excited dc motor.
8. To study speed control of single-phase induction motor using single phase
9. ac voltage controller.
10. To study speed control of three phase induction motor using three phase ac voltage controller.
11. To study speed control of three phase induction motor using three phase current source inverter
12. To study speed control of three phase induction motor using three phase voltage source inverters
13. To study speed control of three phase slip ring induction motor using static rotor resistance control using rectifier and chopper
14. To study speed control of three phase slip ring induction motor using static scherbius slip power recovery control scheme

**Simulation Based Experiments (using MATLAB or any other software)**

15. To study starting transient response of separately excited dc motor
16. To study speed control of separately excited dc motor using single phase fully / half-controlled bridge converter in discontinuous and continuous current modes.
17. To study speed control of separately excited dc motor using chopper control in motoring and braking modes.
18. To study starting transient response of three phase induction motor
19. To study speed control of three phase induction motor using (a) constant/V/F control (b) Constant Voltage and frequency control.

**Textbooks:**

1. G.K. Dubey, “Fundamentals of Electric Drives” Narosa publishing House.
2. S.K.Pillai, “A First Course on Electric Drives” New Age International.

**Reference Books:**

3. M.Chilkin, “Electric Drives”,Mir Publishers, Moscow.
4. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore.

5. N.K. De and Prashant K.Sen, “Electric Drives”, Prentice Hall of India Ltd.
6. V.Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill.

## BEE-402 POWER SYSTEM OPERATION AND CONTROL

**Course category** : Program Core (PC)
**Pre- requisites** **:** Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment** **:** Continuous assessment through tutorials, assignments,
**Methods** quizzes, and two minor tests and One Major Theory Examination.
**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability an understanding of Energy control centre, analysis of real time control of power system parameters, learn about SCADA system
2. Ability to solve load dispatch problems with computer aided techniques for economy load dispatch.
3. Ability to analysis of real & reactive power control, load frequency control & Interconnected power systems
4. Ability to analysis of automatic excitation control systems and explore static and dynamic responses of system.
5. Explain methods to regulate the power for optimum power system stability.
6. Ability to explain the importance of FACTS devices & their controllers.

**Topic Covered**

**UNIT-I**

**Introduction:** **9**

Overview of power system operation, Energy control centre and real time computer control, SCADA system, power system operation and control in India, system security, voltage stability, role of information technology in energy control system, contingency analysis, system states and transient diagrams

**UNIT II**

**Economic Operation:** **9**

Energy demand, demand factor, load factor, diversity factor, types of loads, Economic operation of power system and unit commitment, Input-output characteristics of power plants, Economy loading with and without transmission losses, Penalty factor, computerized approach for economy load dispatch.

**UNIT III**

**Load Frequency Control:** **9**

Role of system frequency in real power control, Concept of load frequency control, control area concept, single area and multi area load frequency control scheme, steady state and dynamic response, Automatic load frequency control for interconnected power systems, Automatic load dispatching

**UNIT IV**

**Voltage and Reactive Power control:** **9**

Schematic diagram and block diagram representation, automatic excitation control systems, static and dynamic response, low power factor causes, improvement in power factor, concept of real and reactive power, Shunt compensation, series compensation, Flexible AC Transmission Systems**:** Concept and objectives of FACTS controllers, Working & Characteristics of different FACTS Controllers.

**Textbooks:**

1. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" Tata McGraw Hill, 3rd Edition.
2. P.S.R. Murty, "Operation and control in Power Systems" B.S. Publications.
3. N. G. Hingorani & L. Gyugyi, "Understanding FACTs" Concepts and Technology of Flexible AC Transmission Systems"
4. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley Sons.

**Reference Books:**

5. O.I. Elgerd, "Electric Energy System Theory" Tata McGraw Hill.
6. P. Kundur, "Power System Stability and Control McGraw Hill.
7. M.H. Rashid, "Power Electronics: Circuits, devices and Applications" Prentice Hall of India,3rd Edition.
8.T. K. Nagsarkar & M.S.Sukhiza,' Power System Analysis' Oxford University Press.

**BEE-403 POWER QUALITY**

**Course category** : Program Core (PC)
**Pre- requisites** : Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :0 , Practical :0
**Number of Credits** **:** 3
**Course Assessment Methods** **:** Continuous assessment through assignments, quizzes, and two minor tests and One Major Theory Examination.
**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire the knowledge of different terms and definitions of power quality.
2. Gains knowledge on causes and effects of voltage sags and its mitigations.
3. Understand power quality monitoring and classification techniques.
4. Gains knowledge on power system transients and harmonics with their effects and mitigation techniques.
5. Know about various power quality measuring, analyzing and testing devices.
6. Get introductory knowledge of custom power devices for further knowledge enhancement

**Topic Covered**

**UNIT I**

**Introduction to Power Quality:** **9**

Terms and definitions of transients, Long Duration Voltage Variations: under Voltage, Under Voltage and Sustained Interruptions**;** Short Duration Voltage Variations: interruption, Sag, Swell; Voltage Imbalance; Notching D C offset, waveform distortion; voltage fluctuation; power frequency variations**.**

**UNIT II**

**Voltage Sag:** **9**

Sources of voltage sag: motor starting, arc furnace, fault clearing etc; estimating voltage sag performance and principle of its protection; solutions at end user level- Isolation Transformer, Voltage Regulator, Static UPS, Rotary UPS, Active Series Compensator.

**UNIT III**

**Electrical Transients: 9**

Sources of Transient Over voltages- Atmospheric and switching transients- motor starting transients, pf correction capacitor switching transients, ups switching transients, neutral voltage swing etc; devices for over voltage protection.

**Harmonics:** Causes of harmonics; current and voltage harmonics: measurement of harmonics; effects of harmonics on – Transformers, AC Motors, Capacitor Banks, Cables, and Protection Devices, Energy Metering, Communication Lines etc. harmonic mitigation techniques.

**UNIT IV**

**Measurement and Solving of Power Quality Problems: 9**

Power quality measurement devices- Harmonic Analyzer, Transient Disturbance Analyzer, wiring and grounding tester, Flicker Meter, Oscilloscope, multimeter etc.

**Introduction to Custom Power Devices**-Network Reconfiguration devices; Load compensation and voltage regulation using DSTATCOM; protecting sensitive loads using DVR; Unified power Quality Conditioner.

**Textbooks:**


1. Roger C Dugan, McGrahan, Santoso&Beaty, "Electrical Power System Quality" McGraw Hill
2. Arinthom Ghosh& Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices" Kluwer Academic Publishers
3. C. Sankaran, "Power Quality" CRC Press.
4. Bhim Singh, Ambrish Chandra, and Kamal Al-Haddad, "Power Quality: Problems and Mitigation Techniques," Wiley.


**BEE-426 MODERN CONTROL SYSTEM**

**Course category** : Program Elective (PE3)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the concept of control system design.
2. Understand the concepts of state-space analysis and construct state space models of dynamic systems.
3. Explain basic control concepts such as controllability, observability, poles and zeros, stability
4. Design state observers, pole placement controller and full-state control systems.

5. Test stability of dynamical system using Lyapunov's stability theorem.
6. Understand the basic concept of Non-Linear System.

**Topic covered**

**UNIT I**

**Introduction to Control Design: 9**

Introduction, review of conventional control design techniques, continuous-time and discrete-time system modelling, time response analysis, and frequency response analysis; control design problem and preliminary considerations; lead, lag and lead-lag networks, compensator design using root locus plots and frequency response plots.

**UNIT II**

**State Space Analysis: 9**

State variable representation, state variable model, conversion of state variable models to transfer function and vice-versa, solution of state equations, state transition matrix, controllability and observability.

**UNIT III**

**State Space Control Design: 9**

Design of state observer and controller. Pole-placement technique, Ackerman formula, observer-controller design.

Stability Analysis: Continuous-time and discrete-time systems stability analysis, Lyapunov's stability theorems.

**UNIT IV**

**Nonlinear System: 9**

Types of nonlinearities, nonlinear systems analysis, linearization method, system analysis by phase-plane method, describing function and their applications.

**References:**


1. I. J. Nagrath and M. Gopal, "Control System Engineering", 4th Edition, New age International.
2. K. Ogata, "Modern Control Engineering", Pearson Education, 4th Indian reprint.
3. D.Roy Choudhary, "Modern Control Engineering", Prentice Hall of India.
4. Ajit K. Mandal, "Introduction to Control Engineering" New Age International, 2006.


## BEE-427 ENERGY EFFICIENCY & CONSERVATION

**Course category** : Program Elective (PE3)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Conceptual knowledge of the technology, economics and regulation related issues associated with energy conservation and energy auditing.
2. The concepts of Energy conservation& Energy Audit.
3. The concept of Demand Side Management.
4. Understand the concepts of Voltage and Reactive power in Distribution System.
5. Ability to analyse the viability of energy conservation projects
6. The concept of Efficiency in Motors and Lighting system.

**Topic covered**

**UNIT I**

**Energy conservation: 9**

Principles of Energy Conservation, Energy conservation Planning, Energy conservation in small scale industries, large scale industries and in electrical generation, transmission, and distribution. Energy conservation Legislation.

**Energy Audit: -**

Aim of energy Audit, Strategy of Energy Audit, Energy management Team Considerations in implementing energy conservation Programme, Instruments for energy audit, Energy audit of Electrical System, HVAC, Buildings, Economic analysis.

**UNIT II**

**Demand Side Management: 9**

Concept and Scope of Demand Side Management, Evolution of Demand Side Management, DSM Strategy, Planning, Implementation and its application. Customer Acceptance & its implementation issues. National and International Experiences with DSM. 8

**UNIT III**

**Voltage and Reactive power in Distribution System: 9**

Voltage and reactive power calculations and control: Voltage classes and nomenclature, voltage drop calculations, Voltage control, VAR requirements and power factor, Capacitors unit and bank rating, Protection of capacitors and switching, Controls for switched capacitors and fields testing.

**UNIT IV**

**Efficiency in Motors and Lighting system: 9**

Load scheduling/shifting, Motor drives- motor efficiency testing, energy efficient motors, and motor speed control. Lighting- lighting levels, efficient options, fixtures, day lighting, timers, Energy efficient windows. PS selection, Installation operation and maintenance. Indian Electricity Act 1956, Distribution Code and Electricity Bill 2003

**Text / Reference Books**

1. Tripathy S. C., “Electric Energy Utilization and conservation”, Tata McGraw Hill.
2. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982.
3. “The Efficient Use of Energy”, Edited by I.G.C.Dryden, Butterworths, London, 1982.
4. Energy Management Handbook, Edited by W.C.Turner, Wiley, New York, 1982.
5. L.C.Witte, “P.S.Schmidt, D.R. Brown, Industrial Energy Management and Utilization”, Hemisphere Publ, Washington, 1988
6. Power Capacitor Handbook, Butterworth & Co (Publishers) Ltd, 1984.

7. Electrical Systems Analysis and Design for Industrial Plants, McGraw-Hill Book Company.
8. IEEE Bronze Book, 'Recommended Practice for Energy Conservation and cost-effective planning in Industrial facilities, IEEE Press.

## BEE-428 BIO INSTRUMENTATION

**Course category** : Program Elective (PE3)
**Pre- requisites** : Nil
**Contact hours/week** : Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The Fundamentals of Bio-Medical Instrumentation.
2. Acquire the knowledge of biomedical instrumentation principles in aspects of device design and applications.
3. Ability to analyze contemporary bioinstrumentation studies to make connections and decisions based on their scientific merit.
4. The concept of the Cardiovascular System and Measurements.
5. The concept of the Nervous & Respiratory System and its Measurements.
6. Patient Care Monitoring & Imaging Techniques.

**Topic covered**

**UNIT I**

**Fundamentals of Bio-Medical Instrumentation: 9**

Introduction to bioinstrumentation, anatomy & physiology, basic medical instrumentation scheme, different physiological systems of body, Problems encountered in measuring living systems, Transducers for biomedical applications. Generation, propagation, and distribution of different bioelectric potentials (ECG, EEG, EMG etc.). Bio-potentials electrodes, electrode theory, types of electrodes, biochemical transducers. Action& resting potentials.

**UNIT II**

**The Cardiovascular System and Measurements: 9**

The heart, electrical &mechanical activity, cardiovascular systems, Electrocardiography, ECG lead configurations ECG recording and their types, Einthoven triangle, interferences. measurement methods of blood flow, heart sound, Phonocardiogram, circulation block diagram of blood pressure and measurement.

**UNIT III**

**The Nervous & Respiratory System and its Measurements 9**

The anatomy of nervous system, Neuronal communication, EPSP & IPSP, Organization of the brain, Measurements from the nervous system, Respiratory system, Different types of Spirometers, Body & skin temperature measurements.

**UNIT IV**

**Patient Care Monitoring & Imaging Techniques: 9**

Elements of intensive care, Organization of the Hospital (HIS) for patient-care monitoring, Pace-makers-types, modes and generators, Defibrillators-types. Instrumentation for diagnostic; X Rays, Ultrasonic, CT & MRI, biomedical computer applications. Shock hazards from electrical equipments, methods of accident prevention.

**Textbook:**

1. T. Cromwell, F.J. Weibell & F. A. Pfieffer, "Biomedical Instrumentation & Measurements" Prentice Hall International

**Reference Books:**

2. R.S. Khanpur, "Handbook of Biomedical Instrumentation" Tata McGraw Hill
3. H.E. Thomas, "Handbook of Biomedical Instrumentation and Measurement" Restone Publishing Company
4. J.G. Webester, "Medical Instrumentation", Houghton Mifflin.

## OEE-401 NON-CONVENTIONAL ENERGY RESOURCES

**Course category** : Open Elective (OE)
**Pre- requisites** : NIL
**Contact hours/week** : Lecture : 2, Tutorial :1 , Practical :0
**Number of Credits** : 3
**Course Assessment Methods** : Continuous assessment through tutorials, assignments, quizzes, and two minor tests and One Major Theory Examination.

**Course Outcome** : The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Demonstrate the generation of electricity from various non-Conventional sources of energy, have a working knowledge on types of fuel cells.
2. Estimate the solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
3. Explore the concepts involved in wind energy conversion system by studying its components, types, and performance.
4. Illustrate Ocean energy and explain the operational methods of their utilization.
5. Acquire the knowledge on Geothermal energy.
6. Understand the concept of Wind Energy Generation.

**Topic covered**

**UNIT I**

**Introduction 6**

Various non-conventional energy resources- Introduction, availability, classification, relative merits, and demerits.

**Solar Cells:** Theory of solar cells. Solar cell materials, solar cell array, solar cell power plant, limitations.

**Biomass:** Availability of biomass and its conversion theory.

**UNIT-II** **6**

**Solar Thermal Energy:**

Solar radiation, flat plate collectors and their materials, applications, and performance, focusing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

**Thermo-electrical and thermionic Conversions:** Principle of working, performance, and limitations.

**UNIT-III** **6**

**Geothermal Energy:**

Resources of geothermal energy, thermodynamics of geo-thermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

**Magneto-hydrodynamics (MHD):** Principle of working of MHD Power plant, performance and limitations.

**Fuel Cells:** Principle of working of various types of fuel cells and their working, performance and limitations.

**UNIT-IV** **6**

**Wind Energy:**

Wind power and its sources, site selection, criterion, momentum theory, classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.

**Ocean Thermal Energy Conversion (OTEC):** Availability, theory and working principle, performance, and limitations.

**Wave and Tidal Wave:** Principle of working, performance, and limitations. Waste Recycling Plants.

**Text/References Books:**


1. Raja etal, "Introduction to Non-Conventional Energy Resources" Scitech Publications.
2. John Twideu and Tony Weir, "Renewal Energy Resources" BSP Publications, 2006.
3. M.V.R. Koteswara Rao, "Energy Resources: Conventional & Non-Conventional "BSP Publications,2006.
4. D.S. Chauhan,"Non-conventional Energy Resources" New Age International.
5. C.S. Solanki, "Renewal Energy Technologies: A Practical Guide for Beginners" PHI Learning.
6. Peter Auer, "Advances in Energy System and Technology". Vol. 1 & II Edited by Academic Press.


## OEE-402 FUNDAMENTALS OF ELECTRIC DRIVES

| | | |
|---|---|---|
| **Course category** | **:** | Open Elective (OE) |
| **Pre- requisites** | **:** | NIL |
| **Contact hours/week** | **:** | Lecture : 2, Tutorial :1 , Practical :0 |
| **Number of Credits** | **:** | 3 |
| **Course Assessment Methods** | **:** | Continuous assessment through tutorials, assignments, quizzes, and two minor tests and One Major Theory Examination. |

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The concepts of basic electric drives & its dynamics.
2. The concept of Motor power rating, Braking and Calculation of Energy loss.
3. The concept of Power Electronic Control of DC Drives.
4. Power Electronic Control of AC Drives, Special Drives & Application of Motors.
5. Understand the basic principles of Permanent Magnet AC (Self-Synchronous AC) drives.
6. Learn speed control of induction motor drives in an energy efficient manner using power electronics.

**Topic covered**

**UNIT I**

**Basic Electric Drives and its Dynamics 6**

Electric Drives and its parts, advantages of electric drives, Classification of electric drives, Speed-torque conventions and multi-quadrant operations, group drives and individual drives, Constant torque and constant power operation. Types of load torque components, nature, and classification. Dynamics of motor-load combination; Steady state stability of Electric Drive; Load equalization

**UNIT II**

**Motor power rating, Braking and Calculation of Energy loss 6**

Thermal model of motor for heating and cooling, classes of motor duty, determination motor power rating for continuous duty, short time duty and intermittent duty. Purpose and types of electric braking, braking of dc, three phase induction and synchronous motors, Calculation of acceleration time and energy loss during starting of dc shunt and three phase induction motors.

**UNIT III**

**Power Electronic Control of DC Drives: 6**

Single phase and three phase controlled converter fed separately excited dc motor drives (continuous conduction only), dual converter fed separately excited dc motor drive, rectifier control of dc series motor. Chopper control of separately excited dc motor and dc series motor**.**

**UNIT IV**

**Power Electronic Control of AC Drives, Special Drives & Application of Motors 6**

Three Phase induction Motor Drive: Static Voltage control scheme, static frequency control scheme (VSI, CSI) static rotor resistance and slip power recovery control schemes. Brushless dc motor. Selection of motor for particular applications.

**Textbooks:**


1. G.K. Dubey, “Fundamentals of Electric Drives”, Narosa publishing House.
2. S.K.Pillai, “A First Course on Electric Drives”, New Age International.


**Reference Books:**


3. M. Chilkin, “Electric Drives”, Mir Publishers, Moscow.
4. Mohammed A. El-Sharkawi, “Fundamentals of Electric Drives”, Thomson Asia, Pvt. Ltd. Singapore.
5. N.K. De and Prashant K. Sen, “Electric Drives”, Prentice Hall of India Ltd.
6. V. Subrahmanyam, “Electric Drives: Concepts and Applications”, Tata McGraw Hill.


**BEE-440 PROJECT PART-II**

| | | |
|---|---|---|
| **Course category** | **:** | Project (P) |
| **Pre- requisites** | **:** | Project Part-1 |
| **Contact hours/week** | **:** | Lecture: 0, Tutorial :0, Practical :6 |
| **Number of Credits** | **:** | 3 |
| **Course Assessment Methods** | **:** | Continuous assessment through one viva voce/presentation, final project report, contribution made to literary world and Major Examination. |
| **Course Outcome** | **:** | The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course |

1. Ability to learn, design & analysis of electrical engineering system modules.
2. Development of hardware based electrical engineering module.
3. Development of software-based simulation module.
4. Innovative tool-based research work in electrical engineering.
5. Communicate with engineers and the community at large in written an oral form.
6. Design engineering solutions to complex problems utilising a systems approach.

**SEE-414 OPTIMAL AND ADAPTIVE CONTROL SYSTEMS**

| | | |
|---|---|---|
| **Course Category** | : | Departmental Minor-1 (DM1) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | This is an advanced course on control system design, covering fundamental aspects of Optimal and adaptive control. A general methodology is developed for systematic design of controllers for 'systems in optimal sense' and 'systems with parametric uncertainty'. It is expected that the students interested in taking this course should have a basic understanding of Lyapunov Stability Theory and working knowledge of MATLAB/Simulink. |
| **Course Outcome** | : | The students are expected to demonstrate the following knowledge, skills, and attitudes after the completion of this course: |

1. Apply the concept of different types of optimal control for solving problems
2. Apply the concept of calculus of variation and principal of optimality for solving problems
3. Apply the concept of Linear Quadratic method for solving problems
4. Apply the concept of adaptive control technique for solving problems
5. Apply the concept of Self Tuning Regulators.
6. Apply Model Reference Adaptive System for solving problems.

**Topics Covered**

**Unit I: Introduction to Optimal Control** **9**

Statement of optimal control problem, Problem formulation and types of optimal control, Selection of performance measures, General Model of feedback control systems, Transient performance analysis, Tracking performance analysis, Disturbance rejection analysis, Cost functions and norms, Mathematical preliminary to optimal control

**Unit II: Optimal Control of Continuous-time System** **9**

The calculus of variation, Fundamental concepts, Functional of a single function, Functional involving several functions, Continuous-time LQR, Steady state closed-loop control and sub-optimal feedback, tracking problems.

**Unit III: Introduction to Adaptive Control** **9**

Introduction: Linear feedback, effects of process variations, adaptive schemes, adaptive control problem. Self-tuning Regulators (STR): Pole placement design, indirect STR, direct STR, stochastic and predictive STR, applications.

**Unit IV: Model-reference Adaptive Control** **9**

The MIT rule, determination of adaptive gain, design of MRAS' using Lyapunov theory, BlBO stability, output feedback, relation between MRAS and STR, applications.

**Textbooks:**

1. Optimal control theory-An Introduction by Donald E.Krik - Prentice Hall Networks series, 2008.
2. Karl J Astrom and Bjorn Wittenmark, “Adaptive Control”, Pearson education Inc., New Delhi, Second Edition, 2008.
3. D S Naidu “Optimal Control Systems”, CRC Press 2002

**References:**

1. A.P. Sage - Optimum Systems Control, Prentice Hall.
2. Yoan D. Landu - Adaptive Control - Model Reference Approach, Marcel Dekker
3. HSU and Meyer - Modern Control. Principles and Applications, McGraw Hill.

**SEE-424** **RESTRUCTURED FLEXIBLE AC POWER SYSTEM**

| | | |
|---|---|---|
| **Course Category** | : | Departmental Minor-2 (DM2) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | : Objective of this course is to give knowledge and develop skill of students in deregulated electricity Indian power market, power management schemes and voltage, frequency and power control in restructured power system. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

1. Able to know restructuring process in power industry
2. Able to know pricing effects in transmission system, cost components and hierarchical supply structure of Indian power market under deregulated schemes

3. Able to know power quality issues, custom power devices and applications, reactive power control techniques.
4. Analytical Overview of FACTS devices and applications, causes of low load power factor and its improvement methods
5. Able to know generating voltage and frequency and its automatic control aspects with load variations
6. Knowledge of High voltage AC and DC Transmission systems, economic operation of generation system, concept of distributed generation system

**Unit I** **9**

Introduction to restructuring of power industry, Key issues and challenges facing power industries, Power system restructuring models, Ancillary services in restructured electric market.

**Unit II** **9**

Transmission pricing in restructured electricity market, cost components of transmission system, congestion management, Electricity supply structure under deregulation in India.

**Unit III** **9**

Power quality issues, Custom Power devices and applications, Concepts of FACTS devices& their Applications, Reactive Power management, Shunt compensation, Series compensation, causes of low load power factor and its improvement.

**Unit IV** **9**

Automatic Generation and Voltage Control, Automatic load frequency control (ALFC), Economic Operation of Power Systems, General aspects of EHVAC and HVDC Transmission Systems, Distributed Generation System.

**Textbooks:**


1. Electric Power Applications of Optimization - James A. Momoh (Marcel Dekker), 2001
2. Optimization of Power System Operation - Jizhog Zhu (Wiley), 2009
3. Power system Optimization - D. P. Kothari, J. S. Dhillon (PHI Publication), 2011
4. K. R. Padiyar , " HVAC-DC Power Transmission System", Wiley Eastern Limited, New Delhi , First Edition 1990.
5. 2. T.J.E. Miller , " Reactive Power Control in Electrical System", John Wiley and Sons, New York , 1982.
6. N.G.Hingorani, "Understanding FACTS :Concepts and Technology of FACTS Systems", IEEE Press, 2000.
7. K.R.Padiyar "FACTS Controllers in Power Transmission and Distribution", New Age International (P) Ltd. 2007.
8. Narin G.Hingorani, "Power Electronics in Electric Utilities: Role of Power Electronics in Future power systems", Proc. of IEEE, Vol.76, no.4, April 1988.

| | | |
|---|---|---|
| **SEE-434** | | **Power Electronics Applications** |
| **Course Category** | : | Department Minor-3 (DM3) |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | Lecture: 3, Tutorial:1, Practical: 0 |
| **No of Credits** | : | 4 |
| **Course Assessment Methods** | : | Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor test, and one major theory examination. |
| **Course Objectives** | : | To learn & apply energy engineering management skills in practical problems for efficient energy management. |
| **Course Outcome** | : | The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course. |

CO1: Capability in designing of Flexible AC transmission systems (FACTS) using power electronics devices.

CO2: Ability to analysis of Sag & swell through power inverter circuit.

CO3: Competency in operation and types of Power converters for renewable energy sources.

CO4: To analysis of power quality active filter.

CO5: Competency in operation and types of DC-AC Inverter for renewable energy sources

CO6: Competency in operation and types of DC-DC converters for renewable energy sources.

**UNIT 1:** (Lecture 9)

Basics of Flexible AC transmission systems (FACTS). Principles of series and shunt compensation. Thyristor controlled compensators-static var compensators (SVC), series compensators (TCSC), phase shifters (SPS), series compensator (SSSC) and Unified power flow controller (UPFC) -structure and circuit analysis.

**UNIT 2:** (Lecture 9)

Power quality problems distribution system and their mitigation using power electronic converters: harmonic mitigation using passive filters. Active filters, hybrid filters.

**UNIT 3:** (Lecture 9)

Sag & swell mitigation using Dynamic voltage restorers, STATCOM/DSTATCOM, Unified power quality conditioners (UPQC). Active Front End Rectifiers: Power factor correction, single phase and three-phase, control schemes.

**UNIT 4:** (Lecture 9)

Power converters for renewable energy sources: Block diagram of converter for various renewable energy sources, Working principle of converter for various renewable energy sources, design of converter, control of converters, selection of line commutated converters (inversion-mode), Boost and buck-boost converters, and filtering requirements, load requirement.

**References**

1. T.J.E. Miller, Static Reactive Power Compensation, John Wiley & Sons, New York,1982.
2. Arindam Ghosh & Gerard Ledwich, "Power Quality Enhancement Using Custom Power Devices," IEEE Press.

| **IEE-400** | **Industrial Practices** |
|---|---|
| **Course category** | : Industrial Practices (IP) |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : Lecture:0, Tutorial:0, Practical:24 |
| **Number of Credits** | : 12 |
| **Course Assessment methods** | : The industrial training of the students will be evaluated in three stages: (i) Evaluation by Industry (ii) Evaluation by faculty supervisor on the basis of (iii) Evaluation through seminar presentation/viva-voce at the Institute. |
| **Course Objectives** | : 1. Participate in the projects in industries during his or her industrial training.<br>2. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry. |
| **Course Outcomes** | : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course |

1. Learn to apply the technical knowledge in real industrial situations.
2. Promote academic, professional and/or personal development
3. Expose students to the engineer's responsibilities and ethics.
4. Familiarize with various materials, processes, products, and their applications along with relevant aspects of quality control. Gain experience in writing technical reports/projects
5. Expose the students to future employers.
6. Understand the social, economic, and administrative considerations that influence the working environment of industrial organizations

**BEE-480 MINOR PROJECT**

| | | |
|---|---|---|
| **Course category** | **:** | Minor Project (MP) |
| **Pre- requisites** | **:** | Nil |
| **Contact hours/week** | **:** | Lecture: 0, Tutorial :0, Practical :8 |
| **Number of Credits** | **:** | 4 |
| **Course Assessment Methods** | **:** | Continuous assessment through one viva voce/presentation, project report Submission, effort and regularity and end semester presentation. |
| **Course Outcome** | **:** | The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course. |

1. Ability to learn, design & analysis of electrical engineering system modules.
2. Acquire knowledge by developing of hardware-based engineering module.
3. Acquire knowledge by developing of software-based simulation module.
4. Obtain the knowledge about the recent tool-based research work in engineering.
5. Communicate with engineers and the community at large in written an oral form.
6. Design engineering solutions to complex problems utilising a systems approach.

**IEE-401 UTILIZATION AND TRACTION**

**Course category** **:** Industrial Elective-1 (IE1)
**Pre- requisites** **:** Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, Quizzes and Two Minor Tests and One Major Theory

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Advantages and methods of electrical heating, concept of resistance heating, electrical arc heating, induction heating and dielectric heating.
2. Knowledge of electric arc welding, resistance welding and electronic welding control, laws of electrolysis, concept of electro deposition and application of electrolysis.
3. Laws of illumination, requirement of good lighting, design of indoor and outdoor lighting, concept of refrigeration and air condoning systems, domestic refrigerator and water cooler, concept of window air conditioner.
4. Knowledge of types of electric traction, system of electrification, traction mechanism, speed time curve specific energy consumption mechanism of train movement, coefficient of adhesion and its influence.
5. Salient features of traction drives, series parallel control of traction drives and energy saving, power electronic control dc and ac traction drives, diesel electric traction.
6. Select most suitable type and specification of illumination source for efficient conversion and recognize different process of utilizing electric energy for heating and electrolytic process in industries purposes mostly in commercial along with few household applications.

**Topic Covered**

**UNIT I**

**Electric Heating: 9**

Advantages and methods of electric heating, Resistance heating, Electric arc heating, Induction heating, Dielectric heating**,** Electric Arc Welding, Electric Resistance welding, electronic welding control, Principles of electro deposition, Laws of electrolysis, applications of electrolysis

**UNIT II**

**Illumination: 9**

Various definitions, Laws of illumination, requirements of good lighting, Design of indoor lighting and outdoor lighting systems, Refrigeration systems, domestic refrigerator, water cooler, Types of air conditioning, Window air conditioner

**UNIT III**

**Electric Traction:** **9**

Types of electric traction, systems of track electrification, types of services, speed time curve and its simplification, average and schedule speeds, Tractive effort, specific energy consumption, mechanics of train movement, coefficient of adhesion and its influence

**UNIT IV**

**Modern Electric Traction** **9**

Salient features of traction drives, Series – parallel control of dc traction drives (bridge transition) and energy saving, Power Electronic control of dc and ac traction drives, Diesel electric traction.

**Textbooks**:

1. H. Partab, "Art and Science of Electrical Energy" Dhanpat Rai& Sons.
2. G.K. Dubey, "Fundamentals of Electric Drives" Narosa Publishing House

**Reference Books:**

3. H. Partab, "Modern Electric Traction" Dhanpat Rai& Sons.
4. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy" New Age International Publications.

## IEE-405 SCADA & ENERGY MANAGEMENT SYSTEM

**Course category** **:** Industrial Elective-2 (IE2)
**Pre- requisites** **:** Nil
**Contact hours/week** **:** Lecture : 3, Tutorial :1 , Practical :0
**Number of Credits** : 4
**Course Assessment Methods** **:** Continuous assessment through tutorials, assignments, Quizzes and Two Minor Tests and One Major Theory

**Course Outcome** **:** The student are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the fundamentals of energy management functions.
2. Understand the concepts of SCADA & its use in power system.
3. The concept of energy management system.
4. Enhance the knowledge in lighting and cogeneration.
5. SCADA System Components and Applications.
6. Expose to the concept of supervisory control and data acquisition.

**Topic covered**

**UNIT I**

**An Introduction to SCADA:** **9**

Purpose and necessity, general structure, data acquisition, transmission & monitoring, general power system hierarchical Structure. Overview of the methods of data acquisition systems, transducers, RTUs, Master terminal unit, various communication channels- cables, telephone lines, power line, microwaves, optical fiber channels and satellites.

**UNIT II**

**SCADA in Power System:** **9**

Tasks in power system operation, Operational tasks at various hierarchical levels, National load control center, regional load control center, generating station control management, SCADA types, Automatic generation control, SCADA in power distribution, SCADA in power grid, distribution substation and feeder automation

**UNIT III**

**Supervisory Power Management:** **9**

Energy Management system, power system operational states, security analysis, state estimation, load forecasting, classification of load forecast, effecting factors, methods of load forecasting, energy audit, utility distributed system design, regulation and distribution automation, fault control management.

**UNIT IV**

**SCADA System Components and Applications:** **9**

Intelligent electronic device, SCADA server, Human-Machine interface, Components of control system, Programmable logic controllers, SCADA applications in various utilities, SCADA applications for transmission and distribution sector, SCADA base Instrumentation, Case studies on SCADA.

**Textbooks:**

1. Torsten Cergrell, " Power System Control Technology", Prentice Hall International.
*2.* George L Kusic "Computer Aided Power System Analysis", Prentice Hall of India,
3. A. J. Wood and B. Woolenberg, "Power Generation Operation and Control", John Wiley & Sons.
4. T.K Bisht, "SCADA and Energy Management System" S K Kataria and sons

| **SEE-415/425/435** | **RESEARCH PROJECT** |
|---|---|
| **Course Category** | : Departmental Minor-1/2/3 (DM1/DM2/DM3) |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : Lecture: 0, Tutorial:0, Practical: 4 |
| **No of Credits** | : 2 |
| **Course Assessment Methods** | : Continuous assessment through attendance, two Viva-voce, project work/record, and Major project Examination. |
| **Course Objectives** | : Student able to formulate the research problem based on department minor course they learned and developed the methodological solution to research objective. |
| **Course Outcome** | : The students are expected to demonstrate a sound technical knowledge of the project topic formulated from the subject of departmental minor. Undertake problem identification, formulation and design engineering solution to complex problems. |

# Syllabus of Audit Courses

# CONSTITUTION OF INDIA

**Course Code:** : **AUC 01** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**COURSE OUTCOME:**
At the end of the course, learners should be able to
CO1- Student will Identify and explore the basic features and modalities about Indian constitution
CO2- Students will be able to differentiate and relate the functioning of Indian parliamentary system at the center and state level.
CO3- Student will be able to differentiate different aspects of Indian Legal System and its related bodies.

**UNIT 1**--Introduction and Basic Information about Indian Constitution: Historical Background of the Constituent Assembly, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System.

**UNIT 2**-Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister, Judiciary.

**UNIT 3**- Introduction and Basic Information about Legal System: The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court).

**UNIT 4**- Intellectual Property Laws and Regulation to Information: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright, Information Technology Act, 2000. The Company's Act:

**Reference:**


1) G. Austin (2004) Working of a Democratic Constitution of India, New Delhi: Oxford University Press.
2) Basu, D.D (2005), An Introduction to the Constitution of India, New Delhi, Prentice Hall.
3) N. Chandhoke & Priyadarshini (eds) (2009) Contemporary India: Economy, Society, Politics, New Delhi: Oxford University Press.
4) N.G Jayal and P.B. Maheta, (eds) (2010) Oxford Companion to Indian Politics, New Delhi: Oxford University Press.

## Indian Culture and Heritage

**Course Code:** : **AUC 02** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Unit-I**
Indian Culture: An Introduction, Characteristics of Indian culture, Significance of Geography on Indian Culture, Society in India, Religion and Philosophy in India.

**Unit-II**
Indian Languages and Literature, Evolution of script and languages in India, Harappan Script and Brahmi Script, History of Buddhist and Jain Literature.

**Unit-III**
A Brief History of Indian Arts and Architecture, Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

**Unit-IV**
Spread of Indian Culture Abroad, Causes Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World.

**Recommended Readings:**


1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson


## Indian Architecture

**Course Code:** : **AUC 03** **Credits (0-0-0)**
**Course Category** : **Audit**

**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course outcome**
CO1- This course will help student learn about the development of Indian architecture and its contextual and traditional aspects.
CO2- The learner will gain knowledge of the development of architectural forms with reference to technology, style and character in various aspects of Hindu architecture.
CO3- The students will comprehend and relate to the theoretical basis of Budhdhist and Jain Architectures.

**UNIT 1**; Indus Valley Civilization: Town planning principles, cultural ethos, economy exemplified. The Aryan civilization: With its emphasis on the Vedic town plan.
**UNIT 2:** Buddhist Architecture Typology of lats, eddicts, stupas, viharas, and chaityas, both in rock-cut or other wise. The Buddhist philosophy and its imprint

**UNIT3**; Hindu Architecture, Indo Aryan: The evolution of the temple form, evolution of the shikhara in north India. The three schools of architecture - the Gujarat, the Khajuraho, and the Orrisan styles, Introduction to Dravidian Hindu Architecture.

**UNIT 4**: Jain Architecture : The temple cities of Palitana, Mount Abu and Girnar. Jain Theory The Jain philosophy and its imprint in built form.

**REFERNCE BOOKS**

1. Stella Kramrisch, The Hindu temple, Volume 1 & 2, Motilal Banarsidass Publications, 1996.
2. Percy Brown, Indian Architecture (Buddhist and Hindu period), D.B.Taraporewala Sons & co Pvt. Ltd. 1965
3. Volwahsen, Andreas, Living Architecture
4. Satish Grover, The Architecture of India- Volume 2, Vikas, 1980.
5. Henri Stierlin, Anne Stierlin, Hindu India: from Khajuraho to the temple city of Madurai, Taschen, 1998.
6. James Fergusson, History of Indian & Eastern Architecture, 2007
7. C. Batley, Design Development of Indian Architecture, John murray, London, 1934.

## Indian Festivals

**Course Code: : AUC 04 Credits (0-0-0)**
**Course Category : Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

CO1-Students will learn about rich cultural aspects associated with Indian religions

CO2-The course will give deep insight in to understand the importance of festivals.

**UNIT 1; Indian Festivals:** Introduction to major Indian festivals Bihu, Raksha Bandhan , Onam, Pongal, Holi, Dipawali, Dushehra, Easter, Good Friday, Christmas , Eid-ul-fitr and Eid-ul-Azha , Cultural aspects of festivals .

**UNIT 2** ; **Characteristics of Indian festivals** ; Seasonal in nature, seasonal festival are Agro based, worships of animals.

**UNIT 3**; festivals observed at same time but with different names in different parts of country.

**UNIT3 :** Artificial or non religious festivals- like Jaisalmer desert festivals, Mango festivals in Delhi, Elephant festivals in India. Etc.

**REFERENCE BOOKS**


1) Discover India; Festival of India by Sonia Mehta

2) Hindu Festival : Origin, sentiments and Rituals by Mukuncharan Das.


## VAIDIC MATHEMEATICS

| | | | |
|---|---|---|---|
| **Course Code:** | **:** | **AUC 05** | **Credits (0-0-0)** |
| **Course Category** | **:** | **Audit** | |
| **Pre-requisite Subject** | : | NIL | |
| **Contact Hours/Week** | : | 1/2 Lecture : , Tutorial : , Practical: | |
| **Number of Credits** | : | 0 Credit | |

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course outcomes:**

● Vedic mathematics methods are used in coding and VLSI implementation of encryption.
● Vedic mathematics method of division, exponentiation and multiplication are used in internet security and cryptographic algorithms for making these calculations faster than before.
● Arithmetic and logic unit (ALU) is responsible for all mathematical and logical calculations in computers. Some sutras like udharvtriyakbhyam and nikhilam are used for implementing multiplication methods.
● Digital Signal Processing (DSP) includes face recognition, text speech conversion, image processing and audio -video processing and also filtering of noise. In this area VM methods are very useful to improve the performance of DSP algorithms.

**UNIT-I**

Introduction & history of Vedic mathematics, Arithmetic and number, Vedic Maths Formulae, Addition and Subtraction: Addition - Completing the whole , Addition from left to right , Addition of list of numbers - Shudh method , Subtraction - Base method , Subtraction - Completing the whole, Subtraction from left to right

**UNIT-II**

Multiplication: Ekadhikenpurven method (multiplication of two numbers of two digits), Eknunenpurven method (multiplication of two numbers of three digits), Urdhvatiragbhyam method (multiplication of two numbers of three digits), Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits), Combined Operations

Division and Divisibility: Division, Nikhilam Navtashchramam Dashtaha (two digits divisor), Paravartya Yojyet method (three digits divisor)

Divisibility: Ekadhikenpurven method (two digits divisor), Eknunenpurven method (two digits divisor)

**UNIT-III**

Least Common Multiple **(LCM)** and Highest Common Factor **(HCF)**

Power and Root Power: Square (two digit numbers), Cube (two digit numbers).

Root: Square root (four digit number), Cube root (six digit numbers)

**UNIT-IV**

Contribution of Indian Mathematicians (In light of Arithmetic) , Aryabhatt , Brahmagupt , Mahaveeracharya , Bharti Krishna Tirtha

**Reference Books:**

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.

2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.

3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.

4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.

5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.

6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

## ASTRONOMY

**Course Code:** : **AUC 06** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

### UNIT-I

Historical introduction: Old Indian and western – astronomy – Aryabhatta, Tycho Brahe, Copernicus, Galileo – Olbers paradox – solar system – satellites, planets, comets, meteorites, asteroids.
Practical astronomy – telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.
Celestial mechanics – Kepler's laws – and derivations from Newton's laws.
Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

### UNIT-II

Stellar astronomy: H-R diagram, color-magnitude diagram – main sequence – stellar evolution – red giants, white dwarfs, neutron stars, black holes – accretion disc – Schwartzchild radius – stellar masses Saha–Boltzman equation – derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables – Novae and Super novae. Binary and multiple star system – measurement of relative masses and velocities. Interstellar clouds – Nebulae.

### UNIT-III

Transformations Generalized Coordinates, Canonical transformations, Conditions for canonical transformation and problem, Poisson brackets, invariance of PB under canonical transformation, Rotating frames of reference, inertial forces in rotating frames.

### UNIT-IV

Relativity and Application Concept of Special Theory of Relativity, Lorentz Transformation, Length Contraction and time dilation, Relativistic addition of velocities, conservation of mass and momentum, Concept of General Theory of Relativity, Equivalence of mass and energy, Relativistic Doppler shift and aberration of light. Lagrangian and Hamiltonian of relativistic particles, Relativistic degenerate electron gas.

**Reference Books:**

- "Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.
- William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977
- Bradley W.Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.
- Bradley W.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison Wesley Publishing Company,1996
- 'Stellar Astronomy' by K. D Abhayankar.
- 'Solar Physics' by K. D Abhayankar.


## ARTS OF INDIA

**Course Code:** : **AUC 07** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

CO1- Students will be introduced to emergence and development of art traditions upto 6th century C.E. Monuments will be studied in their cultural context.

CO2-Students will able to understand the monuments in their religious, regional and stylistic context. Students will be able to prepare plans of the monuments.

**Unit 1:**

Introduction to traditions of Art and Architecture in India . Introduction to Art and Architecture and prelude to historical art. ii. Art of the pre-Mauryan period. iii. Art and Architecture of Mauryan Period iv. Sources of Inspiration of Mauryan Art and Architecture: Foreign and Indigenous.

**Unit 2:**

Emergence and Development of Structural Stupa Architecture . Origin of Stupa Architecture. ii. Stupa Architecture - Pre-Mauryan and Mauryan periods. iii. North India, Central India, Deccan and Gandhara iv. Structural monasteries and Chaityas.

Emergence and Development of Rock-cut Architecture. Origin of Rock-cut Architecture. ii. Eastern India, Western Deccan, Eastern Deccan, Central India.

**Unit 3:**

Unit 4: Emergence and Development of Temple Architecture (08 hrs) i. Origin of Temple Architecture- Theoretical aspects. ii. Concept and symbolism of Temple. iii. Archaeological remains of structural temples. iv. Temple Architecture during the Gupta period. v. Temple Architecture during the Vakataka period.

**Unit 4:**

Sculptural Art and Paintings - Emergence and Development (10 hrs) i. Sculptural Art and Paintings -Concept and Symbolism. ii. Terracottas, Ivories and Bronzes iii. Paintings iv. Stone sculptures-Gandhara, Mathura, Sarnath and Andhra schools of Art. v. Art during the Gupta-Vakataka period.

**Recommended Readings:**


1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson


## INTELLECTUAL PROPERTY RIGHTS

| | | | |
|---|---|---|---|
| **Course Code:** | **:** | **AUC 08** | **Credits (0-0-0)** |
| **Course Category** | **:** | **Audit** | |
| **Pre-requisite Subject** | : | NIL | |
| **Contact Hours/Week** | : | 1/2 Lecture : , Tutorial : , Practical: | |
| **Number of Credits** | : | 0 Credit | |

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

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

CO1: Create an understanding on Intellectual Properties and the importance of it.

CO2: Understand Trademarks and Trade secrets. To create awareness of unfair completion and methods of it.

CO3: Create awareness on the protection copyrights and patents. Understand the Ownership rights and transfer.

CO4: Create awareness of Cyber laws, Cyber Crime and get understanding of Privacy of Data.

CO5: To create awareness international aspects of IPR and the Emerging Trends in IPR.

**Course Content**

**UNIT – I:** Introduction to Intellectual property: Introduction, types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, other international organizations,

agencies and treaties, importance of intellectual property rights. Creating Intellectual Property. Intellectual Property Management. Emerging Issues in IPR. Research and Development in India.

**UNIT – II:** Fundamentals of Patent: Historical Overview of Patent Law; Concept of Patent; Patentable Inventions; Procedure for Obtaining Patent; Rights and Obligations of Patent Holder; Transfer and Infringement of Patent Rights, Geographical Indications, Case Study: Apple versus Samsung Patent Dispute.

**UNIT – III:** Trademarks: Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes.

**UNIT – IV:** Copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

**Textbooks**

- Textbook of Intellectual Property Rights, N.K. Acharya. Asia Law House, ed. 2021.
- Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- Intellectual Property Rights–Pandey Neeraj, Dharni Khushdeep. PHI.
- Intellectual Property Rights: Text and Cases R. Radhakrishnan, S. Balasubramanian. Excel Books.

**Reference Books**

1) Intellectual property right – Unleashing the knowledge economy, Prabuddha Ganguli, Tate McGraw Hill ltd.

2) A short course in International Intellectual Property Rights – Karla C. Shippey, World Trade Press.

3) Intellectual Property Rights – Heritage, Science, & Society under international treaties – A. Subbian, - Deep & Deep Publications – New Delhi.

## HUMAN RIGHTS

| | | | |
|---|---|---|---|
| **Course Code:** | **:** | **AUC 09** | **Credits (0-0-0)** |
| **Course Category** | **:** | **Audit** | |
| **Pre-requisite Subject** | : | NIL | |
| **Contact Hours/Week** | : | 1/2 Lecture : , Tutorial : , Practical: | |
| **Number of Credits** | : | 0 Credit | |

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes:**

On completion of the course, students will be able to:

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. Strengthen the respect for human rights and fundamental freedoms.
3. Enable all persons to participate effectively in a free society.
4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.

**UNIT-I**

**The Basic Concepts:** Individual, Group, Civil Society, State, Equality, Justice, Human Values: Humanity, Virtues, Compassion.

**UNIT-II** **Human Rights and Human Duties:**

i) Philosophical and historical foundation of human rights and duties
ii) Theories of rights
iii) Concept and classifications of human rights and duties
iv) Human rights and duties

1. Correlation of rights and duties/responsibilities
2. Tensions between rights inter se, duties inter se, and rights and duties

**UNIT-III**

**Society, Religion, Culture, and their Inter-Relationship:** Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

**UNIT-IV**

**Social Structure and Social Problems:** Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

**Books & References:**

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

## LOGICAL RESEARCH

**Course Code: : AUC 10 Credits (0-0-0)**
**Course Category : Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination
**Course outcome:** In this course you should develop the following competencies:

CO1: To understand about research methodology with its different aspects, about logical reasoning, and types of research.
CO2: It will also result in knowledge appraisal from data collection to data interpretation.
CO3: Mathematical reasoning will also help them to acquire several skills required for the placement.

**Course Content**

**UNIT1**- Research Methodology: meaning, characteristics, Types of research; Process of research; Research methods and Ethical issues in research.

**UNIT2-** Logical Reasoning: arguments, deductive and inductive research, quantitative and qualitative research, scientific research; logical approach in research - Venn diagram; Inferences; analogies.

**UNIT3-** Data collection, Organization of data, Data analysis and mapping, Parametric and non-parametric; Data Interpretation.

**UNIT4-** Mathematical Reasoning, number series, letter series, codes; relationships, classification.

**References:**
1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Marketing Research- G C Beri
5. Logical reasoning- R S Agarwal

## PROFESSIONAL ETHICS

**Course Code: : AUC 11 Credits (0-0-0)**
**Course Category : Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**Course Outcomes**

Course Outcomes: After the completion of the course the student will be able to-

CO1: Understand the core values that shape the ethical behaviour of a professional.

CO2: Identify the multiple ethical interests at stake in a real-world situation or practice.

CO3: Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.

CO4: Solve moral and ethical problems through exploration and assessment by established experiments.

CO5: Apply the knowledge of human values and social values to contemporary ethical values and global issues.

**Course Content**

**Unit I:**

**Understanding Professional Ethics and Human Values:** Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment Empathy-Self Confidence -Social Expectations.

**Unit II:**

Ethics for Engineers: Ethics – its importance – code of ethics – person and virtues – habits and morals – 4 main virtues – ethical theories – Kohlberg's theory – Gilligan's theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology.

**Unit III:**

Environmental Ethics and Sustainability: Problems of environmental ethics in engineering – engineering as profession serving people – engineer's responsibility to environment – principles of sustainability – industrial, economic, environmental, agricultural, and urban sustainability – Sustainable development. - Global Ethical Issues.

**Unit IV:**

Social Experimentation, Responsibility and Rights: Engineers and responsible experiments – safety and risk – confidentiality – knowledge gained confidentiality – experimental nature of engineering – Intellectual Property Rights – professional rights – employee rights – occupational crime.

**Textbooks**

- Mike W Martin, Roland Schinzinger, " Ethics in Engineering", Tata McGraw –Hill.
- Govindarajan M, Natarajan S, Senthil Kumar V S, "Engineering Ethics" PHI India.
- R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

**Reference Books**

- Aarne Vesblind, Alastair S Gunn, "Engineering Ethics and the Enviornment".

- Edmund G Seebauer, Robert L Barry, "Fundamentals of Ethics for scientists and engineers" Oxford University Press.
- B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.


## ENVIRONMENTAL LAWS

**Course Code:** : **AUC 12** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture : , Tutorial : , Practical:
**Number of Credits** :
**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.
**Course Outcomes:**

The course gives students the opportunity to grapple with contemporary legal debates in environment law. Therefore, the learning outcomes of this course can be encapsulated as follows:

1) The primary learning outcome is to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.
2) Students will develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.
3) Students will be able to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.
4) Students will be able to assist industries and projects in obtaining environmental clearance and compliances with other environmental laws.

**UNIT-I**

**Development of Environmental Laws and Policies in India:**

I. Concept of 'environment' and understanding scope of environmental law.
II. Two approaches towards environmental protection- 'Eco-centric approach' and 'Anthropocentric' approach.
III. Impact of IEL on environmental law in India.
IV. Significance of Environmental Protection in Five Year Plans.
V. Development of the 'Right to Environment' as a Fundamental Right and challenges.

**UNIT-II** **Judicial remedies and the role of National Green Tribunal:**

I. Civil Remedies i.e. Tortious remedy and Class Action

II. Criminal Law Remedies under relevant provisions of Indian Penal Code, 1860 and Criminal Procedure Code, 1973
III. Constitutional Law Remedies i.e. Writ Jurisdiction & Public Interest Litigation
IV. Statutory Remedies i.e. Remedies under Public Liability Insurance Act 1991, National Environment Tribunal Act, 1995, National Green Tribunal Act, 2010

**UNIT-III**

**Statutory framework for Prevention of Environmental, Air and Water Pollution:**

I. Water (Prevention and Control of Pollution) Act 1974 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Constitutional Challenges of Restraining Orders under Section 33]
II. The Air (Prevention and Control of Pollution) Act 1981 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Noise Pollution]
III. Environment (Protection) Act, 1986 [Framework of the Act, Enforcement mechanisms and Role of Pollution Control Boards, Environment Impact Assessment, Coastal zone regulations Notifications]
IV. Law on Waste Management and Handling
V. Procedural environmental rights under various environmental laws
   - Right to Information
   - Right to public consultation
   - Right of access to justice

**UNIT-IV**

**Statutory framework governing Forest, Wildlife and Biodiversity:**

II. Statutory Framework on Forest Preservation [The Indian Forest Act, 1927; Forest (Conservation) Act, 1980; National Forest Policy, 1988; The Scheduled Tribe and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006]
III. Statutory Framework on Wildlife & Biodiversity Protection [The Wildlife (Protection) Act, 1972; Implementation and gaps and Judicial Perspective; Biological Diversity Act, 2002]

**Books & References:**


1) Shyam Divan & Armin Rosencranz, Environmental Law & Policy in India (2 nded, Oxford University Press, 2014)
2) P. Leelakrishnan, Environmental law in India (4th ed, LexisNexis, 2016)
3) Lavanya Rajamani and Shibani Ghosh, Indian Environmental Law: Key Concepts and Principles (Orient Blackswan, 2019)
4) Gitanjali Nain Gill, Environmental Justice in India: The National Green Tribunal (Routledge, 2017)
5) Patricia Birnie, Alan Boyle and Catherine Redgwell, International Law and the Environment (3rd ed., Oxford University Press, 2009)
6) Philippe Sands, Principles of International Environmental Law (2nd ed, Cambridge University Press, 2003)

## HEALTH LAW

**Course Code:** : **AUC 13** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:
**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

**Course Outcome:** In this course you should develop the following competencies:

CO1: Knowledge and understanding of the values and policies underlying Health Law.

CO2: Knowledge and understanding of substantive law related to health care, health care insurance markets as well as related procedural law.

CO3: Written and oral communication in the legal context.

**Course Content**

**UNIT-1** BASICS OF HEALTH LAW- Basic of Health and its provider, Origin & Evaluation, All Council Acts.

**UNIT-2** NEED FOR HEALTH LAW -Fraudulence, Negligence and Abuse, Human Rights, Rights & Duties of Health Care Provider (Public & Private Activities).

**UNIT-3** LEGAL ASPECTS OF HEALTH LAW- Role of Health Policy & Health Care Delivery, General Laws on Health Law (Medical Allied Agencies), Specific Laws on Health Law (NDT, PWD/etc.).

**UNIT-4** MEDICAL INSURANCE –Introduction-Various types, Significance and Kind of Medical Insurance/Policies, Insurance & Assurance, General Principles of Law and Contract, Medical Insurance Regulations.

**REFERENCES:**

1)Jonathan Herring- Medical Law and Ethics
2)Mason and Mc Call Smith- Law and Medical Ethics
3)S. V. Jogarao- Current Issues in Criminal Justice and Medical Law

## National Cadet Corps (NCC)

**Course Code:** : **AUC 14** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : ½ Lecture : , Tutorial : , Practical:

**Number of Credits** : 0 Credit

**Course Outcome:** In this course you should develop the following competencies:

CO1: Imbibe the conduct of NCC cadets.
CO2: Respect the diversity of different Indian culture.
CO3: Perform his/her role in Nation Building
CO4: Do the social services on different occasions.
CO5: Practice togetherness and empathy in all walks of their life.
CO6: Do the asana and gain the physical& mental fitness

**Course Content**

**UNIT 1**
**NCC General**

History, Aims, Objective of NCC, NCC as Organization. Incentives of NCC, Duties of NCC Cadet, NCC Camps: Types & Conduct.

**UNIT 2**
**National Integration & Awareness**

National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security

**UNIT 3**
**Social Service and Community Development**

Celebration of Days of National & International Importance, Social Service and Community Development Activities to be conducted.

**UNIT 4**
**Health & Hygiene:**

Yoga- Introduction, Definition, Purpose, Benefits.
Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

**Textbooks:**

1. R. Gupta, "NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations" 1st Edition (English, Paperback, RPH Editorial Board)

## Basics of Human Health and Preventive Medicines

**Course Code:** : **AUC 15** **Credits (0-0-0)**
**Course Category** : **Audit**
**Pre-requisite Subject** : NIL
**Contact Hours/Week** : 1/2 Lecture: , Tutorial : , Practical:
**Number of Credits** : 0 Credit

**Course Assessment Methods:** Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

**UNIT- 1**

**Health-** Definition, dimensions, concept of wellbeing, Physical quality of life index, Spectrum of health, Determinants of health.

**Concept of disease**- Epidemiological triad, Natural history of disease, Risk factors, risk group, Iceberg of disease, Disease control, Disease elimination, Disease eradication, **Monitoring and surveillance-** Concept of prevention, Primary, Secondary and Tertiary, Modes of Intervention.

**UNIT- 2**

**Communicable diseases**- Type of microorganisms, Mode of transmission, Prevention of infectious diseases, Vaccination/immunization**.**

**Diarrheal diseases and dehydration**- Prevention and role of ORS**.**

**Fever-** cause and how to deal with.

**Respiratory problems and cough**

**UNIT - 3**

**Non communicable diseases/ Lifestyle related disorder-** Risk factors, CAD, risk and prevention, Hypertension, Diabetes mellitus, Obesity, Cancer, Accidents.

**UNIT – 4**

**Nutrition and health**- Classification of food, Balance diet.

**Occupational hazards**

**Mental health and substance abuse**

**Medical Emergencies**- BLS and ALS.

**Reference Textbook**


1) K. Park – "Park's Textbook of Preventive and Social Medicine"
2) Yash Pal Bedi & Pragya Sharma– "Handbook of Preventive and Social Medicine, Seventeenth Edition, CBS Publication".
3) Sunder Lal, Adarsh, Pankaj – "Update on Textbook of Community Medicine Preventive and Social Medicine with Recent Advances" 5th Edition, Publication 2018.
4) Dr. B. Saha- "Preventive and Social Medicine Communicable Disease Hygiene".
5) Rabindra Nath Roy, Indernil Saha- "Mahajan and Gupta Textbook of Preventive and Social Medicine" 4th Edition, Japee

# Detail Syllabus of Extra Curricular Activities (ECA) Courses under Council of Student Activities

## Skill Development- I (ECA-151)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and IEEE:** An introduction to technical sub-council and IEEE. An overview of IEEE and the events conducted by them.

**UNIT- 2**

- **Robotics Classes:** Informative classes conducted on by the students of IEEE about Bot modelling and electronics as well as embedded. It is conducted for both Wired and Wireless Robotics.

**UNIT- 3**

- **Introduction to Workshops by IEEE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A number of workshops are conducted by IEEE like Ethical hacking, Soft skills, Artificial Intelligence etc.

**UNIT- 4**

- **Events under TechSrijan:** Techsrijan is the annual techno-management fest held every year like Enigma, Robotics, Incognito, Quizzes, World Parliament, etc.

## Skill Development- II (ECA-201)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and SAE:** An introduction to technical sub-Council and SAE. An overview of SAE and the events conducted by them.

**UNIT- 2**

- **Aeromodelling Classes:** Informative classes and workshop conducted on by the students of SAE about Drone and remote-controlled modeling and electronics as well as embedded.

**UNIT -3**

- **Introduction to Workshops by SAE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A no. of workshops is conducted by SAE like Aeromodelling workshop, Bridge modeling etc.

**UNIT- 4**

- **Events under TechSrijan by SAE:** Techsrijan is the annual techno-management fest held every year. SAE conducts a number of events in TechSrijan like Junkyard Wars, Bride Kriti, El Tiro etc.

## Skill Development- III (ECA-251)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and UIC:** The University Innovation Cell supports and provides opportunity for Innovation works. You will get to learn about the things they do and promote.

**UNIT -2**

- **Introduction to Innowizion:** Every year University Innovation Cell organizes a national level event that provides opportunities for students across all disciplines to team up and use their creativity, passion, and knowledge of technology. Events like I-Expo and I-Quiz.

**UNIT- 3**

- **Introduction to Spectra:** It is a special event organized by University Innovation Cell which foster an opportunity for students to showcase their creativity and talent. It comprises of three events InQUIZitive, Replica and MindBuzz**.**

**UNIT- 4**

- **Learnings and Innovation:** Innovation increases your chances to react to changes and discover new opportunities. It can also help foster competitive advantage as it allows you to build better products and services for your customers in the industry.

## Skill Development- IV (ECA-301)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and SEB:** The Social Engineers Board (SEB) tries to achieve its goals by series of various events conducted throughout the academic year, both inside and outside the university.The members of the board are highly motivated individuals striving for noble cause, and voluntarily take initiatives which ensure betterment of the people and society in any way possible.

**UNIT- 2**

- **Introduction to Drishya:** A career counselling event by college final year, and an event designed to crave out the creativity inside the students and their ability to make something novel out of normality in situation

**UNIT- 3**

- **Introduction to Dhishan:** Bringing out the oration skill and leadership personality among the students by providing them chance to stand and represent themselves by this event.

**UNIT -4**

- **Introduction to Paravartan and NGOs:** Paravartan consists of a audio visual round and the second round is a skit presentation developing character of a student. They also collab with NGOs for social works.

## Skill Development- Vth (ECA-351)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and E CELL:** E-Cell of Madan Mohan Malaviya University of Technology promotes entrepreneurship abilities among the students of the university and conducts events to promote these ideas.

**UNIT- 2**

- **Introduction to Fresher's Talk:** A creative talk with the freshers of our university in which the fresher students provide some insights of what and how are they feeling about the college and its environment.

**UNIT- 3**

- **Introduction to Start Up Week:** Understanding the aspects of and entrepreneurial background and train to become one, through various personality developing as well as professionally balanced events.

**UNIT- 4**

- **Entrepreneurship Development:** It is the process of enhancing the skillset and knowledge of entrepreneurs regarding the development, management and organization of a business venture while keeping in mind the risks associated with it. Students will learn and cultivate skills which will promote entrepreneurship.

## Skill Development-VIth (ECA-401)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Participation and Training |
| Course Outcome | : | Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events. |

**UNIT- 1**

- **Introduction to TSC and Robotics Club:** Robotics Club speaks a name for itself in this domain with a sheen of itself that has been set by the high standards of the club members and strict adherence to the tagline Transforming ideas into reality, Events Details

**UNIT- 2**

- **Introduction to Web D Classes:** Classes on web development helps students to develop skills like Front-end and Back-end development which they can use to make websites.

**UNIT -3**

- **Introduction to Engineers Week:** a seven-day event paying tribute to all the engineers across the globe by conducting a no. of exciting events for technical development of students.

**UNIT- 4**

- **Robomania:** Develop the knowledge of robotics and circuitry in the students through training of students on circuits and the conduction of Robo Wars, Electronic chess, diffusion of a bomb in a set up made by students, demonstration of live game of the virtual events of NFS and Tekken, Lazer strike, Designing of Lazer maze.

## Unity and Discipline (NCC)-I (ECA-171)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: |

- Imbibe the conduct of NCC cadets.
- Do the social services on different occasions.

**UNIT -1**
**Introduction of NCC**: History, Aims, Objective of NCC.

**UNIT -2**
NCC as Organization. Incentives of NCC, Duties of NCC Cadet.
**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities
**UNIT- 4**
NCC Parade on Independence Day.

## Unity and Discipline (NCC)-II – (ECA- 221)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to: - |

- Respect the diversity of different Indian culture.
- Do the social services on different occasions.

**UNIT- 1**
National Integration & Awareness, Importance & Necessity

**UNIT- 2**
Factors Affecting National Integration, Unity in Diversity

**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities
**UNIT- 4**
NCC Parade on Republic Day.

## Unity and Discipline (NCC)-III – (ECA-271)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to:<br>- |

- Perform his/her role in Nation Building.
- Do the social services on different occasions.

**UNIT- 1**
Role of NCC in Nation Building.

**UNIT- 2**
Threats to National Security.

**UNIT -3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities
**UNIT- 4**
NCC Parade on Independence Day.

## Unity and Discipline (NCC)-IV- (ECA-321)

| | | |
|---|---|---|
| Course Category | : | NCC |
| Pre Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Lecture & Practical |
| Course Outcome | : | After completing this course, the students will be able to:<br>- |

- Contribute to environmental awareness and conservation activities.
- Develop Leadership Qualities.
- Do the social services on different occasions.

**UNIT -1**
Environmental Awareness and Conservation.

**UNIT -2**
Leadership Development: Important Leadership traits, Indicators of leadership.

**UNIT- 3**
Celebration of Days of National & International Importance, Social Service and Community Development Activities

**UNIT -4**
NCC Parade on Republic Day.

**National Service Scheme-I (ECA-172)**

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.

- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.

- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall

strive for the well-being of the society.

**Introduction to National Service Scheme:**

**UINIT-I:** History and its Objectives

**UNIT-II:** Organizational structure of N.S.S. at National, State, University and College Levels

**UNIT-III:** Advisory committee and their functions with special reference to University CSA, Program officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

**UNIT-IV:** Organization/ Participation in "Tree-Plantation Drive"

## National Service Scheme- II (ECA-222)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

**UNIT-I:** National Integration, Need and importance of National integration

**UNIT-II:** Various obstacles in the way of National Integration, such as caste, religion, language and provisional problems etc.

**UNIT-III:** NSS related Activities: Awareness to various activities under NSS.

**UNIT-IV:** Organization/Participation in "Cleanliness Drive" at home, hostel, Department and University

**UNIT-V:** Organization/Participation in "Winter cloth collection and distribution to needy people"

## National Service Scheme- III (ECA-272)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |

Course Outcome : The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers

shall strive for the well-being of the society.

**UNIT-I: Special Programme in NSS-I**

A) Legal awareness
B) Health awareness
C) First-aid

**UNIT-II: Special Programme in NSS-II**

A) Career guidance
B) Leadership training-cum-Cultural Programme
**C)** Globalization and its Economic Social Political and Cultural impacts.

**UNIT-III: Special Camping programme in NSS-I**

A) Nature and its objectives
B) Selection of campsite and physical arrangement
**C)** Organization of N.S.S. camp through various committees and discipline in the camp.

**UNIT-IV: Special Camping programme in NSS-I**

A) Activities to be undertaken during the N.S.S. camp.
**B)** Use of the mass media in the N.S.S. activities.

# National Service Scheme- IV (ECA-322)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | NIL |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments. |
| Course Outcome | : | The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course: |

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

**UNIT-I: N.S.S. Regular Activities-I**

A) Traffic regulation
B) Working with Police Commissioner's Office
C) Working with Corporation of Gorakhpur District

**UNIT-II: N.S.S. Regular Activities-II**

A) Working with Health Department
B) Blind assistance
**C)** Garments collection and distribution

**UNIT-III: N.S.S. Regular Activities-III**

A) Non-formal Education
B) Environmental Education Awareness and Training (EEAT)'
**C)** Blood donation

**UNIT-IV: N.S.S. Regular Activities-IV**

A) Adopted Village related works
**B)** Disaster/Pandemic management

## GAMES & SPORTS-I (ECA-181)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at $12^{th}$ standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills, and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track.

**Track & Field-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS:**

- Starting techniques: Standing start, Crouch start and its variations, Proper use of blocks.
- Finishing Techniques: Run, Through, Forward lunging, Shoulder Shrug.

**UNIT- 3**

- **FUNDAMENTAL SKILLS-II:**

- Various patterns of Baton Exchange.
- Understanding of Relay Zones.
- Rules & their interpretation.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Track & Field

**Books & References**


1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

# GAMES & SPORTS-II (ECA-231)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track. |

**Basketball-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS- I:**

- Player stance and ball handling.
- Passing-Two Hand chest pass, Two hand Bounce Pass, One Hand Baseball pass, Side Arm Pass, Over Head pass, Hook Pass.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

**UNIT- 3**

- **FUNDAMENTAL SKILLS- II:**

- Dribbling-How to start dribble, how to drop dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble.
- Shooting-Lay-up shot and its variations, one hand set shot, one hand jump shot, Hook shot, and Free throw.
- Individual Defensive-Guarding the man with and without the ball, pivoting.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**


1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS-III (ECA-281)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.<br>• Understand the concept of skill.<br>• Acquire the required motor skills.<br>• Demonstrate and assess various techniques of starts and finish.<br>• Interpret the rules & regulations.<br>• Acquire skill of marking track |

**Volleyball-**

**UNIT- 1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS-I:**

- Service-Under Arm Service, Tennis Service, Floating Service.
- Overhead finger pass.
- The Dig (Under Arm pass).

**UNIT- 3**

- **FUNDAMENTAL SKILLS –II:**

- Back court defense.
- Defensive and Offensive strategies.
- Smash
- Block–individual and team.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Field.

**Books & References**


1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS-IV (ECA-331)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track for running events.

**Hockey-**

**UNIT-1**

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

**UNIT- 2**

- **FUNDAMENTAL SKILLS-I:**

- Player stance & Grip,
- Rolling the ball, Dribbling.
- Push, Stopping.
- Hit, Flick, Scoop.
- Reverse hit.

**UNIT- 3**

- **FUNDAMENTAL SKILLS-II:**

- Passing–Forward pass, square pass, triangular pass, diagonal pass, return Pass.
- Goalkeeping–Hand defense, foot defense.
- Positional play in attack and defense.

**UNIT- 4**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**


1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## GAMES & SPORTS- V (ECA- 381)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track for running events.

**UNIT 1**

- **YOGA- HOLISTIC HEALTH:**

 Health- Concept of Health, its importance in human life.
 Components of health.

**UNIT-II**

- **YOGA AND ITS IMPORTANCE:**

- Definition of Yoga.
- Importance of Yoga in daily life.
- Aims and Objective of yoga.
- Misconception of yoga.

**UNIT-III**

- **SURYA NAMASKAR:**

- Benefits of Surya Namaskar
- Practices of Surya Namaskar

**Unit- IV**

- **YOGA PRACTICES:**

 Asana- Meditative
  i) Sukhasana
  ii) Padmasana
  iii) Swastikasana
 Cultural- Trikonasana, Makarasana, Bhujangasana, Sarpasana, Dhanurasana.
 Pranayama- Yogic Breathing, Anulom-Vilom.

**Books & References**


1. Indra Devi, “Yoga For You”, Gibbs, Smith publishers, Salt Lake City, 2002 Domen& Publishers, New Delhi-2001.
2. Yoga se Arogya, Indian Yoga Society, Sagar.

## Games & Sports -VI (ECA- 431)

| | | |
|---|---|---|
| Course Category | : | Extra-Curricular Activities |
| Pre-Requisite | : | Physical Education at 12th standard |
| Contact/Hours of Work | : | 2 Hours/Week |
| Number of Credits | : | 0 |
| Course Assessment Method | : | Practical Training and Practices. |
| Course Outcome | : | The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. |

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track for running events.

**UNIT- 1**

- **Badminton**

**INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International.

**UNIT-II**

- **FUNDAMENTAL SKILLS-I:**

- Racket parts, Racket grips, Shuttle (dimensions).
- The basics stances.
- Basic foot movements.

**UNIT-III**

- **FUNDAMENTAL SKILLS-II:**

- The basic strokes-Serves.
- Forehand-overhead and underarm.
- Backhand-overhead and underarm.
- Types of games-Singles, doubles, including mixed doubles.

**Unit- IV**

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

**Books & References**


1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

## Culture, Art & Literary-I (ECA-182)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment Methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their Personality through cultural and literary activities. |

**UNIT-1**

Workout, Warm up, Stretching, Introduction to various dance forms, Dance form – Bollywood, Footwork, Body Movement, Theatre History, Literature and Aesthetics, Introduction to Acting, Yoga(Breathing, Exercise, Voice Control and Sound Modulation).

**UNIT-2**

Introduction to music, Basic Terminologies related to music, Origin of sound, Historical study of musical terms, Basic Introduction to Fine Arts, Roll of FAC in cultural sub-council, Basics of Fine Arts and Types, File extension, Editing software, Resources for stock images and video.

**UNIT-3**

**MALVIKA**: Basic knowledge of designing software (I) : Adobe In Design ,Photoshop ,Notice Making, Article writing.

**UNIT-4**

**TIRESIA**: Basic knowledge of designing software (I): Adobe In Design, Photoshop, Interview skills, Vocabulary development, Knowledge about technical advancements, knowledge of campus activities.

## Culture, Art & Literary-II (ECA-232)

| | |
|---|---|
| **Course category** | : Cultural, Art &Literary |
| **Pre-requisite Subject** | : NIL |
| **Contact hours/week** | : 2 Hours/Week |
| **Number of Credits** | : 0 |
| **Course Assessment Methods** | : Practical Participation |
| **Course Outcomes** | : Students are expected to develop their soft skills and their personality through cultural and literary activities. |

**UNIT-1**

Intro to basics of sketching, Painting, Craft, Sculpturing.

Sketch-Tools of sketching, Types of Sketching- Pencil/ Pen/ Color Pencil/ Charcoal/ Graphite/Ink/ Chalk / Digital Sketch. History of Indian Music, About life and contributions of Indian Musician sand Musicologists.

Two forms of Indian Classical Music (Hindustani/Karnataka).

**UNIT-2**

Introduction to Theatre Technique and Design, Character Analysis and practical on principle of Stanislavski Method (relaxations, concentration of attention and emotion memory), Workout, Warm up, Stretching, Dance Form- Hip-Hop, Footwork, Body movement, Choreography, Equipment, Types of lenses, building web site using template.

**UNIT-3**

**ARUNODAY**: Development of thinking ability with JAM (Just a Minute), Word Building, Letter rearrangement, Knowledge of spellings, Syllables, Critical thinking skill development, Vocabulary development, Thought expressing skill development, public speaking skill development.

**UNIT-4**

**SPELLCZAR**: Word building, Vocabulary development, Decision making ability development, Coordination capabilities.

## Culture, Art & Literary-III (ECA-282)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment Methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality through cultural and literary activities. |

**UNIT-1**

**Photo editing** (Photoshop)
**Ras**- (Sringar Ras, Hasya Ras, Rodra Ras, Karun Ras, Vir Ras, Adbhut Ras, Vibath Ras, Bhayanak Ras, Shaant Ras)

**UNIT-2**

Workout, Warmup, Stretching, Pranam, Types of classical dance forms and their outfits, Dance form-Kathak, Hand movements, Choreography, Basic knowledge of Talas for Instance Teental, Dadra and Kherwa, Practice of AUM and vocal exercises of sargam (sa, re, ga, ma, pa, dha, ni) of 45. Alankaras, Styles of Sketching-Line/
Hatching/Blending/Scribbles/Tattoo/Doodling/Cartoon/Graffiti/Typography/Calligraphy/Caricat Ure

**UNIT-3**

**ANNUAL DEBATE COMPETITION**: General Knowledge & Current Affairs, Public speaking skill development, Oratory skill development, Sense of Team spirit, Knowledge of language, Social Study, Development of presentation skills.

**UNIT-4**

**TWIST AND TWAIN**: Development of imaginative power and creativity, Development of vocabulary, Development of writing skills, Thinking skill development.

## Culture, Art & Literary-IV (ECA-332)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their Personality through cultural and literary activities. |

**UNIT-1**

Video editing, Basic knowledge about musical instruments (Tabla, flute, guitar etc.) about Swarmalika and two bragas-Bhupaliand Yaman.

**UNIT-2**

Monologue, reciting a poem, reading short stories, developing speech skill, Mime, Working on scene with partner and in a group, Painting-Tools of painting, Styles of painting-Abstract/Imagination/Expression/Cubism/Indian/Chinese/Japanese, All the theory covered upto Praveshi ka Purna, define and explain Kataaksha,Primalu, Nartan Bhedas- Nritta Nrutya and Natya, define Tandav and Lasya, Fourty pesof neck movements according to Abhinaya Darpan, Eight types of eye movements according to Abhinaya Darpan, Define and differentiate "FolkDance" and "Modern Dance" (Uday Shankar style), Life story of: Bindadin Maharaj, Kalka Prasadji, Harihar Prasadji& Hanuman Prasadji, Specialty of Jaipur and Lucknow Gharana,Definition and uses of the following Asanyukta Hasta Mudras: Sarpsheersha, Murga-sheersha, Simha-Mukha, Kangula, Alapadma, Chatura, Bhrama, Hansasya, Hansa-paksha, Sandausha, Mukula, Tamrachuda, Vyagraha, Trishula, Sanyukta HastaMudra: Anjali, Kapota, Karkata, Swastik, Dola, Pushpaputa, Utsanga, Shivalinga, Katakawardhan, Kartari-swastk, Shakata, Shankha.

**UNIT-3**

**VAGMITA1**: Development of oratory skill, Development of poetry writing skill, Alankar, Ras, Creative thinking ability development.

**UNIT-4**

**VAGMITA 2**: How to overcome camera consciousness, enhancement of the expression and presentation of the participants, development of the public speaking skill, Knowledge of tone adjustment while presenting.

## Culture, Art & Literary-V (ECA-382)

| | | |
|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality |

**UNIT-1**

Types of painting-Oil painting/ Watercolor painting/ Pastel painting/ Acrylic painting/ Digital painting/Spray Painting, Basic of Contemporary Dance, Foot Position and Transference, Center Technique, Travelling Technique, Dance, Dance (A) Peter Pan, dance (B) Emergence of a Butterfly.

**UNIT-2**

Improvisation, Elementary knowledge of Acting, Body language, Rhythm, Clarity and fluency in dialogue delivery, Understanding the depth of character, about terms related to Hindustani music like Naad, Shuruti, Saptak, Thaat, Vaadi, Samvadi, Photography Skill.

**UNIT-3**

**MALAVIYAN THINKER**: Creative thinking, how to pen down thoughts of our mind, Development of writing skill, Development of Expression, Public Speaking skill development.

**UNIT-4**

**ABHYUDAYA**: Multidimensional skill development: Technical skill development with software like Adobe Photoshop, MS word, MS PowerPoint, MS Excel, Content Writing skill development, public addressing, public engagement, Team work Mechanism, Leadership qualities, Time management, art and craft, Pottery, Oratory skill development, Presentation skill, Event management.

## Culture, Art & Literary-VI (ECA-432)

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|---|---|---|
| **Course category** | : | Cultural, Art &Literary |
| **Pre-requisite Subject** | : | NIL |
| **Contact hours/week** | : | 2 Hours/Week |
| **Number of Credits** | : | 0 |
| **Course Assessment methods** | : | Practical Participation |
| **Course Outcomes** | : | Students are expected to develop their soft skills and their personality |

**UNIT-1**

Cinematography, Basic knowledge of Thaat system, Raga formation rules, 5 Ragas- Bhupali, Yaman, Bihag, Kafi, Deskar.

**UNIT-2**

Introduction to Nukkad, Mono Act, Skit, Introduction to Comedy, Tragic Comedy, Tragedy, Melodrama, Craft- Tools of craft, Types of Craft- paperwork/ Wood work/ foam work/ Cloth work, Popping/ Introto music theory, Angles and Movement/Music Theory, Direction and Levels/Rhythms for Grooves, Twists and isolated movements/8 Count Phrasing, Footwork/Floats and Glides, Waves/Movements Dynamics, Waves 2/Musical Phrasing, Putting it all together.

**UNIT-3**

**WRITING SKILLS:** Invitation making, Notice making, Article writing.

**SKILL FOR INTEVIEWER**: How to take formal interview, approaching the personality, Questions preparation, management, platform selection, public engagement.

**UNIT-4**

**INTERVIEW SKILLS FOR INTERVIEWEE**: Body language, Attire, Hand gestures, voice tone, Language, General Interview Questions- How to introduce yourself.