**Batch 2019-2023**
**2020-2024**
**2021-2025**
**2022-2026**

# Revised Syllabus (CBCS)
# (According to AICTE Model Curriculum)
# w.e.f. 2019-20

# B.TECH
# IN
# ELECTRICAL ENGINEERING

## (Semester I/Semester II)

## FACULTY OF ENGINEERING & TECHNOLOGY
## GURUKULA KANGRI VISHWAVIDYALAYA, HARIDWAR

## ACADEMIC SESSION 2019-2020

**Revised Syllabus (Effective from the session 2019-20)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**
**B. Tech. First Year**

**SEMESTER-I**

| S. No. | | DSC/SEC/ DSE | SUBJECT | PERIODS | | | | EVALUATION SCHEME | | | | SUBJECT TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COURSE OPTED | COURSE CODE | | | | | | Sessional Evaluation | | | Exam ESE | |
| THEORY | | | | | | | | | | | | |
| | | | | L | T | P | Credit | CT | TA | Total | | |
| 1. | BSC 101 | BEM-C 102 | Engineering Mathematics – I | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 2. | BSC 102 | BAP-C102 | Engineering Physics | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 3. | ESC 104 | BEE -C 102 | Basic Electrical Engineering | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 4. | ESC 105 | BET-C 102 | Electronic Devices | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 5. | SEC-1 | BHU-S 102 | Vedic Science and Engineering | 2 | 0 | 0 | 0 | 20 | 10 | 30 | 70 | 100 |
| 6. | | | Induction Program | | For First Three Week | | | | | | | |
| | | | TOTAL | 14 | 4 | 0 | 16 | 100 | 50 | 150 | 350 | 500 |
| PRACTICAL | | | | | | | | | | | | |
| 7. | BSC 102 | BAP-C 151 | Engineering Physics Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 8. | ESC 104 | BEE -C 151 | Basic Electrical Engineering Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 9. | ESC 105 | BET-C 151 | Electronic Devices Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 10. | ESC 102 | BME-C 152 | Workshop Practice | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 11. | MC | BSP-S151 | Physical Training and Yoga | 0 | 0 | 2 | 0 | 10 | 05 | 15 | 35 | 50 |
| | | | TOTAL | 0 | 0 | 10 | 4 | 50 | 25 | 75 | 175 | 250 |
| | | TOTAL | | | | | 20 | | | | | 750 |

**L**-LECTURE;**T**-TUTORIAL; **P**-PRACTICAL;**CT**-CUMULATIVE TEST; **TA**- TEACHER ASSESSMENT; **ESE–**END SEMESTER EXAMINATION; **BSC**- Basic Science Course; **ESC**- Engineering Science Course; **PEC**- Professional Elective Course;**PCC**- Professional Core Courses;**SEC**- Skill Enhancement Course; **HSMC**- Humanities and Social Sciences including Management Courses; **MC**- Mandatory Courses; **OEC**- Open Elective Courses; **PROJ**- Project.

**Coding:**

BEE : Electricals BET : Electronics BEM : Mathematics
BHU:Humanities BME : Mechanical BAP : Physics

**Revised Syllabus (Effective from the session 2019-20)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**
**B. Tech. First Year**

**SEMESTER-II**

| S. No. | | DSC/SEC/ DSE. | SUBJECT | PERIODS | | | | EVALUATION SCHEME | | | | SUBJECT TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COURSE OPTED | COURSE CODE | | | | | | Sessional Evaluation | | | Exam ESE | |
| THEORY | | | | | | | | | | | | |
| | | | | L | T | P | Credit | CT | TA | Total | | |
| 1. | BSC 103 | BEM -C202 | Engineering Mathematics – II | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 2. | BSC 104 | BAC-C202 | Engineering Chemistry | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 3. | ESC 106 | BME-C203 | Basic Mechanical Engineering | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 4. | ESC 101 | BCE -C202 | Programming for Problem Solving | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 5. | MC | BEN -A203 | Environmental Studies | 2 | 0 | 0 | 0 | 20 | 10 | 30 | 70 | 100 |
| | | | TOTAL | 14 | 3 | 0 | 15 | 100 | 50 | 150 | 350 | 500 |
| PRACTICAL | | | | | | | | | | | | |
| 6 | BSC 104 | BAC-C251 | Engineering Chemistry Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 7. | ESC 101 | BCE -C251 | Programming for Problem Solving Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 8. | ESC 103 | BME-C253 | Engineering Graphics and Design Lab | 1 | 0 | 2 | 2 | 10 | 05 | 15 | 35 | 50 |
| 9. | HSMC101 | BEG-A251 | Technical Communication Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| | | | TOTAL | 1 | 0 | 08 | 5 | 40 | 20 | 60 | 140 | 200 |
| | | TOTAL | | | | | 20 | | | | | 700 |

**L**-LECTURE; **T**-TUTORIAL; **P**-PRACTICAL; **CT**-CUMULATIVE TEST; **TA**- TEACHER ASSESSMENT; **ESE–**END SEMESTER EXAMINATION; **BSC-** Basic Science Course; **ESC-** Engineering Science Course; **PEC-** Professional Elective Course; **PCC-** Professional Core Courses; **SEC-** Skill Enhancement Course; **HSMC-** Humanities and Social Sciences including Management Courses; **MC-** Mandatory Courses; **OEC-** Open Elective Courses; **PROJ-** Project.

**Coding:**

BEM : Mathematics
BME : Mechanical
BCE: Computers
BAC: Chemistry
BEG : Humanities
BEN: Environmental

Effective from the session 2019-20

## Mandatory Induction Program

| | |
|---|---|
| Induction program forstudents to be offered rightat the start of the first year.<br><br>**(3 weeks duration)** and **credit:0** | |
| Activities carried out during three weeks induction program | • Physical activity<br>• Creative Arts<br>• Universal Human Values<br>• Literary<br>• Proficiency Modules<br>• Lectures by Eminent People<br>• Visits to local Areas<br>• Familiarization to Dept./Branch & Innovations |

**Revised Syllabus (Effective from the session 2020-21)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**
**B. Tech. Second Year**

**SEMESTER-III**

| S. No. | | DSC/SEC/ DSE. | SUBJECT | PERIODS | | | | EVALUATION SCHEME | | | | SUBJECT TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COURSE OPTED | COURSE CODE | | | | | | Sessional Evaluation | | | Exam ESE | |
| THEORY | | | | | | | | | | | | |
| | | | | L | T | P | Credit | CT | TA | Total | | |
| 1. | BSC 201 | BEM-C302 | Engineering Mathematics-III | 3 | 1 | 0 | 4 | 20 | 10 | 30 | 70 | 100 |
| 2. | PCC-EE04 | BEE-C305 | Electrical Machines – I | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 3. | PCC-EE01 | BEE-C308 | Electrical Circuit Analysis | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 4. | PCC-EE06 | BEE-C309 | Electromagnetic Fields | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 5. | PCC-EE02 | BET-C307 | Analog Circuit | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| | | | TOTAL | 15 | 1 | 0 | 16 | 100 | 50 | 150 | 350 | 500 |
| PRACTICAL | | | | | | | | | | | | |
| 6. | PCC-EE05 | BEE-C351 | Electrical Machines-I Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 7. | PCC-EE01 | BEE-C352 | Electrical Circuit and Simulation Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 8. | SEC-3 | BEE-C353 | Seminar | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 9. | PCC-EE03 | BET-C351 | Analog Circuit Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| | | | TOTAL | 0 | 0 | 8 | 4 | 40 | 20 | 60 | 140 | 200 |
| | | TOTAL | | | | | 20 | | | | | 700 |

**L**-LECTURE; **T**-TUTORIAL; **P**-PRACTICAL; **CT**-CUMULATIVE TEST; **TA**- TEACHER ASSESSMENT; **ESE–**END SEMESTER EXAMINATION; **BSC**- Basic Science Course; **ESC**- Engineering Science Course; **PEC**- Professional Elective Course; **PCC**- Professional Core Courses; **SEC**- Skill Enhancement Course; **HSMC**- Humanities and Social Sciences including Management Courses; **MC**- Mandatory Courses; **OEC**- Open Elective Courses; **PROJ**- Project.

**Coding:**
BEE : Electrical BET : Electronics

**Revised Syllabus (Effective from the session 2020-21)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**
**B. Tech. Second Year**

**SEMESTER-IV**

| S. No. | | DSC/SEC/ DSE. | SUBJECT | PERIODS | | | | EVALUATION SCHEME | | | | SUBJECT TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | COURSE OPTED | COURSE CODE | | | | | | Sessional Evaluation | | | Exam ESE | |
| THEORY | | | | | | | | | | | | |
| | | | | L | T | P | Credit | CT | TA | Total | | |
| 1. | PCC-EE09 | BEE-C410 | Electrical Machines – II | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 2. | PCC-EE11 | BEE-C411 | Power Electronics | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 3. | PCC-EE22 | BEE-C412 | Electrical Measurement and Measuring Instruments | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 4. | PCC-EE13 | BEE-C413 | Signals and Systems | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 5. | PCC-EE07 | BET-C414 | Digital System Design | 3 | 0 | 0 | 3 | 20 | 10 | 30 | 70 | 100 |
| 6. | HSMC-2 | BKT-A403 | Indian Knowledge Tradition | 2 | 0 | 0 | 0 | 20 | 10 | 30 | 70 | 100 |
| | | | | | | | | | | | | |
| | | | TOTAL | 17 | 0 | 0 | 15 | 120 | 60 | 180 | 420 | 600 |
| PRACTICAL | | | | | | | | | | | | |
| 8. | PCC-EE10 | BEE-C461 | Electrical Machines-II Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 9. | PCC-EE12 | BEE-C462 | Power Electronics Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 10. | PCC-EE22 | BEE-C463 | Electrical Measurement and Measuring Instruments | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| 11. | PCC-EE08 | BET-C464 | Digital System Design Lab | 0 | 0 | 2 | 1 | 10 | 05 | 15 | 35 | 50 |
| | | | TOTAL | 0 | 0 | 8 | 4 | 40 | 20 | 60 | 140 | 200 |
| | | TOTAL | | | | | 19 | | | | | 800 |

**L**-LECTURE; **T**-TUTORIAL; **P**-PRACTICAL; **CT**-CUMULATIVE TEST; **TA**- TEACHER ASSESSMENT; **ESE**–END SEMESTER EXAMINATION; **BSC**- Basic Science Course; **ESC**- Engineering Science Course; **PEC**- Professional Elective Course; **PCC**- Professional Core Courses; **SEC**- Skill Enhancement Course; **HSMC**- Humanities and Social Sciences including Management Courses; **MC**- Mandatory Courses; **OEC**- Open Elective Courses; **PROJ**- Project.

**Coding:**
BEE : Electricals BET : Electronics BEM : Mathematics
BKT: Indian Knowledge Tradition

Note:- The students have to undergo an industrial training/ mini project/ internship program during summer vacation (June - July) after IV semester examination. The report and certificate of completion of training program has to be submitted in the department which will be evaluated in V semester. Also the students have to present PPT of the insustrial training/ mini project/ internship for presentation in the department.

**CHOICE BASED CREDIT SYSTEM**

**EVALUATION SCHEME**

**AND**

**COURSE OF STUDY**

**IN**

**B.TECH.**

**ELECTRICAL ENGINEERING**

**(THIRD YEAR)**

**SCHEME OF EXAMINATION & SYLLABUS**

**FACULTY OF ENGINEERING AND TECHNOLOGY**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**ACADEMIC SESSION 2021-22**

**(Effective from the academic session 2021-22)**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**Faculty of Engineering & Technology**

**Electrical Engineering**

**B. Tech. Third Year**

**Syllabus in accordance with AICTE Model Curriculum**

**SEMESTER-V**

| Sl. No. | Course Code | SUBJECT | PERIODS | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY** | | | | | | | | | | | |
| 1 | BEE-C 511 | Power Systems - I | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 2 | BEE-C 512 | Control Systems | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 3 | BEE-C 513 | Electrical Drives and Their Control | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 4 | BEE-M 001 | Universal Human Values | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 5 | BXX-P XXX | Program Elective - I | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 6 | BEE-O XXX | Open Elective - I | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| **PRACTICAL** | | | | | | | | | | | |
| 7 | BEE-C 561 | Power Systems Laboratory - I | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 8 | BEE-C 562 | Control Systems Laboratory | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 9 | BEE-C 563 | Electrical Drives Laboratory | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 10 | BEE-S 569 | Summer Training and Internship Program-I /Mini Project (3-4 Weeks) | To be pursued during summer vacation, submit a certificate of completion in the department (in summer break after IV semester exam and will be assessed during V semester) | | | | | | | 50 | 1 |
| | **TOTAL** | | **18** | **0** | **6** | **150** | **75** | **225** | **525** | **800** | **22** |

**Program Elective-I**

1. BEE-P 514 Line Commutated and Active Rectifiers
2. BCE-P 515 Object Oriented Programming using CPP

**Open Elective -I**

1. BCE-O 534 Introduction to AI
2. BEE-O 517 Industrial Electrical Systems.

**(Effective from the academic session 2021-22)**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**Faculty of Engineering & Technology**

**Electrical Engineering**

**B. Tech. Third Year**

**Syllabus in accordance with AICTE Model Curriculum**

**SEMESTER-VI**

| Sl. No. | Course Code | SUBJECTS | PERIODS | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| **THEORY** | | | | | | | | | | | |
| 1 | BEE-C 611 | Power Systems II | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 2 | BEE-C 612 | Computer Aided Design of Electrical Machine | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 3 | BET-C 613 | Microprocessors and Interfacing | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 4 | BEE-P 6XX | Program Elective-II | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 5 | BEE-O 6XX | Open Elective II | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| **PRACTICAL** | | | | | | | | | | | |
| 6 | BEE-C 661 | Power Systems Laboratory - II | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 7 | BET-C 666 | Microprocessors Laboratory | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 8 | BEE-C 663 | Computer Aided Design of Electrical Machine Laboratory | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| **TOTAL** | | | **15** | **0** | **6** | **130** | **65** | **195** | **455** | **650** | **18** |

**Note:-** The students have to undergo an industrial training/mini project/internship program II during summer vacation (June –July) after VI semester examination. The report and certificate of completion of training program has to be submitted in the department which will be evaluated in VII semester. Also the students have to present PPT of the industrial training/mini project/internship for presentation in the department.

**Program Elective-II**

1. BEE-P 614 Special Electrical Machines
2. BEE-P 615 Advanced Electric Drives.

**Open Elective-II**

1. BET-O 616 Fundamentals of IOT and its Applications
2. BET-O 612 Digital Signal Processing

# CHOICE BASED CREDIT SYSTEM
# EVALUATION SCHEME
# AND
# COURSE OF STUDY
# IN
# B. TECH
# ELECTRICAL ENGINEERING
# (FOURTH YEAR)
# SCHEME OF EXAMINATION & SYLLABUS

**FACULTY OF ENGINEERING AND TECHNOLOGY**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**ACADEMIC SESSION 2022-23**

**(Effective from the academic session 2022-23)**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**Faculty of Engineering & Technology**

**Electrical Engineering**

**B. Tech. Fourth Year**

**Syllabus in accordance with AICTE Model Curriculum**

**SEMESTER-VII**

| Sl. No. | Course Code | SUBJECTS | PERIODS | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| 1 | BEE-C 711 | Switchgear And Protection | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 2 | BEE-P 7XX | Program Elective-III | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 3 | BEE-P 7XX | Program Elective-IV | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 4 | BEE-O 7XX | Open Elective-III | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 5 | BEE-O 7XX | Open Elective-IV | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 6 | BEE-P 770 | Project Stage-I | 0 | | 6 | 20 | 10 | 30 | 70 | 100 | 3 |
| | **PRACTICAL** | | | | | | | | | | |
| 7 | BEE-C 761 | Switchgear And Protection Laboratory | 0 | 0 | 2 | 10 | 5 | 15 | 35 | 50 | 1 |
| 8 | BEE-S 769 | Summer Training and Internship Program-II /Mini Project (3-4 Weeks) | To be pursued during summer vacation, submit a certificate of completion in the department (in summer break after VI semester exam and will be assessed during VII semester) | | | | | | | 50 | 1 |
| | | | | | | | | | | | |
| **TOTAL** | | | **15** | **0** | **8** | **130** | **65** | **195** | **455** | **700** | **20** |

**Program Elective-III**

1. BEE-P 712 High Voltage Engineering
2. BEE-P 713 Electrical Standards and Engineering Practices.
3. BEE-P 714 Utilization of Electrical Energy & Traction

**Program Elective-IV**

1. BEE-P 715 Digital Control Systems
2. BEE-P 716 Power System Restructuring & Deregulation
3. BEE-P 717 Switch Mode Power Supply

**Open Elective-III**

1. BEE-O 718 Sensors and Transducers
2. BEE-O 719 Introduction to PLC and SCADA Systems

**Open Elective-IV**

1. BEE-O 720 Robotics Engineering
2. BEE-O 721 Reliability Engineering
3. BEE-O 722 Testing and Commissioning of Electrical Equipment

**(Effective from the academic session 2022-23)**

**GURUKULA KANGRI (DEEMED TO BE UNIVERSITY), HARIDWAR**

**Faculty of Engineering & Technology**

**Electrical Engineering**

**B. Tech. Fourth Year**

**Syllabus in accordance with AICTE Model Curriculum**

**SEMESTER-VIII**

| Sl. No. | Course Code | SUBJECTS | PERIODS | | | EVALUATION SCHEME | | | | SUBJECT TOTAL | CREDITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | SESSIONAL EVALUATION | | | EXAM ESE | | |
| | | | L | T | P | CT | TA | TOTAL | | | |
| 1 | | MOOC-I | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 2 | | MOOC-II | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 3 | | MOOC-III | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 4 | | MOOC-IV | 3 | 0 | 0 | 20 | 10 | 30 | 70 | 100 | 3 |
| 5 | BEE-P 861 | Project Stage-II | 0 | 0 | 16 | 0 | 100 | 100 | 300 | 400 | 8 |
| | | **TOTAL CREDITS** | **12** | **0** | **16** | **80** | **140** | **220** | **580** | **800** | **20** |

List of MOOC courses shall be decided by the departmental committee in each semester depending upon the list from SWAYAM/NPTEL and other recognized online platforms. Students have to study from Online Platform doubt sessions shall be held by Internal teachers and exams shall be taken by university. If a student wishes he can give exam of Online Platform for certification. SWAYAM courses to run every year from July onwards (Odd Semester) are declared in the month of May and for courses to run every year from January onwards (Even Semester) are declared in the month of December on website https://swayam.gov.in/.

**Notice:-** The SWAYAM course coordinator will ensure that the students are informed about MOOCs courses well before time so that students get registered in the courses decided by the department committee.

Revised Syllabus (Effective from the session 2019-20)
Gurukula Kangri Vishwavidyalaya, Haridwar
Faculty of Engineering & Technology

## BEM-C101-ENGINEERING MATHEMATICS -I

MM: 100
Time: 3 hrs
L T P
3 1 0

Sessional: 30
ESE: 70
Credits 4

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**Differential Calculus I :** Successive differentiation, Leibnitz theorem, Taylor's & Maclaurin's Expansion, Indeterminate forms, Radius of curvature, Asymptotes, Double points and their classification, Tracing of curves.

### UNIT II

**Differential Calculus II:** Function of two variables, limit, continuity, Partial Differentiation of functions, Normal to surfaces and tangent plane, Change of variables, Jacobian, Taylor's series of two variables, Truncation errors, Extrema of function of two and more variables, Method of Lagrange's multipliers.

### UNIT III

**Multiple Integrals :** Fundamental Theorem of integral calculus, Differentiation under the integral sign, Double and triple integrals, Change of order of integration, change of variables. Application to arc length, area, volume, centroid and moment of inertia. Gamma and Beta functions, Dirichlet's integral.

### UNIT IV

**Vector Calculus :** Differentiation of a vector, Scalar and vector fields, Gradient, Divergence, Curl and their physical meanings, Differential operator and identities, Line, Surface and Volume integrals, Green's theorem in plane. Gauss and Stoke's theorems (without proof). Simple applications.

### UNIT V

**Matrices :** Elementary row/ column operations, Rank of a matrix and its applications, Eigen-values and Eign vectors, Cayley-Hamilton theorem, Diagonalization of Matrices, Linear dependence and independence, Normal matrices, Complex matrices and unitary matrices.

**Text Books / References**


1. Thomas, G.B., Finney, R.L., Calculus, Pearson, 1996.
2. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
3. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
4. Prasad C., A First Course in Mathematics for Engineers, Prasad Mudranalaya, 1995.
5. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000

# BAP-C102
# ENGINEERING PHYSICS
## Branch: Electronics & Communication Engineering
## &
## Electrical Engineering

MM: 100 | Sessional: 30
Time: 3 hrs | ESE: 70
L T P | Credit: 4
3 1 0

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course objectives:** The main objective of this course is to improve the ability to think logically about the problems of Science and Technology and obtain their solutions. This course is aimed to offer broad areas of physics which are required as an essential background to Electronics & Communication engineering and Electrical engineering students.

### UNIT -I

**Electronic materials: (8 hours)**
Free electron theory of metals, quantum theory of free electrons, Fermi level, Density of states, Energy bands in solids, Direct and indirect bandgaps, Types of electronic materials: metals, semiconductors, and insulators, Density of states, Occupation probability, Fermi level,

### UNIT –II

**Semiconductors: (8 hours)**
Intrinsic and extrinsic semiconductors, Dependence of Fermi level on carrier-concentration and temperature (equilibrium carrier statistics), concentration of charge carriers, Carrier generation and recombination, Carrier transport: diffusion and drift in p-n junction.

### UNIT –III

**Quantum Mechanics: (8 hours)**
Introduction to quantum physics, black body radiation, explanation using the photon concept, photoelectric effect, Compton effect, de Broglie hypothesis, verification of matter waves, Davisson-Germer's experiment, uncertainty principle, Schrodinger wave equation & its solution for particle in a box, physical significance of wave function.

### UNIT –IV

**Electrostatics: (8 hours)**
Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution, Practical examples like Faraday's cage and coffee-ring effect, Boundary conditions of electric field and electrostatic potential; method of images with simple examples, energy of a charge distribution and its expression in terms of electric field.

## UNIT –V

**Magnetostatics & LASERS: (8 hours)**

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby laser, He-Ne and CO2 laser, properties and applications of lasers.

**References:**


1.I.G. Main, Vibrations and Waves in Physics, Cambridge University Press (1993).
2. H. J. Pain, The Physics of Vibrations and waves, Wiley India Pvt., Ltd. 6th Edition (2010).
3. David Griffiths, Introduction to Electrodynamics, Pearson Education India Learning Private Ltd. 4th Edition (2015).
4. Halliday, Resnick, Walker, Fundamental of Physics, Wiley India Pvt. Ltd; 10th Edition (2015).
5.W. Saslow, Electricity, magnetism and light, Academic Press, 1th Edition (2002).
6. E. Hecht, Optics, Pearson Education, India, 4 th Edition (2008).
7. A. Ghatak, Optics, Tata McGraw-Hill Education India, 5th Edition (2012).
8. O. Svelto, Principles of Lasers, Springer Science & Business Media (2010).
9. D.J. Griffiths, Quantum Mechanics, Pearson Education (2014).
10. R. Robinett, Quantum Mechanics, OUP Oxford (2006).
11. L.I. Schiff, Quantum Mechanics, Tata McGraw-Hill Education Pvt. Ltd, 4th Edition (2014)
12. D.A. Neamen, Semiconductor Physics and Devices, Times Mirror High Education Group, Chicago (1997).
13. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore (1998).
14. B. G. Streetman, Solid State Electronic Devices, Prentice Hall of India (1995).
15. K. Charles, Introduction to Solid State Physics, John Wiley, Singapore, 7th Edition (1996).


**Learning outcomes**

After successful completion of the course the students will have desire and adequate understanding of different phenomena associated with developments in Physics.

Revised Syllabus (Effective from the session 2019-20)

Gurukula Kangri Vishwavidyalaya, Haridwar

Faculty of Engineering & Technology

Electrical Engineering

# BEE-C 102

## BASIC ELECTRICAL ENGINEERING

MM : 100
Time : 3 hrs
L T P
3 1 0
Credits 4

Sessional : 30
ESE : 70

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**D.C. Network Theory:** Concept of elements, Circuit theory concepts- Mesh and node analysis, Star-Delta transformation. Network Theorems- Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem, DC Transients- RL, RC circuits.

### UNIT II

**Steady State Analysis of A.C. Circuits:** Sinusoidal and Phasor representation of voltage and current, average and rms value, form and peak factor of sinusoidal and different waveforms, single -phase A.C. circuit- behavior of resistance, inductance and capacitance and their combination in series & parallel and power factor, series parallel resonance-band width and quality factor.

**Three Phase A.C. Circuits:** Star-Delta connections, line and phase voltage/current relations, three - phase power and its measurement.

### UNIT III

**Magnetic Circuits:** Ampere turns, magnetomotive force, permeability, reluctance, composite magnetic circuits, comparison between magnetic and electric circuits.

**Transformer:** Principle of operation, types of construction, phasor diagram, equivalent circuit, efficiency and voltage regulation of single-phase transformer, O.C. and S.C. tests.

### UNIT IV

**D. C. Machines:** Working principle, Construction and types of D.C. machines, E.M.F. equation, Magnetization and load characteristics, losses and efficiency, speed control of D.C. motors and applications.

### UNIT V

**A.C Machine:** Working principle of single phase and three phase Induction machine and three phase Synchronous machines.

**Measuring Instruments:** Principle of working and constructional features of Permanent Magnet Moving Coil and Moving Iron ammeters and voltmeters, Electrodynamic Wattmeter, Induction type single-phase Energy meter.

**Books**

1. V. Del Toro, Principles of Electrical Engineering, Prentice Hall International.
2. H. Cotton, Advanced Electrical Technology, Wheeler Publishing.
3. E. Huges, Electrical Technology.

**erences**

1. B. L., Theraja, Electrical Technology, Vol-I, S. Chand Publisher, New Delhi.
2. W.H. Hayt & J.E. Kennedy, Engineering circuit Analysis{ Mc Graw Hill.
3. I.J. Nagrath, Basic Electrical Engineering, Tata Mc Graw Hill.
4. A.E. Fitgerald, D.E., Higginbotham and A Grabel, Basic Electrical Engineering, Mc Graw Hill.
5. Ashfaq Hussain, Fundamentals of Electrical Engineering, Dhanpat Rai Publish.

Effective from the session 2019-20

# BET-C102/BET-C202
# ELECTRONIC DEVICES

Sessional : 30
ESE : 70
Credit : 4

MM : 100
Time : 3 Hr
L T P
3 1 0

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

Semiconductors, energy band description of semiconductors, effect of temperature on semiconductors, intrinsic and extrinsic semiconductors, donor and acceptor impurities, electron and hole concentration, conductivity of a semiconductor, mobility and resistivity, Generation and Recombination, Hall effect, Fermi level, mass action law, charge densities in a semiconductor, diffusion and Poisson and continuity equation.

## UNIT II

P-N junction and its properties, V-I characteristics of P-N junction, application of junction diode as clippers, clampers and rectifiers (Half-wave, Full-wave and bridge), Zener and avalanche breakdown mechanism, Zener diode and its characteristics, equivalent circuit of Zener diode, Zener diode as a voltage regulator, LED, photo diode and solar cell.

## UNIT III

Bipolar junction transistor(BJT) and its action, Transistor configurations (CB, CE and CC) and their characteristics, cut-off, active and saturation regions. Transistor as a switch, operating point, dc load line, Transistor biasing and its necessity, thermal runaway, types of biasing and their analysis, stability factors, Transistor as a regulator. Concept of Transistor amplifier, graphical analysis of CE amplifier, dc and ac equivalent circuits, Emitter follower and its ac model.

## UNIT IV

Ebers-Moll model of BJT, T model of BJT, Hybrid model of BJT at low frequency, computation of voltage gain, current gain and power gain, Zi and Zo and approximate formulas, high frequency transistor hybrid π model.

## UNIT V

Field Effect Transistor: JFET and its characteristics, configurations of JFET, MOSFET, FET biasing, Fixed-bias configuration, Self-bias configuration, Voltage-Divider biasing, MESFET

(Enhancement & depletion types) their construction and characteristics, configuration of MOSFET, MOS capacitor.

**References**


1. Integrated Electronics: Jacob Millman & C.C. Halkias
2. Malvino and leach "Digital principle and applications.
3. Streetman Ben.G, "Solid state electronic devices" (3/e), PHI
4. Millman and grabel, "Microelectronics" PHI
5. Robert Bolycstad "Electronic devices and circuit", PHI


**Course Outcomes:**

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics
2. Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems.

Revised Syllabus (**Effective from the session 2020-21**)
Gurukula Kangri Vishwavidyalaya, Haridwar
Faculty of Engineering & Technology

## BHU-S102/BHU-S202-VEDIC SCIENCE & ENGINEERING

**MM: 100** **Sessional: 30**
**Time: 3 hrs** **ESE: 70**
**L T P** **Credits 0**
**2 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**Science in Vedic literature and Indian Philosophy-I**: Kanad's atomic theory, concept of parmanu, Formation of molecules, Parimandal, Comparison with Modern atomic theory. Concept of SAMATA and VISHAMTA vs Maxwell-Boltzmann's distribution of velocities and energies. Maharshi Kanad's Law of Motion and Law of Gravitation.

### UNIT II

**Science in Vedic literature and Indian Philosophy-II**: First and Second Law of thermodynamics in daily life. Law of helplessness of mankind in thermodynamics and Indian philosophy. Entopy in life and concept of pralaya. Dhananjay Vs concept of Radioactivity-life after death. Atomic spectrum Vs concept of Kundalini.

### UNIT III

**Vedic Mathematics**: Measurements in Vedic Times, ancient scale of length, mass, time and temperature, Number system, Geometry according to sulba Sutra. Overview of Vedic Mathematical Rules (ekadhiken pooren, Nikhil navtascharaman dashatah, oordhavatriyagyabhyam)

### UNIT IV

**Electrical, Electronics & Aeronautical Engineering in Vedas**: Concept of electrical Engineering, type of electricity – Tadit, Saudamini, Vidyut, Shatakoti, Haradini, Ashani. Electronics Engineering in Vedic literature. Aeronautical Engineering in Vedic literature, Types of Vimanas and their construction and working, Shakun vimana, Rukma vimana, Tripura vimana.

### UNIT V

**Mechanical, Chemical, Civil & Architectural engineering in Vedic Literature**: Mechanical & Chemical Engineering in ancient India, Civil and Architectural engineering in Vedic literature.

**Text Books / References**

1. Science in Vedas by Acharya Vaidyanath Sashtri.
2. Science in the Vedas by Hansraj, Shakti Publications, Ludhiana.
3. Vedic Mathematics by Swamisri Bharati Krishana Teerathaji, Motilal Banarasi Das, Delhi.
4. Brahad Viman shastra by Maharishi Bhardwaj.
5. Vymanika shastra, English translation by G. R. Josyer.
6. Alchemy and Metallic Medicines in Ayurveda by: Vaidya Bhagwan Das.
7. History of Hindu Chemistry by: P. C. Raya
8. Indian Alchemy by: Dr. S. Mahdihassan.
9. Ancient Scientist of Indian by Satya Prakash.
10. Vaishaishik Darshan by Maharishi Kanad.
11. Vedas: The sources of ultimate science by S. R. Verma, Nag Publisher, New Delhi.

# BAP-C151/BAP-C251
# ENGINEERING PHYSICS LAB

Sessional: 15
ESE: 35
Credit : 1

MM :50
Time: 2 hrs
L T P
0 0 2

## LIST OF EXPERIMENTS

1. To verify the inverse square law of radiation using Photoelectric effect.
2. To determine the value of Planck's constant and photoelectric work function of the material of the cathode using Photoelectric cell.
3. To determine the frequency of an unknown signal by the drawing the Lissajous patterns for various frequency ratios and evaluate the phase difference between two sinusoidal signals applied to X and Y inputs of cathode ray oscilloscope.
4. To determine the value of e/m of an electron by helical method / Thomson method.
5. To verify the existence of Bohr's energy level with Frank-Hertz apparatus.
6. To determine the resistivity and energy band gap by Four Probe method.
7. To determine the Curie temperature of the given Ferrite material.
8. To find the refractive index of the material of given Prism using Spectrometer.
9. To determine the wavelength of He-Ne laser by Diffraction Method.

**NOTE**

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

**Course Outcomes:**

- After Successful completion of the applied physics laboratory course, student should be able to:
- verify the theoretical formulations/ concept of physics.
- know the art of recording the observations of an experiment scientifically.
- learn by doing.
- handle and operate the various elements/ parts of experiments.
- understand the importance of experiments in engineering & technology.

Revised Syllabus (Effective from the session 2019-20)

Gurukula Kangri Vishwavidyalaya, Haridwar

Faculty of Engineering & Technology

Electrical Engineering

# BEE-C 151
# BASIC ELECTRICAL ENGINEERING LAB

Sessional: 15
ESE: 35

MM : 50
Time : 2 hrs
L T P
0 0 2
Credits 1

## LIST OF EXPERIMENTS

1. Verification of Kirchoff's laws.
2. Verification of Thevenin's theorems.
3. Verification of Norton's theorem
4. Verification of Superposition theorem.
5. Verification of maximum power transfer theorem.
6. Measurement of power in three-phase circuit by two wattmeter method.
7. Determination of efficiency of a single-phase transformer by load test.
8. To perform open circuit test on single-phase transformer & find equivalent circuit parameters.
9. To perform short circuit test on single-phase transformer & find equivalent circuit parameters.
10. D.C. generator characteristics
    - (a) Shunt generator
    - (b) Series generator
    - (c) Compound generator
11. Speed control of D.C. shunt generator.
12. To study running and reversing of a three-phase Induction Motor.
13. To study & calibration of a single-phase Energy Meter.
14. Calibration of voltmeter and ammeter.
15. To study of resonance in RLC circuit.

**NOTE**

1.In practical examination the student shall be required to perform one experiment.
2.A teacher shall be assigned 20 students for daily practical work in laboratory.
3.No batch for practical class shall consist of more than 20 students.
4.The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-20

# BET-C151/BET-C251
# ELECTRONIC DEVICES LAB

MM :50
Time : 2 hrs
L T P
0 0 2

Sessional: 15
ESE: 35
Credit : 1

## LIST OF EXPERIMENTS

1. To draw the V-I characteristics of PN junction diode.
2. To draw the V-I characteristics of Zener diode and study it as voltage regulator.
3. To study junction diode as half wave and full wave rectifier.
4. To study junction diode as clipper and clamper.
5. To draw the input and output characteristics of a transistor in CE and CB configuration.
6. To find the small signal h-parameters of a transistor.
7. To draw the input and output characteristics of FET and to measure the pinch off voltage.
8. To draw the drain and transfer characteristic curve of MOSFET.
9. To draw the frequency response of FET amplifier.
10. To draw the frequency response curve of Emitter Follower.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Effective from the session 2019-2020

# BME-C252 / BME-C152
# WORKSHOP PRACTICE

**MM: 50**
**Time: 2 hrs.**
**L T P**
**0 0 2**

**Sessional: 15**
**ESE: 35**
**Credit: 1**

## LIST OF EXPERIMENTS

**Carpentry Shop**

1. Study of Carpentry Tools, Equipment and different joints.
2. To prepare a half T joint of given dimensions.

**Foundary Shop**

3. Introduction to Patterns, pattern allowances, Gate, Riser, and Runner.
4. To prepare a mould of half bearing.

**Metal Joining.**

5. To prepare a butt joint of MS strips using Arc welding.
6. To prepare a T joint of MS strips using Oxy Acetylene gas welding.

**Fitting Shop**

7. To prepare a rectangular piece with slant edge of given size from M.S. flat.

**Machine Shop**

8. To prepare a job on Lathe machine of given shape and size.
9. To prepare a job on Shaper machine of given shape and size.
10. To prepare a job on Milling machine of given shape and size.
11. To prepare a job on CNC train master of given shape and size.
12. To prepare a job on drilling machine of given shape and size.

**NOTE**

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

**Revised Syllabus (Effective from the session 2019-20)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**

# BSP-S 151
# PHYSICAL TRAINING & YOGA

**MM : 50**
**Time : 2 hrs**
**L T P**
**0 0 2**
**Credits 0**

**Sessional: 15**
**ESE: 35**

## Unit I

1 Warming Up (Meaning, Types and Method)

2.Componenet of physical fitness (strength, endurance, speed, flexibility and agility and co- coordinative ability)

3.Methods of Improving Strength

4.Methods of Improving Endurance

5 Methods of Improving Speed

6 Method of Improving Flexibility

7 Limbering down

## Unit II

1.Yama

2 Niyama

3.Asana

4.Shaktkarma

5.Dharna and dhyana

6.Meditation and Samadhi

Gurukula Kangri Vishwavidyalaya, Haridwar
Faculty of Engineering & Technology

# BEM-C201-ENGINEERING MATHEMATICS-II

**Sessional: 30**
**ESE: 70**
**Credits 4**

**MM: 100**
**Time: 3 hrs**
**L T P**
**3 1 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Differential Equations:** Ordinary differential equations of first order, orthogonal trajectories, linear differential equations with constant coefficients, Simple applications, Euler- Cauchy equations, Equations of the form $y''= f(y)$. Solution of second order differential equations by change of dependent and independent variables, Method of variation of parameters for second order differential equations..

## UNIT II

**Partial Differential Equations:** Introduction of partial differential equations, solution of Linear partial differential equations of second order with constant coefficients and their classification, Method of separation of variables.

## UNIT III

**Solution in Series:** Solution in series of second order linear differential equations, Bessel's and Legendre's equations and their solutions, Properties of Bessel function and Legendre's polynomials, Rodrigue's formula, Recurrence relations, Generating functions, Jacobi series, Integral representation of Bessel's functions.

## UNIT IV

**Fourier Series:** Fourier series, Dirichlet's condition and convergence, Change of interval, Half range series, Harmonic analysis.

## UNIT V

**Statistics:** Random variables, Probability mass function, Probability density function, Moments, Moment generating functions. Binomial, Poisson and Normal distributions. Correlation and Regression. Method of least squares and curve fitting - straight line and parabola.

**Text Books / References**


1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
2. Simmons, G.F., Differential Equations with Applications and Historical Notes, McGraw-Hill, 1991.
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000
4. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
5. Miller and Freunds, Probability and Statistics for Engineers, PHI, 2011.
6. Kapur J. N. & Saxena H.C., Mathematical Statistics, S Chand, 2010.

## BAC-C101/ BAC-C201
## ENGINEERING CHEMISTRY

**MM: 100**
**Time: 3 hrs**
**L T P**
**3 1 0**

**Sessional: 30**
**ESE: 70**
**Credit: 4**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT -I

**Periodic properties (8 hours)**

Effective nuclear charge, Penetration of orbitals, Variations of s, p, d and f orbital energies of atoms in the periodic table, Atomic and Ionic sizes, Ionization energies, Electron affinity and Electronegativity, Polarizability, Oxidation states, Coordination numbers and Geometries, Hydrogen bonding, Concept of hybridization.

### UNIT -II

**Chemical kinetics & Use of free energy in chemical equilibria (8 hours)**

Introduction, Rate of reaction, Factors influencing rate of reaction, Order and Molecularity of reaction, Arrhenius equation, Concept of activation energy and its determination, Collision theory of reaction rates. Thermodynamic functions: Energy, Entropy and Free energy, Estimations of entropy and Free energies, Free energy and emf. Cell potentials, the Nernst equation and applications (without derivation) Acid-base equilibria.

### UNIT -III

**Polymers (8 hours)**

Polymers, Nomenclature of polymers, Types of polymerization, Classification of polymerization, Industrial application of polymers, Conducting polymers.

**(i) Plastics:** Structure, Properties and uses of thermoplastic (Polyvinyl chloride, Teflon, Nylons and Polymethyl methacrylate) & Thermosetting (Bakelite) materials, Uses of plastics.

**(ii) Rubber:** Natural rubber & Synthetic rubber, Vulcanization of rubber, Advantages of vulcanization of rubber.

### UNIT -IV

**Nano chemistry (8 hours)**

Introduction, Nanotechnology applications, Role of bottom-up & Top-down approaches in Nanotechnology, Material self-assembly, Self-assembling materials, Nanomaterials, Nanocrystals/Nanoparticles, Properties and applications of Nanoparticles, Carbon Nano tube (Basic concept Only).

### UNIT -V

**Organic reactions and synthesis of a drug molecule (8 hours)**

Introduction to reactions involving Substitution, Addition, Elimination, Oxidation, Reduction, Basic concept of stereoisomerism (Geometrical & Optical isomerism).

Synthesis of a commonly used drug molecule (Definitions of different classes of drugs, Synthesis of Aspirin, Phenacetin & Paracetamol Only, Excluding mechanism).

**Suggested Text Books**


(i) University chemistry, by B. H. Mahan
(ii) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
(iii) Fundamentals of Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
(iv) Physical Chemistry, by P. W. Atkins
(v) Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp
(vi) Principles of Physical Chemistry, by B.R. Puri, L.R. Sharma, M. Pathania
(vii) A text book of Organic Chemistry, by S. K. Jain
(viii) A text book of Engineering Chemistry, by S. S. Dara
(ix) A text book of Engineering Chemistry, by Jain & Jain


**Course Outcomes**

The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications.

Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the student to:

Analyze microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces. Rationalize bulk properties and processes using thermodynamic considerations. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

Rationalize periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.

List major chemical reactions that are used in the synthesis of molecules.

Effective from the session 2019-2020

# BME-C10B / BME-C203
# BASIC MECHANICAL ENGINEERING

MM: 100
Time: 3 hrs.
L T P
3 0 0

Sessional: 30
ESE: 70
Credit: 3

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Thermodynamics I:** Introduction to SI units, Definition of thermodynamic system, Surrounding and Universe, Quasi static process, Energy interaction Zeroth law, Concept of temperature First law of thermodynamics, Application to closed and open system, Concept of Enthalpy, steady flow energy equation, Throttling process. 8

## UNIT II

**Thermodynamics II:** Second law, reversible and irreversible process, Thermal reservoir, heat engines and thermal efficiency, COP of heat pump and refrigerator, Carnot cycle, Claudius inequality, Concept of entropy, Entropy change for ideal gases. 7

## UNIT III

**Thermodynamics III:** Generation of steam at constant pressure, Properties of steam, Use of property diagram, Process of vapor in closed and open system, Rankine cycle. Stroke clearance ratio, Compression ratio, Definition and calculation of mean effective pressure (no proof) for air standard cycles (Otto and diesel cycles. 8

## UNIT IV

**Mechanics:** Trusses: Plane structure, (Method of Joints and Sections only) Beams: Bending moment and shear force diagram for statically determinate beams. 9

## UNIT V

**Strength of Materials:** Simple stresses and strain, strain energy, stress- strain diagram, elastic constants. Compound stress and strain: state of stress at a point, Simple tension, pure shear, general two-dimensional stress system, principal planes, principal stresses and strains, Mohr's stress circle, Poisson's ratio, maximum shear stress. 8

## Suggested Books:

| S.No. | Name of Authors /Books /Publisher | Year of Publication |
|---|---|---|
| 1. | Kumar, D.S., "Thermal Science and Engineering", 2nd Ed., S.K. Kataria & Sons Publisher, ISBN-10: 935014428X | 2013 |
| 2. | Nag, P.K., "Engineering Thermodynamics", 6th Ed., McGraw Hill Publisher, ISBN-10:9789352606429 | 2017 |
| 3. | Yadav, R., "Thermal engineering" 7th Ed., Central Publishing House, ISBN-10: 818544403X | 2011 |
| 4. | Shames Irving H., "Engineering Mechanics" 4th Ed., Pearson Education Publisher, ISBN-10: 8131764850 | 2011 |
| 5. | Hibler, R., "Statics and Dynamics" 14th Ed., Pearson Education Publisher, ISBN: 9789332584747 | 2017 |

Revised Syllabus (Effective from the session 2019-20)
Gurukula Kangri Vishwavidyalaya, Haridwar
Faculty of Engineering & Technology
Computer Science & Engineering

# BCE-C101/ BCE-C201

# PROGRAMMING FOR PROBLEM SOLVING

**MM: 100**
**Time: 3 hrs**
**L T P**
**3 1 0**

**Sessional: 30**
**ESE: 70**
**Credits 4**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Introduction to Computers:** Block diagram of computers, functions of its important components, Memory and I/O devices. Concept of assembler, interpreter, compiler & generation of languages.
**Number System:** Decimal, Binary, Octal, and Hexadecimal numbers and their arithmetic (addition, subtraction, multiplication, and division): 1's and 2's complements

## UNIT II

**Programming in C:** History, Introduction to C Programming Languages, Structure of C Programs, Compilation and Execution of C Programs, Debugging techniques, Data Type and sizes, Declarations of variables, Modifiers, Identifiers and keywords, Symbolic Constants, Storage classes(automatic, external, register and static), Enumerations, command line parameters, Macros, The C Preprocessor.
**Operators:** Unary operators, Arithmetic & Logical operators, Bit wise operators, Assignment operators and expressions, Conditional expressions, Precedence and order of evaluation.
**Control Statements:** If-else, switch, break, continue, the coma operator, go to statement.
**Loops:** while, do-while, for loop.

## UNIT III

**Arrays:** One-dimensional arrays: declaration, initialization and application. Two-dimensional array: declaration, initialization and application, Multidimensional arrays.
**Handling of Character Strings:** Declaring and initializing string variables, Reading strings, Writing strings, Arithmetic operation on strings, comparison of two strings and string handling functions.
**Pointers:** Accessing the address of the variable, Declaring and initializing pointers, accessing a variable through its pointer expression, pointer increment and scale factor, pointers and array, pointers and character strings.

## UNIT IV

**Functions:** Need for user defined function, return value and its type, function calls, No argument and No return values function, Argument and No return values functions, argument and return value functions. Handling of non-integer function, Scope and life time of variable in functions.
**Recursion:** Recursive Definition and processes, recursion in C, example of recursion, Tower oh Hanoi Problem, simulating recursion, Backtracking, recursive algorithms, principles of recursion, tail recursion, removal of recursion.

## UNIT V

**Structures:** Structures definition, giving value to members, structure initialization, array of structures, array within structures, structures within structures, structures and functions, Structure Pointers.

**File Handling:** Creating and Deleting a File, Updating File, Copying File, Searching & Sorting in a File.

**Text Books / References**

1. Rajaraman V.(3/e), Fundamental of Computers, PHI, New Delhi, 1999
2. Sanders,D.H., Computers Today, Mcgraw Hill, 1998
3. Kris Jamsa, DOS the complete reference, Tata McGraw Hill
4. J.Peek Tim O'reilly & M.Loeekides, UNIX POWER TOOLS, BPB Publication
5. Yashwant Kanetkar, Let Us C, BPB
6. Yashwant Kanetkar, C In Depth, BPB

Effective from the session 2019-20

# BEN-A102/BEN-A202
# ENVIRONMENTAL STUDIES

**Sessional : 30**
**ESE : 70**
**Credit : 0**

**MM : 100**
**Time : 3 hrs**
**L T P**
**2 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Multidisciplinary Nature of Environmental Studies & Ecosystems:** (a) definition, scope and importance of ecology and environment (b) ecological components: (i) abiotic components: soil, water, light and temperature (ii) biotic components & their relationships- symbiosis, commensalisms, parasitism, predation and antibiosis (c) concept of an ecosystem (d) structure and function of an ecosystem (e) producers, consumers and decomposers (f) energy flow in the ecosystem (g) ecological succession (h) food chains, food webs and ecological pyramids (i) introduction, types, characteristic features, structure and function of the following ecosystems: (i) forest ecosystem (ii) grassland ecosystem (iii) desert ecosystem (iv) aquatic ecosystems (pond, river, ocean) (j) Need for public awareness

## UNIT II

**Natural Resources:** (a) forest resources: use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forest and tribal people (b) water resources: use and over-utilization of surface and ground water, benefits and problems of dams (c) mineral resources: use and exploitation, environmental effects of extracting and using mineral resources (d) energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources (e) land resources: land as a resource, land degradation, man induced landslides, soil erosion and desertification (f) biodiversity & its conservation: definition- genetic, species and ecosystem diversity, values of biodiversity- consumptive use, productive use, social, ethical, aesthetic and option values (g) India as a mega-diversity nation, hot-spots of biodiversity, threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts; endangered and endemic species of India, conservation of biodiversity: *in-situ* & *ex-situ* methods (h) bio-geographical classification of India (i) role of an individual in conservation of natural resources (j) equitable use of resources for sustainable lifestyles

## UNIT III

**Environmental Pollution:** (a) Definition, causes, effects and control measures of: air pollution, water pollution, soil pollution, noise pollution, thermal pollution and nuclear hazards (b) solid waste management- causes, effects and control measures of urban and industrial wastes (c) role

of an individual in prevention of pollution (d) disaster management: floods, earthquake, drought & landslides

## UNIT IV

**Social Issues and the Environment:** (a) from unsustainable to sustainable development (b) urban problems related to energy (c) rain water harvesting (d) resettlement & rehabilitation of people- problems and concerns (e) environmental ethics- issues and possible solutions (f) wasteland reclamation (g) population growth and family welfare programme (h) environment and human health, human rights, value education (i) HIV/AIDS (j) role of information technology (IT) in environment and human health (k) global environmental issues: global warming, acid rain, ozone layer depletion

## UNIT V

**Environmental policies and laws:** (a) salient features of following acts i. Environment Protection Act 1986 ii. Air (Prevention and Control of Pollution) Act 1981 iii. Water (Prevention and Control of Pollution) Act 1974 iv. Wildlife Protection Act 1972 v. Forest Conservation Act 1980 (b) issues involved in enforcement of environmental legislation (c) public awareness

**References**


1. Agarwal, K.C. *Environmental Biology*, Nidhi Publ. Ltd., Bikaner.
2. Bharucha E. *The Biodiversity of India*, Mapin Publishing Pvt. Ltd., Ahmedabad.
3. Clark R.S. *Marine Pollution*, Clanderson Press Oxford.
4. Cunningham, W.P., Cooper, T.H., Gorhani, E. & Hepworth, M.T. *Environmental Encyclopedia*, Jaico Publ. House, Mumabai.
5. De A.K. *Environmental Chemistry*, Wiley Eastern Ltd.
6. Gleick, H.P. *Water in Crisis*, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press.
7. Hawkins R.E. *Encyclopedia of Indian Natural History*, Bombay Natural History Society, Bombay.
8. Heywood, V.H & Waston, R.T. *Global Biodiversity Assessment*, Cambridge Univ. Press.
9. Odum, E.P. *Fundamentals of Ecology*, W.B. Saunders Co. USA.
10. Rao M N. & Datta, A.K. *Waste water treatment*, Oxford & IBH Publ. Co. Pvt. Ltd.
11. Sharma B.K. *Environmental Chemistry*, Geol Publ. House, Meerut.
12. Trivedi R.K. *Handbook of Environmental Laws, Rules Guidelines, Compliances and Standards*, Vol. I and II, Enviro Media.
13. Trivedi R. K. and Goel, P. K. *Introduction to air pollution*, Techno-Science Publication.
14. Wanger K.D. *Environmental Management*, W.B. Saunders Co. Philadelphia, USA.

## BAC-C151/ BAC-C251
## ENGINEERING CHEMISTRY LABORATORY

**MM: 100**
**Time: 2hrs**
**L T P**
**0 0 2**

**Sessional: 30**
**ESE: 70**
**Pass Marks: 40**

### LIST OF EXPERIMENTS

**Choice of 10-12 experiments from the following:**

1. Chemical analysis of a salt (mixture of one acidic radical and one basic radical).
2. Determination of relative surface tension of given liquid by Satalagmometer.
3. Determination of relative viscosity of given liquid by Ostwald's viscometer.
4. Separation of given binary mixture by thin layer chromatography.
5. Separation of given binary mixture by ascending paper chromatography.
6. Titration of a strong acid with a strong base.
7. Titration between potassium permanganate and ferrous ammonium sulphate solution.
8. Titration between potassium permanganate and oxalic acid solution.
9. Determination of turbidity of unknown sample by using turbiditimeter.
10. Determination of cell constant and conductance of solutions.
11. Determination of the pH of unknown solutions by using pH meter.
12. Determination of redox potentials and emfs.
13. Determination of refractive index of unknown sample by using Abbe's refractometer.
14. Determination of chloride content in a water sample by Mohr's method.
15. Determination of molar mass of an unknown solid using the colligative property of freezing point depression.
16. Determination of the partition coefficient of a substance between two immiscible liquids.
17. Determination of moisture content present in hydrated copper sulphate.
18. Determination of saponification value of an oil.
19. Determination of acid value of an oil.

**Laboratory Outcomes**

The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn to:
Estimate rate constants of reactions from concentration of reactants/products as a function of time
Measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
Synthesize a small drug molecule and analyze a salt sample.

**Suggested Books**

**(i)** Advanced practical physical chemistry, by J. B. Yadav
**(ii)** Analytical chemistry Vol. I, II, III, by Subhash, Satish
**(iii)** Applied chemistry, by Virmani and Narula

**NOTE**

1. In practical examination, the student shall be required to perform one experiment which carries 40 marks and 30 marks shall be reserved for practical record and viva-voce examination.
2. The number of students in a batch allotted to an examiner for practical examination shall not exceed 30 students.
3. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

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# BCE-C151/ BCE-C251

# PROGRAMMING FOR PROBLEM SOLVING LAB

**MM: 50**
**Time: 2 hrs**
**L T P**
**0 0 2**

**Sessional: 15**
**ESE: 35**
**Credits 1**

## LIST OF EXPERIMENTS

**20 programs will be performed from the following topics**

Conversion from one number system to another
perform different arithmetic operations.
greater of two numbers using logical operators
check whether no. is odd or even using arithmetic operators
check whether no. is prime or not.
print Fibonacci series.
print factorial of a no. using recursion
add two matrices.
search a no. in array.
reverse an array.
find a leap year.
multiply two matrices.
pass by reference in functions
find factorial of a number.
Create a menu function for all arithmetic operations using one program
Addition subtraction using call by functions.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D.

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## BME-C153 / BME-C253
## ENGINEERING GRAPHICS AND DESIGN LAB

**MM: 50**
**Time: 2 hrs.**
**L T P**
**1 0 2**

**Sessional: 15**
**ESE: 35**
**Credit: 2**

**1: Introduction to Engineering Drawing**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering and dimensioning, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, and Hypocycloid Scales – Plain, Diagonal and Vernier Scales. **(2 Drawing sheet)**

**2: Orthographic Projections and Projections of Regular solids**

Principles of Orthographic Projections-Conventions – Principal planes, Auxiliary Planes, Introduction to first angle and third angle projection, Projections of Points, projection of lines-parallel to both the planes, parallel to one and inclined to other, inclined to both the planes, true length and traces of a line, and lines inclined to both planes, Projections of planes, traces of planes, angles of inclinations of planes, parallel planes. **(2 Drawing sheet)**

**3: Sections and Sectional Views of Right Angular Solids and Isometric Projections**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

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; **(3 Drawing sheet)**

**4: Overview of Computer Graphics Customization and CAD Drawing**

Computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software (AUTOCAD) [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in AUTOCAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids **(3 Drawing sheet)**

**5: AUTOCAD as a tool for design and drawing objects**

Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); orthographic projection techniques; Drawing sectional views of composite right regular geometric solids CAD software(AUTOCAD) modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling. Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows,

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doors, and fixtures such as WC, bath, sink, shower, etc. Appling Colour coding according to building drawing practices; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM). **(3 Drawing sheet)**

**Suggested Books:**

| S.No. | Name of Authors /Books /Publisher | Year of Publication |
|---|---|---|
| 1. | Bhatt N.D., Panchal V.M. & Ingle P.R., "Engineering Drawing", Charotar Publishing House | 2014 |
| 2. | Shah, M.B. & Rana, B.C., "Engineering Drawing and Computer Graphics", Pearson Education | 2008 |
| 3. | Agrawal B. & Agrawal C. M., "Engineering Graphics", TMH Publication | 2012 |
| 4. | Narayana, K.L. & Pannaiah, "Text book on Engineering Drawing", Scitech Publishers | 2008 |

**NOTE**

1. In practical examination the student shall be required to prepare one sheet according to problem given.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

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# BEG-A151/251
# TECHNICAL COMMUNICATION LAB

**MM: 50** **Sessional: 15**
**Time: 2hrs** **ESE: 35**
**L T P** **Credits 1**
**0 0 2**

## Objective:

1. To expose the learners to English sound system and acquire phonetics skill and speech rhythm
2. To help the learners use grammar correctly
3. To train the learners to speak English, clearly, intelligently and effectively
4. To equip the learners to compete for a career, and enable them to function effectively in careers which demand good communicative skills
5. To impart moral values

Contents:

1. Nonverbal communication
- Use of hands
- Posture of shoulders
- Eye contact
- Weight of the body
- Movement of the body

2. Applied phonetics
- Sound of English – consonants and vowels
- Phonemic transcription
- Stress, Rhythm and intonation

3. Remedial grammar
- Some useful expression (introduction, greetings etc.) that are used frequently
- Common mistakes in the use of nouns, pronouns, adjectives, adverbs, prepositions, conjunctions
- Use of the who and whom, much and many, still and yet, so as and so that, make and do
- Tense and their use
- Confusion of participles
- Tag questions

4. Reading and speaking skills, listening and speaking skills
- Presentation and addresses
- Group discussions
- Interviews
- Role playing

5. Reading and writing skill, listening and writing skills
- Letter writing – formal and informal
- Real life social situations
- Curriculum vitae
- Agenda, notice and minutes

6. Case studies
- Study of renowned speeches of famous personalities
  - Swami Vivekananda

- Mahatma Gandhi
- Jawaharlal Nehru
- Swami Shraddhanand
- Steve Jobs

**Text Books / References**

1) Balasubramaniam, T. *Phonetics for Indian Students*. Macmillan India Ltd.
2) Daniel, Jones. English Pronouncing Dictionary. Cambridge University Press.
3) Oxford Advanced Learners' Dictionary.
4) Taylor, Grant "conversation practice", Tata Mc Graw Hills, new Delhi
5) F.T.A. Wood, "Remedial English Grammar", macmillan India Ltd.
6) Berry, Thomas Elliot, "The Most Common Errors in English Usage" Tata Mc Graw Hills, New Delhi
7) Krishnaswamy, N. "*Modern English*. Macmillan India Ltd.
8) Desmond, "people watching"

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# BEM-C302-ENGINEERING MATHEMATICS – III

**MM: 100**
**Time: 3 hrs**
**L T P**
**3 1 0**

**Sessional: 30**
**ESE: 70**
**Credits 4**

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Laplace Transform:** Laplace transform of elementary functions, Shifting theorems, Transform of derivatives, Differentiation and Integration of transforms, Heaviside unit step and Dirac Delta functions, Convolution theorem, Solution of ordinary linear differential equations used in Mechanics, Electric circuits and Bending of beams.

## UNIT II

**Fourier Transform :** Definition of Fourier transform, Fourier sine and cosine transforms. Fourier integral formula, Parsevel's identity, Applications of Fourier transform in solving heat equations.

## UNIT III

**Z transform :** Definition, Linearity property, Z transform of elementary functions, Shifting theorems, Initial and final value theorem, Convolution theorem, Inversion of Z transforms, Solution of difference equations by Z transforms.

## UNIT IV

**Functions of Complex Variable:** Limit and Continuity of functions of Complex Variables: Analytic Functions, Harmonic Conjugate, Cauchy-Riemann Equations (without proof), Line Integral, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Singular Points, Poles & Residues, Residue Theorem, Application of Residues theorem for Evaluation of Real Integral (Unit Circle).

## Unit V

**Errors and Roots of Equations:** Absolute, relative, round-off and truncation errors. Significant digits. Algebraic and Transcendental Equations, Numerical solution, Method of bisection, Newton-Raphson method, Direct iterative method, convergence.

**Text Books / References**


1. Kreyszig E., Advanced Engineering Mathematics, John Wiley, New York, 1999
2. Gerald, C.F., Wheatley P.O., Applied Numerical Analysis, Pearson, 2007.
3. Grewal B.S., Higher Engineering Mathematics, Khanna, New Delhi, 2000.
4. Jain R. K., Iyenger S.R.K., Advanced Engineering Mathematics, Narosa , 2002.
5. Jain R. K., Iyenger S.R.K., Jain M.K., Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 2012.

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# BEE-C 305
# ELECTRICAL MACHINES-I

**MM:100**
**Time:3Hr**
**L T P**
**3 0 0**
**Credits 3**

**Sessional : 30**
**ESE : 70**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Principles of Electro-Mechanical Energy Conversion:** Review of magnetic circuits - MMF, flux, reluctance, inductance; Introduction, Flow of Energy in Electromechanical Devices, Energy in magnetic systems, Singly Excited Systems; determination of mechanical force, mechanical energy, torque equation, Reluctance and Hysteresis motor.
Doubly excited Systems; Energy stored in magnetic field, electromagnetic torque, Generated EMF in machines; torque in machines with cylindrical air gap. Basics of rotating machines, Introduction to rotating magnetic field.

## UNIT II

**D.C. Machines-Generators:** Construction of DC Machines, Armature winding, EMF and torque equation, Armature Reaction, Commutation, Interpoles and Compensating Windings, Performance Characteristics of D.C. generators.

## UNIT III

**D.C. Machines- Motors**: Performance Characteristics of D.C. motors, Starting of D.C. motors; Concept of starting (3 point and 4 point starters), Speed control of D.C. motors; Field Control, Rheostatic control and Voltage Control (Ward Lenonard method), Efficiency and Testing of D.C. machines.

## UNIT I V

**Transformers:** Principle, construction and operation of single-phase transformers, equivalent circuit, phasor diagram, voltage regulation, losses and efficiency Testing - open circuit and short circuit tests, polarity test, back-to-back test. Nature of magnetizing current.

## UNIT V

**Three-phase transformer** - Construction, types of connection and their comparative features, Parallel operation of single-phase and three-phase transformers, Autotransformers - construction, principle, applications and comparison with two winding transformer, Magnetizing current, Phase conversion - Scott connection, three-phase to six-phase conversion, Open Delta connection, Tap-changing transformers, Introduction to Three-winding transformers. Cooling of transformers.

**Text Books**

I.J. Nagrath & D.P. Kothari, Electrical Machines, Tata McGraw Hill.
Irving L. Kosow, Electric Machine and Transformers, Prentice Hall of India.
M.G. Say, The Performance and Design of AC machines, Pit man & Sons.
Langsdorf, Theory of Alternating Current Machinery, Tata McGraw Hill.

**Reference Books**

A.E. Fitggerald, C.Kingsley Jr. and Alexander Kusko, Electric Machinery, McGraw Hill, International Student Edition.
Hussain Ashfaq, Electrical Machines, Dhanpat Rai & Sons.

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# BEE-C 308
# ELECTRICAL CIRCUIT ANALYSIS

**MM:100**
**Time:3Hr**
**L T P**
**3 0 0**
**Credits 3**

**Sessional : 30**
**ESE : 70**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**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 Node methods of analysis.

## UNIT II

**Network Theorems:** Applications to ac networks- Super-position theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem, Reciprocity theorem. Millman's theorem, compensation theorem, Tellegen's theorem.

## UNIT III

**Sinusoidal steady state analysis:** Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. series and parallel resonances. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer

## UNIT IV

**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. Image parameters and characteristics impedance.

## UNIT V

**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.

**Text Books**

M.E. Van Valkenburg, Network Analysis, Prentice Hall of India.
D. Roy Chaudhary, Networks and Systems, Wiley Eastern Ltd.
Donald E. Scott, An Introduction to Circuit analysis: A System Approach, McGraw Hill Book Company.

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# BEE-C 309
# ELECTROMAGNETIC FIELDS

**Sessional : 30**
**ESE : 70**

**MM : 100**
**Time : 3 Hr**
**L T P**
**3 0 0**
**Credits 3**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Electrostatics** – Fundamentals: Electric charges – Coulomb's Law – Electric Field Intensity – Linear, Surface and Volume charge density – Gauss Law and its application – electric Scalar Potentials and potential difference – Potential due to uniformly charged disc and uniformly charged line, potentials between two coaxial cylinders and between two conducting spherical shell – Electric field lines and equipotential contours
– Potential gradient and electric field due to electric dipoles – Conservative nature of electric field.

## UNIT II

**Dielectrics & Capacitance:** Dielectric boundaries – Capacitance – Capacitance of system of conductors – Overhead lines and underground cables – Methods of images and its application – Electrostatic energy and energy density – Force between charged conductors – dielectric strength and breakdown. Divergence and curl of vector fields – Divergence theorem – Stokes theorem – solutions of electrostatic problems – Examples on Laplace's equation.

## UNIT III

**Magnetic Fields** – Fundamentals: Magnetic field intensity and magnetic flux density – Biot Savarat law – Force between current carrying wires. Torque on closed circuits – Ampere's law – Magnetic scalar and vector potentials – Boundary conditions at magnetic surfaces.

## UNIT IV

**Magnetic Circuits and Inductance:** Faraday's law of electromagnetic induction – Inductor and inductance – Inductance of solenoids, toroids, transmission lines and cables – Mutual inductance – Inductors in series and parallel – energy stored in magnetic field – Pull of an electromagnet – magnetic circuits.

## UNIT V

**Electro Magnetic Waves:** Maxwell's equations – Equation of continuity – displacement current – Maxwell's equation in point and integral forms – The wave equations – Uniform plane wave – relation between electric and magnetic field intensities in a uniform plane wave, Poynting vector – Poynting theorem.

**Text Books**

1. Gangodhar, K.A., ' Field Theory', Khanna Pub. Delhi 11th edition, 1994.
2. William H. Hayt, ' Engineering electromagnetics', Tata- McGraw Hill, 5th edition, 1992.

**References**

1. Sarwate, V.V., ' Electromagnetic Fields and Waves', Wiley Eastern Limited, New Delhi, 1993.
2. Mahajan, A.S. and Rangawala, A.A. 'Electricity and Magnetism, Tata-McGraw Hill Publishing Company, Ltd, New Delhi, 1989.
3. Seely, S., Introduction to electromagnetic Fields', McGraw Hill.
4. Joseph, a. Edminister, ' Electromagnetic – Schaum's outline Series', International Edition, McGraw Hill Inc., New York, 1993.
5. Narayana Rao, N., 'Elements of Engineering Electromagnetics', Prentics Hall of India, 1991.
6. David J. Griffths, ' Introcuation to electrodynamics', Prentice Hall of India, New Delhi, 1991.

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# BET-C 307

## ANALOG CIRCUIT

**MM : 100**
**Time : 3 Hr**
**L T P**
**3 0 0**
**Credits 3**

**Sessional : 30**
**ESE : 70**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions. Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**Multistage Amplifier:** Effect of coupling and by-pass capacitors, types of coupling (DC, RC and TC), Darlington connection, cascode amplifier, coupling schemes for multistage amplifier and frequency response of transistor amplifier.

Power amplifiers: ClassA, Class B, Class C and Class AB amplifiers and their efficiencies, harmonic distortion, push-pull amplifier. Basic idea of tuned amplifier.

### UNIT II

**IC OP-AMP Applications:** OP-AMP Fundamentals (brief review of differential amplifier, current mirror, active load, level shifter, output stage; ac and dc characteristics) Basic building blocks using OP-AMPS. Inverting/ Non-inverting VCVS, Integrators, Differentiators, CCVS and VCCS, Instrumentation Amplifiers.

### UNIT III

**Waveform Generator:** Square wave generators: 555Timer,Triangle generator, Sawtooth generator, Sine wave generator, Wien-bridge and twin-T oscillators. Function Generators: Multi op-amp function generators, IC function generators PLL Fundamentals.

Non-linear Circuits: Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits. OP-AMP as Comparator, Schmitt Trigger, Square and Triangular Wave Generator, Monostable Multivibrator. IC Analog Multiplier applications OTA

### UNIT IV

**Active Filters:** Introduction to filtering: Frequency response, Characteristics and terminology, Active versus passive filters, Low pass filter: First order low pass active filter, second order active filter model, second order low pass filter characteristics, Higher order filters.High pass active filter. Band pass filter: single op-amp band pass filter, multistage band pass filter,State variable filter.

## UNIT V

**Oscillators:** Positive feedback, Berkhausen criterion for sinusoidal oscillation, Phase-shift oscillator, Weinbridge oscillator, Tuned oscillator, Hartley, Colpitts and Crystal oscillator. Voltage Regulators: OP-AMP Regulators, IC Regulators, Fixed Voltage Regulators (78/79, XX), SMPS.

**Text/ Reference Books**

1. Sedra and Smith, Microelectronic Circuits", Oxford University press, 5th Edition, 2005.
2. J. Michael Jacob, Applications and design with Analog Integrated Circuits", PHI, 2nd Edition, 2004
3. Gayakwad, R.A, Op-Amp and linear integrated circuits, PHI

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**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**

# BEE-C 351
# ELECTRICAL MACHINES- I LAB

**Sessional : 15**
**ESE : 35**

**MM : 50**
**Time : 2 Hr**
**L T P**
**0 0 2**
**Credits 1**

## LIST OF EXPERIMENTS

1. To obtain magnetization characteristics of a D.C. shunt generator.
2. To obtain load characteristics of a D.C. compound generator (a) Cummulatively compounded (b) Differentially compounded.
3. To obtain load characteristics of a D.C. shunt generator.
4. To obtain speed-torque characteristics of a D.C. shunt motor.
5. To obtain speed-torque characteristics of a D.C. series motor.
6. To obtain efficiency of a D.C. shunt machine using Swinburn's test.
7. To obtain speed control of dc shunt motor using (a) armature resistance control (b) field control
8. To perform open circuit and short circuit tests on a single-phase transformer and determine parameters of equivalent circuit.
9. To obtain 3-phase to 2-phase conversion by Scott connection.
10. To obtain efficiency and voltage regulation of a single phase transformer by load test.
11. To perform Sumpner's test (back-to-back) on single-phase transformers.
12. To perform parallel operation of single phase transformer.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

Gurukula Kangri Vishwavidyalaya, Haridwar

Faculty of Engineering & Technology

Electrical Engineering

# BEE-C 352
# ELECTRICAL CIRCUIT AND SIMULATION LAB

**Sessional : 15**
**ESE : 35**

**MM : 50**
**Time : 2 Hr**
**L T P**
**0 0 2**
**Credits 1**

## LIST OF EXPERIMENTS

1. Verification of principle of superposition theorem with A.C. source.
2. Verification of principle of Thevenin's theorem with A.C. source.
3. Verification of principle of Norton's theorem with A.C. source.
4. Verification of principle of maximum power transfer theorem with A.C. source.
5. To study RLC series circuit.
6. To study RLC parallel circuit.
7. Determination of transient response of current in RL and RC circuits.
8. Determination of transient response of current in RLC circuit.
9. Determination of frequency response of current in RLC circuit with sinusoidal A.C. input.
10. To study T and ∏ networks.
11. Determination of z and h parameters (D.C. only) for a network and computation of Y and ABCD parameters.
12. Determination of driving point and transfer functions of a two port ladder network and verify with theoretical values.
13. Verification of parameter properties in inter-connected two port networks: series, parallel and cascade also study loading effect in cascade.
14. Determination of frequency response of a Twin-t notch filter.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

# BEE-C 353
# SEMINAR

**MM : 50**
**Time: 2 hrs**
**L T P**
**0 0 2**
**Credits 1**

**Sessional :15**
**ESE:35**

**Objective:** To increase the communication ability on students and to prepare then for presenting seminar on advanced topics of their branch.

The students will be required to deliver a seminar on a topic of general interest in or any advanced technical topics related to the theory papers studied. The topic will be decided by mutual consent of the Faculty- in-charge and students.

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# BET-C 351
# ANALOG CIRCUIT LAB

**MM : 50**
**Time : 2 Hr**
**L T P**
**0 0 2**
**Credits 1**

**Sessional : 15**
**ESE : 35**

## LIST OF EXPERIMENTS:

1. To draw the frequency response curve of RC Coupled Amplifier.
2. To draw the frequency response curve of Transformer Coupled Amplifier.
3. To find the efficiency of A, B & AB Push pull Amplifier.
4. To find the frequency of oscillation of various Oscillator.
5. To find the CMRR of differential amplifier.
6. To study the gain and frequency response of Inverting Amplifier and Non Inverting Amplifier.
7. To study the operational amplifier as Differentiator and Integrator.
5. To study the Op-Amp as summer and subtractor.
8. To study the OP-AMP as square wave generator.
9. To study 2nd order Low Pass active Filter and High Pass active Filter.
10. To study the hysteresis characteristics of the Op- Amp based Schmitt trigger.
11. To study the monostable multivibrator using Timer IC 555.
12. To find the frequency of oscillation for astable multivibrator using Timer IC 555.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

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# BEE-C 410

## ELECTRICAL MACHINES –II

**Sessional : 30**
**ESE : 70**

**MM : 100**
**Time : 3 Hr**
**L T P**
**3 0 0**
**Credits 3**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

Synchronous Machine-Generator: Constructional features, Armature winding, EMF Equation, Winding coefficients, equivalent circuit and phasor diagram, Armature reaction, O. C. & S. C. tests, Voltage Regulation using Synchronous Impedance Method, MMF Method, Potier's Triangle Method, Parallel Operation of synchronous generators, operation on infinite bus, synchronizing power and torque co-efficient.

### UNIT II

Synchronous Machine-Motor: Two Reaction Theory, Power flow equations of cylindrical and salient pole machines, operating characteristics, Starting methods, Effect of varying field current at different loads, V- Curves, Hunting & damping, synchronous condenser.

### UNIT III

Three phase Induction Machine – I: Constructional features, Rotating magnetic field, Principle of operation, Phasor diagram, equivalent circuit, torque and power equations, Torque- slip characteristics, no load & blocked rotor tests, efficiency, Induction generator.

### UNIT IV

Three phase Induction Machine- II: Starting, speed control (with and without emf injection in rotor circuit), Deep bar and double cage rotors, Cogging & Crawling,

### UNIT V

Single phase Induction Motor: Double revolving field theory, Equivalent circuit, No load and blocked rotor tests, Starting methods, repulsion motor.
AC Commutator Motors: Universal motor, Single-phase a.c. series compensated motor, stepper motors.

**Text Books**

1. D.P.Kothari & I.J. Nagrath, Electric Machines, Tata Mc Graw Hill.
2. P.S. Bimbhra Generalized Theory of Electrical Machines, Khanna Publishers.
3. Fitzerald, A.E., Kingsley and S.D.Umans, Electric Machinery, MC Graw Hill.

**Reference Books**

1. P.S. Bimbhra, Electrical Machines, Khanna Publisher.
2. M. G. Say, Alternating Current Machines, Pitman & Sons.
3. O.C. Taylor, The performance & design of A.C. Commutator Motors, A.H. Wheeler & Co(P) Ltd.

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# BEE-C 411

## POWER ELECTRONICS

Sessional : 30
ESE : 70

MM : 100
Time : 3 Hr
L T P
3 0 0
Credits 3

**NOTE**: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions. Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**Power Semiconductor Devices**: Power semiconductor devices their symbols and static characteristics and specifications of switches, types of power electronic circuits BJTO operation steady state and switch characteristics, switching limits Operation and steady state characteristics of IGBT Thyristor – Operation V- I characteristics, two transistor model, methods of turn-on Operation of GTO, MCT and TRIAC, Protection of devices, Series and parallel operation of thyristors Commutation techniques of thyristor.

### UNIT II

**DC-DC Converters**: Principles of step-down chopper, step down chopper with R-L Load Principle of step-up chopper, and operation with RL load, classification of choppers.
**Phase Controlled Converters:** Single phase half wave controlled rectifier with resistive and inductive loads, effect of freewheeling diode. Single phase fully controlled and half controlled bridge converters.

### UNIT III

**Three Phase Converters:** Performance Parameters Three phase half wave converters Three phase fully controlled and half controlled bridge converters, Effect of source and load impedance, Single phase and three phase dual converters.

### UNIT IV

**AC Voltage Controllers:** Principle of On-Off and phase controls Single phase ac voltage controller with resistive and inductive loads Three phase ac voltage controllers (various configurations and comparison) Single phase transformer tap changer. Cyclo Converters Basic

principle of operation, single phase to single phase, three phase to single phase and three phase to three phase cyclo converters, output voltage equation.

**UNIT V**

Inverters: Single phase series resonant inverter Single phase bridge inverters Three phase bridge inverters Voltage control of inverters Harmonics reduction techniques Single phase and three phase current source inverters.

**Text Books**

1. M.H. Rashid, Power Electronics: Circuits, Devices & Applications, Prentice Hall of India Ltd. 3rd Edition, 2004.
2. M.D. Singh and K.B. Khanchandani, Power Electronics, Tata MC Graw Hill, 2005

**Reference Books**

1.M.S. Jamil Asghar, Power Electronics, Prentice Hall of India Ltd., 2004
2. A. Chakrabarti, Rai & Co. , Fundamentals of Power Electronics &Drives, Chanpat Rai &Co.
3. K. Hari Babu , Power Electronics, Switch Publications.

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**Faculty of Engineering & Technology**

**Electrical Engineering**

# BEE-C 412

# ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS

**MM : 100** **Sessional : 30**
**Time : 3 Hr** **ESE : 70**
**L T P**
**3 0 0**
**Credits 3**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

**Philosophy Of Measurement:** Methods of Measurement, Measurement System, Classification of instrument systems , Characteristic of instrument & measurement system, Errors in Measurement & its Analysis , Standards .

**Analog Measurement of Electrical Quantities:** Electrodynamics ,Thermocouple Electrostatic & rectifier type Ammeters & Voltmeters , Electrodynamics Wattmeter, Three Phase Wattmeter, Power in three Phase System , Errors & remedies in Wattmeter and energy meter.

## UNIT II

**Instrument Transformer** (CT and PT), and their application in the extension of instrument range, Introduction to measurement of speed, Frequency and Power factor, Vibration etc.

## UNIT- III

**Measurement of Parameter:** Different methods of measuring low, medium and high resistances, Measurement of Inductance & Capacitance with the help of AC Bridges, Q Meter.

## UNIT- IV

**AC Potentiometer**: Polar type & Co-ordinate type AC potentiometer, Application of AC Potentiometers in Electrical measurement.

**Magnetic Measurement**: Ballistic Galvanometer, Flux meter, Determination of Hysteresis loop Measurement of iron losses.

## UNIT- V

**Digital Measurement of Electrical Quantities**: Concept of digital Measurement, Block Diagram Study of digital voltmeter, frequency meter power analyzer and harmonics analyzer; Electronic Multimeter.

**Cathode Ray Oscilloscope** :Electronic multimeter , Power Analyzer, Harmonics analyzer, , Electronic multimeter , Power Analyzer, Harmonics analyzer , Basic CRO circuit (Block Diagram),Cathode ray tube (CRT) & its component , Application of CRO in measurement ,Lissajous Pattern., Dual trace & dual beam Oscilloscope.

**Text Books**

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. Forest K. Harries , "Electrical Measurement " Willey Eastern Pvt. Ltd. India .
2. M.B. Stout , "Basic Electrical Measurement" Prentice hall of India ,India.
3. W. D. Cooper , "Electronic Instrument & Measurement Technique" prentice hall International.

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# BEE-C 413
# SIGNALS & SYSTEMS

**Sessional : 30**
**ESE : 70**

**MM : 100**
**Time : 3 Hr**
**L T P**
**3 0 0**
**Credits 3**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

## UNIT I

Signals and Systems: Continuous-time and discrete-time Signals, Transformations of the Independent Variable, Exponential and Sinusoidal Signals, Continuous-Time and Discrete-Time LTI Systems and their properties, convolution sum and convolution integrals, LTI System described by differential and difference equations.**Z-Transform:** Z-Transform, Region of convergence, Inverse Z-transform, analysis and characterization of LTI system, Block diagram representation, Unilateral Z-transform.

## UNIT II

Fourier Series and Fourier Transform: The response of LTI Systems to Complex Exponentials, Fourier Series Representation of Continuous-time Periodic Signals and their Properties, Continuous time and discrete time Fourier Transforms and their properties, System Characterized by Linear Constant Coefficient Differential equations and Difference equations.

## UNIT III

Time and Frequency Characterization of Signals and Systems: Magnitude Phase Representation of the Fourier Transform, Magnitude Phase Representation of the Frequency response of LTI systems, Time domain Properties of Ideal Frequency Selective filter, Time Domain and Frequency Domain aspects of Non ideal filters, First Order and Second Order Continuous Time and Discrete time Systems.

## UNIT IV

Sampling and Laplace Transform: Signal representation by samples, sampling theorem, Impulse train sampling, sampling of discrete time signals, discrete time processing of continuous time signals. Laplace Transform, Region of convergence, inverse Laplace Transform, Analysis and characterization of LTI System, Block diagram representation, Unilateral Laplace transform.

## UNIT V

Random variable, random process correlation functions, cumulative distribution function, probability density function, joint-cumulative distribution, probability density function. Expectation, mean, variance, covariance, auto-correlation, power spectral density, Gaussian Pdf and Raleigh Pdf.

**Text Books**

1. V. Oppenheim, A.S. Willsky and S. Hamid Nawab, 'signals & System', Pearson Education, Second Edition, 2003.

**References**

1. Roberts, "Signals and Systems" Tata McGraw Hills.
2. P. Ramesh Babu, R. Ananda Natarajan,"Signals and Systems", SCITECH Publications.
3. Charles L. Phillips, John M.PARR and EVEA. RISKIN, "Signals, Systems and Transforms", PEARSON Education, Third Edition.
4. Chen 'Signals & Systems, Oxford University, Press.

BET-C306 / BET-C414

**Effective from the session 2020-21**

BET-C306 / BET-C414

## DIGITAL SYSTEM DESIGN

**MM : 100**
**Time : 3 hrs**
**L T P**
**3 0 0**

**Sessional : 30**
**ESE : 70**
**Credit : 3**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

### UNIT I

**Number System**: Representation of negative numbers, 9's and 1's complement, 10's and 2's complement, arithmetic using 2's complement. BCD Code, Gray Code, Excess-3 Code, Introduction to Boolean algebra, Truth table verification of various gates, Realization of Switching functions with gates.
**K- Map:** Representation up to 4 variables, simplification and realization of various functions using gates, Tabular Method, Combinational logic and design procedure.

### UNIT II

**Combinational logic Circuits:** Arithmetic circuits, Half and Full adder, Subtractors, BCD adders, Code Conversion, 4 bit Magnitude Comparator (IC -7485), Cascading of IC 7485, Decoder, Multiplexer, Demultiplexers, Encoders. Parallel Binary adder, IC 7483, 4-bit Binary parallel adder/subtractor.

### UNIT III

**Sequential Logic Circuits:** Flip Flops, S-R latch, gated latches, Edge triggered Flip Flops, Master-slave Flip Flops, Conversion of flip flops, Analysis of clocked sequential circuits, Design of synchronous circuits, State transition diagram, state reduction and assignment.

### UNIT IV

**Counters:** Design of Asynchronous and Synchronous Counters, Two bits & four bits up & down counters and their design, Shift registers, Serial & Parallel data transfer, Shift left/Right register, Shift Register applications.

### UNIT V

**Logic Families:** Diode switching, Transistors as a switching element, MOS as a digital circuit element, concept of transfer characteristics, input characteristics and output characteristics of logic gates, fan in, fan out, noise margin, Logic families: TTL, IIL, ECL, NMOS, & CMOS, Open collector outputs.

**Reference**


1. M.Morris Mano, Digital Design, PHI
2. R.P.Jain, Modern Digital electronics, TMH
3. A.Anand Kumar, Fundamentals of Digital Circuits, PHI
4. Lee S.C, Modern Switching Theory and Digital design, PHI
5. Greenfield J.D., Practical Digital design using ICs, John Wiley.

**Course outcomes:**

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits

समस्त स्नातक स्तर की कक्षाओं हेतु
अनिवार्य पाठ्यक्रम
तृतीय / चतुर्थ सत्र Semester III/IV

समय (Time) – 03 घंटे (Hours)
पूर्णांक -100
सत्रान्तपरीक्षा -70
आन्तरिकपरीक्षा – 30
Credit- 0

BKT-A403
BKT-A301/A401 भारतीय ज्ञानपरम्परा
Bharteeya Jnanaparampara

BKT-A403

प्रस्तावित पाठ्यक्रम (Prescribed Course)

घटक-1

1 वैदिक एवं लौकिक साहित्य का परिचय एवं उसका उद्देश्य (वैदिक साहित्य,आर्ष साहित्य एवं स्मृति साहित्य)
2 वैदिक प्रार्थनाएं गायत्री, भद्रप्राप्ति, शान्ति, संगठन, सौमनस्य एवं पञ्च महायज्ञ का सामान्य परिचय
3 ब्रह्मचर्य महिमा, वैदिक राष्ट्रभक्ति एवं शिवसंकल्प ( ब्रह्मचर्य सूक्त- अथर्ववेद ११.५, पृथिवी सूक्त - अथर्ववेद १२.१, शिवसंकल्प सूक्त - यजुर्वेद ३४.१-६ में वर्णित विषयवस्तु के आधार पर )

घटक-2

1 वैदिक कालीन सामाजिक एवं शिक्षा व्यवस्था
2 संस्कारों की जीवन में उपयोगिता
3 पुरुषार्थ चतुष्टय – धर्म, अर्थ, काम, मोक्ष

घटक-3

1 त्रैतवाद - ईश्वर, जीव एवं प्रकृति का स्वरूप
2 कर्म एवं पुनर्जन्म सिद्धान्त ( कर्म- निष्काम कर्मयोग एवं कर्मफल सिद्धान्त)

घटक-4

1 मानव जीवन के विकास में योग की महत्ता
2 अष्टांग योग- यम, नियम, आसन, प्राणायाम, प्रत्याहार ,धारणा, ध्यान, समाधि

घटक-5

1 भारतीय संस्कृति एवं सभ्यता : एक परिचय
2 महर्षि दयानन्द एवं स्वामी श्रद्धानन्द का व्यक्तित्व एवं कृतित्व
3 आर्य समाज की स्थापना, उद्देश्य एवं कार्य (सामाजिक जनजागरण, अछूतोद्धार, महिला शिक्षा, शुद्धि आन्दोलन, सामाजिक कुरीतियों का उन्मूलन, स्वतन्त्रता संग्राम में योगदान)

सहायक पुस्तकें –

1 वैदिक साहित्य एवं संस्कृति, डॉ० कपिल देव द्विवेदी।
2 उपनिषद् दीपिका, डॉ० रामनाथ वेदालंकार।
3 वैदिकदर्शन, डॉ० कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन, वाराणसी
4 प्राचीन भारत तथा सामाजिक एवं आर्थिक इतिहास, डॉ० देवेन्द्र शर्मा, भारतीय बुक कॉर्पोरेशन, नई दिल्ली।
5 योगदर्शन, स्वामी रामदेव, पतञ्जलि योगपीठ, हरिद्वार।
6 सत्यार्थ प्रकाश, स्वामी दयानन्द।
7 आर्यसमाज का इतिहास, डॉ० सत्यकेतु विद्यालंकार।
8 भारतीय नवजागरण के पुरोधा, डॉ० भवानी लाल भारतीय
9 संस्कृत साहित्य का इतिहास, डॉ० कपिल देव द्विवेदी, विश्वविद्यालय प्रकाशन, वाराणसी

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**Faculty of Engineering & Technology**

**Electrical Engineering**

# BEE-C 461

## ELECTRICAL MACHINES-II LAB

**MM : 50**
**Time : 2 Hr**
**L T P**
**0 0 2**
**Credits 1**

**Sessional : 15**
**ESE : 35**

### LIST OF EXPERIMENTS

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:
(i) Torque -speed characteristics
(ii) Power factor-line current characteristics
3. To perform no load and blocked rotor tests on a single phase induction motor and determine equivalent circuit.
4. To study speed control of three phase slip ring induction motor by varying rotor resistance.
5. 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 and leading power factors by (i) EMF method (ii) MMF method.
6. To determine V-curves and inverted V-curves of a three phase synchronous motor.
7. To determine Xd and Xq of a three phase salient pole synchronous machine using the slip test.
8. To study the synchronization of an alternator with bus bars.

### NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

**Revised Syllabus (Effective from the session 2020-21)**

**Gurukula Kangri Vishwavidyalaya, Haridwar**

**Faculty of Engineering & Technology**

**Electrical Engineering**

# BEE-C 462

# POWER ELECTRONICS LAB

**Sessional : 15**
**ESE : 35**

**MM : 50**
**Time : 2 Hr**
**L T P**
**0 0 2**
**Credits 1**

## LIST OF EXPERIMENTS

1. To study the DC voltage trigger with superimposed AC (SCR triggering circuit)
2. SCR trigger by R and R-C phase shift circuit.
3. To study the SCR phase control circuit.
4. To study the Triac phase control circuit.
5. To study the voltage commutated DC Chopper.
6. To study the current commutated DC Chopper.
7. To study the IGBT single-phase Inverter.
8. To study MOSFET single-phase Inverter.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

**Revised Syllabus (Effective from the session 2020-21)**
**Gurukula Kangri Vishwavidyalaya, Haridwar**
**Faculty of Engineering & Technology**
**Electrical Engineering**

# BEE-C 463

# ELECTRICAL MEASUREMENT AND MEASURING INSTRUMENTS LAB

**MM : 50**
**Time : 2Hr**
**L T P**
**0 0 2**
**Credits 1**

**Sessional : 15**
**ESE : 35**

## LIST OF EXPERIMENTS

1. Calibration of A.C. voltmeter and A.C. ammeter.
2. Measurement of low resistance by Kelvin's double bridge.
3. Measurement of voltage, current and resistance using D.C. potentiometer.
4. Measurement of inductance by Maxwell's bridge.
5. Measurement of inductance by Hay's bridge.
6. Measurement of inductance by Anderson's bridge.
7. Measurement of capacitance by Owen's bridge.
8. Measurement of capacitance by De Sauty bridge.
9. Measurement of capacitance by Schering bridge.
10. Measurement of power and power factor of a single-phase inductive load and to study effect of capacitance connected across the load on the power factor.
11. Measurement of power and power factor of a three-phase load.
12. Measurement of phase difference and frequency of a sinusoidal A.C. voltage using C.R.O.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

**Effective from the session 2020-21**

**BET-C355/BET-C464**

# DIGITAL SYSTEM DESIGN LAB

**MM : 50**
**Time : 2Hr**
**L T P**
**0 0 2**

**Sessional : 15**
**ESE : 35**
**Credit : 1**

## LIST OF EXPERIMENTS :

1. To verify the truth tables of various types of gates using IC 7400.
2. To verify the truth tables of Multiplexer & also implement a function using Multiplexer.
3. To design & verify the truth table of half & full adder.
4. To design & verify the truth table SR flip-flop using NOR/NAND gates.
5. To design & verify the truth table JK flip-flop using NOR/NAND gates.
6. To design & study Counters.
7. To design & study Shift registers.
8. To verify the truth tables of de Multiplexer.

## NOTE

1. In practical examination the student shall be required to perform one experiment.
2. A teacher shall be assigned 20 students for daily practical work in laboratory.
3. No batch for practical class shall consist of more than 20 students.
4. The number of students in a batch allotted to an examiner for practical examination shall not exceed 20 students.
5. Addition/deletion in above list may be made in accordance with the facilities available with the approval of H.O.D./Dean.

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# POWER SYSTEMS-I
# BEE-C 511

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The basic concepts and structure of power systems, Bulk Power Grids and Micro-grid,
- Sources of electric energy: conventional and nonconventional; Renewable Energy Sources,
- Over Head transmission lines and Mechanical Design of transmission line,
- Neutral Grounding, EHV AC and HVDC Transmission.

## UNIT I

**Basic Concepts:** Evolution of Power Systems and Present-Day Scenario, Structure of a power system: Bulk Power Grids and Micro-grids. Single line Diagram of Power system, Brief description of power system Elements: Synchronous machine, transformer, transmission line, bus bar, circuit breaker and isolator.
**Power Generation:** Sources of electric energy: conventional and nonconventional; Renewable Energy Sources. Distributed Energy Resources, Energy Storage.

## UNIT II

**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.
**Overhead 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, ABCD, h, Image Parameters.

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## UNIT III

**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.

## UNIT IV

**Mechanical Design of transmission line:** Catenary curve, calculation of sag & tension, effects of wind and ice loading, sag template, vibration dampers. 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 V

**Neutral Grounding:** Necessity of neutral grounding, various methods of neutral grounding, earthing transformer, grounding practices. 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.
**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.

**Course Outcomes:**

- To introduce the students to the basic concepts, structure of power systems and Sources of electric energy.
- Understand the different kinds of supply system and configuration of transmission lines
- Calculate the inductance and capacitance of transmission line. Understand the corona formation and overhead line insulators.
- Understand the Mechanical Design of transmission line, Neutral Grounding, EHV AC and HVDC Transmission

**Text Books:**

1. W. D. Stevenson, Element of Power System Analysis, McGraw Hill, USA
2. C. L. Wadhwa, Electrical Power Systems, New age international Ltd. Third Edition
3. S. L. Uppal, Electric Power, Khanna Publishers, India.
4. B.R. Gupta, "Generation of Electrical Energy", S. Chand Publication.
5. A. J. Wood & B.F. Wollenburg, "Power Generation, Operation and Control "John Wiley & Sons.

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**Reference Books:**

1. S.N.Singh, Electric Power Generation, Transmission & distribution, PHI, New Delhi.
2. Asfaq Hussain, 'Power System, CBS Publishers and Distributors, India.
3. B. R. Gupta, Power System Analysis and Design, Third Edition, S. Chand & Co.
4. M. V. Deshpande, Electrical Power System Design, Tata Mc Graw Hill.

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# CONTROL SYSTEMS
# BEE-C 512

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

NOTE: The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- In this subject, we will study the various types of mathematical models of physical systems.
- Concept of stability and the design specification.
- Various types of stability criterion.

## UNIT-I

Introduction to control problem: Industrial Control examples. Mathematical models of physical systems. Control hardware and their models. Transfer function models of linear time-invariant systems. Feedback Control: Open Loop and Closed-loop systems. Benefits of Feedback. Block diagram algebra.

## UNIT-II

Time Response Analysis: Standard test signals. Time response of first and second order systems for standard test inputs. Application of initial and final value theorem. Design specifications for second-order systems based on the time-response. Concept of Stability. Routh-Hurwitz Criteria. Relative Stability analysis. Root-Locus technique. Construction of Root-loci.

## UNIT-III

Frequency-response analysis: Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion. Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

## UNIT-IV

Introduction to Controller Design: Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems. Root-loci method of feedback controller design. Design specifications in frequency-domain. Frequency-domain methods of design. Application of Proportional, Integral and Derivative Controllers, Lead and Lag compensation in designs. Analog and Digital implementation of controllers.

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## UNIT-V

State variable Analysis: Concepts of state variables. State space model. Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability. Pole-placement by state feedback. Discrete-time systems. Difference Equations. State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

**Course Outcomes:** At the end of this course, students will demonstrate the ability to

- Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
- Understand the concept of stability and its assessment for linear-time invariant systems.

**Text Books:**

1. Franklin G.F., Powell J.D., Emami-Naeini A., Feedback Control of Dynamic Systems, Pearson,Upper Saddle River, New Jersey, 5th edition, 2006.
2. M. Gopal, "Control Systems: Principles and Design", McGraw Hill Education, 1997.
3. I. J. Nagrath and M. Gopal, " Control Systems Engineering", New Age International, 2009

**Reference Books:**

1. Modern Control Engineering," K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002. ISBN 978 - 81 - 203 - 4010 – 7.
2. Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
3. Feedback and Control System," Joseph J Distefano III et al., Schaum's Outlines, TMH, 2 n d Edition2007.
4. Ogata K., Modern Control Engineering, Prentice-Hall of India Pvt Ltd., New Delhi, 3rd edition, 2000.

Revised Syllabus (Effective from the session 2021-22)

**Gurukula Kangri (Deemed to be University), Haridwar**
**Faculty of Engineering & Technology**
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# ELECTRICAL DRIVES AND THEIR CONTROL
# BEE-C 513

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To impart knowledge about fundamentals of Electric drives and control
- Operational strategies of dc and ac motor drives as per different quadrant operations and to discuss.

## UNIT I

Fundamentals of Electric Drive: Electric Drives and its parts, advantage of electric drives, Classification electric drives, Speed-torque conventions and multi-quadrant operations, Constant torque and constant power operations, Types of load, Load torque: components, nature and classification.

## UNIT II

Dynamics of Electric Drives: Dynamics of motor-load combination; Steady states stability of Electric Drives; Transient stability of Electric Drives.

## UNIT III

Electric Breaking: Purpose and types of electric breaking, breaking of dc, Three Phase induction and synchronous motors. Dynamics during Starting and Breaking: Calculation of acceleration time and energy loss during starting of dc shunt and 3-Phase induction motors, method of reducing energy loss during starting. Energy relation during breaking, Dynamics during breaking

## . UNIT IV

Power Electronic Control of DC Drives: Single phase and three phase controlled converter feed separately excited dc motor drives (continuous conduction only) ; dual controlled converter feed separately excited dc motor drives, 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 V

Power Electronic Control of AC Drives: Three phase Induction motor drive: static Voltage control scheme, static frequency control scheme (VSI, CSI, and cyclo-converter based) static rotor resistance and slip power recovery control schemes. Three Phase Synchronous Motors:

Self-control schemes. Special Drivers: Switched Reluctance motor, Brushless dc motor, selection of motor for particular applications.

**Course Outcomes:** Upon successful completion of the course, the students will be able

- To acquire the knowledge of selection of drives as per practical operational industrial requirement.
- To apply their knowledge to prepare control schemes as per different types of motors used in industries.
- To estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

**Text Books:**

1. Thyristor Dc Drives By P. C. Sen Tata McGraw-Hill Education
2. Murphy J. M. D. and Turnbull F. G., "Power Electronics Control of AC Motors", Peragmon Press.
3. S.L. Uppal, Electrical Power, Khanna publishers, New Delhi, 1992.
4. S. K. Pallai, A First course on Electric Drives, New age International.
5. Vector Control of AC Machines" by P Vas, Oxford University Press (November 1, 1990)
6. Fundamentals of Electrical Drives" by G K Dubey, Narosa

**Reference Books:**

1. Electric Drives ,By N. K. DW, P. K. SEN, PHI Learning Private Limited, Rimjhim House, 111, Patparganj Industrial Estate, Delhi-110092
2. Electric Motor Drives" by R Krishnan, Prentice Hall India Learning Private Limited
3. Electric Drives" by D P Kothari and Rakesh Singh Lodhi, I K International Publishing House
4. Linear Electric Machines, Drives, and MAGLEVs Handbook" by Ion Boldea, Taylor and Francis.
5. Power Electronic Control of AC Motors, by J. M. D. Murphy, F. G. Turnbull,Publisher Franklin Book Company, 1988

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# UNIVERSAL HUMAN VALUES
# BEE-M 001

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

## UNIT I

**Course Introduction** - Need, Basic Guidelines, Content and Process for Value Education.Purpose and motivation for the course, recapitulation from Universal Human Values-I Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration Continuous Happiness and Prosperity- A look at basic Human Aspirations Priority Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

## UNIT II

**Understanding Harmony in the Human Being** - Harmony in Myself ! Understanding human being as a co-existence of the sentient 'I'& the Material 'Body'. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer) Understanding the characteristics and activities of 'I' and harmony in 'I' Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

**UNIT III**

**Understanding Harmony in the Family and Society-** Harmony in Human- Human Relationship

Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship. Understanding the meaning of Trust; Difference between intention & competence. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

**UNIT IV**

**Understanding Harmony in the Nature and Existence -** Whole existence as Coexistence.

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self-regulation in nature. Understanding Existence as Co-existence of mutually interacting units in all- pervasive space. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

**UNIT V**

**Implications of the above Holistic Understanding of Harmony on Professional Ethics**

Natural acceptance of human values. Definitiveness of Ethical Human Conduct. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems. Case studies of typical holistic technologies, management models and production systems. Strategy for transition from the present state to Universal Human Order: At the level of individual: as socially and ecologically responsible engineers, technologists and managers. At the level of society: as mutually enriching institutions and organizations. Sum up Include practice Exercises and CaseStudies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

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**Course Outcomes:**

- By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature).
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
- This is only an introductory foundational input. It would be desirable to follow it up by
- Faculty-student or mentor-mentee programs throughout their time with the institution.
- Higher level courses on human values in every aspect of living. E.g. as a professional.

**Text Book:**

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books,New Delhi, 2010

**Reference Books**

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karam chand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

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**Course Outcomes:**

- By the end of the course, students are expected to become more aware of themselves, and their surroundings (family, society, nature).
- They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind. They would have better critical ability. They would also become sensitive to their commitment towards what they have understood (human values, human relationship and human society).
- It is hoped that they would be able to apply what they have learnt to their own self in different day-to-day settings in real life, at least a beginning would be made in this direction.
- This is only an introductory foundational input. It would be desirable to follow it up by
- Faculty-student or mentor-mentee programs throughout their time with the institution.
- Higher level courses on human values in every aspect of living. E.g. as a professional.

**Text Book:**

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**Reference Books**

1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karam chand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – PanditSunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

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# LINE COMMUTATED AND ACTIVE RECTIFIERS
# BEE-P 514

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To Analyzed controlled rectifier circuits.
- To understand the operation of line-commutated rectifiers, 6 pulse and multi-pulse configurations, operation in rectification and regeneration modes and lagging, leading and unity power factor mode.

## UNIT I

Diode rectifiers with passive filtering: Single phase half wave diode rectifier with R and RL load Single phase half wave diode rectifier with RC load, input current wave shape Single phase full wave diode rectifier with R, RL and RC load, Performance parameter of single-phase full wave diode rectifier, continuous and discontinuous conduction

## UNIT II

Thyristor rectifiers: Principle of phase-controlled converter operation single phase Half-wave thyristor rectifier with R load and RL load, continuous and discontinuous conduction, input current wave shape

## UNIT III

Three phase thyristor rectifiers: Principle of phase-controlled converter operation, single-phase Half-wave thyristor rectifier with R load and RL load, continuous and discontinuous conduction, input current wave shape

## UNIT IV

Pulse Width Modulated rectifier: Power factor improvement of controlled rectifier, Concept of Pulse width modulated rectifier, power circuit of single-switch ac-dc converter, three phase PWM rectifier, Three phase sinusoidal pulse width modulation

## UNIT V

DC to AC converter-Pulse Width Modulated inverter, Pulse Width Modulated inverter, multiple pulse width modulation, dc-dc fly back converter, output voltage as a function of duty ratio and transformer turns ratio

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**Course Outcomes:** At the end of this course, students will demonstrate the ability to

- Application and use of diode rectifier.
- Practical usage of pulse width modulation.
- Usage of rectifier in three phase system

**Text Books:**

1. G. K. Dubey, "Power Semiconductor Controlled Drives", Prentice Hall, 1989.
2. R. Krishnan, "Electric Motor Drives: Modeling, Analysis and Control", Prentice Hall, 2001.
3. G. K. Dubey, "Fundamentals of Electrical Drives", CRC Press, 2002.
4. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.

**Reference Books:**

1. J. VITHAYATHIL, *Power Electronics: Principles and Applications*, New York: McGraw-Hill, 1995.
2. J. PHIPPS, "Phase-Shifting Transformers and Passive Harmonic Filters: Interfacing for Power Electronic Motor Drive Controllers," M.S. Thesis, University of Colorado at Denver, 1993.
3. J. ARRILLACA, D. BRADLEY, and P. BODGER, Power System Harmonics, New York: John Wiley Sons, 1985.
4. W. Leonhard, "Control of Electric Drives", Springer Science & Business Media, 2001.

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**Electrical Engineering**

# OBJECT ORIENTED PROGRAMMING USING CPP
# BCE-P 515

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives**:

- Introduction to Object oriented Paradigm
- Features of object-oriented programming, class and object: state, identity, and behavior
- Data Abstraction and Data Hiding
- Encapsulation, Inheritance and polymorphism.
- Inheritance in OO design.
- Implementing OO language features.
- Memory management.
- Generic types and collections.

## UNIT I

**Introduction:** Review of C, Difference between C and C++, Cin, Cout, new, delete operators,abstraction, encapsulation, inheritance, polymorphism, Structured versus object-oriented development, elements of object-oriented programming.

**Class Overview:** Class specification, class objects, accessing class members, defining member functions, outside member functions as inline, accessing member functions within a class, data hiding, access boundary of objects revisited, empty classes, pointers within a class, passing objects as arguments, returning objects from functions, friend functions and friend classes, constant parameters and member functions, structures and classes, static data and member functions, class, objects and memory resource, class design steps.

## UNIT II

**Object Initialization and Cleanup:** Class revisited, constructors, parameterized constructors, destructor, constructor overloading, order of construction and destruction, constructors with default arguments, copy constructor, static data members with constructors and destructors.

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**Operator Overloading:** Introduction, over loadable operators, unary operator overloading, operator keyword, operator return values, limitations of increment/decrement operators, binary operator overloading, arithmetic operators, data conversion, conversion between basic data types, conversion between objects and basic types, conversion between objects of different classes, overloading with friend functions.

**UNIT III**

**Inheritance:** Introduction, class revised, derived class declaration, forms of inheritance, inheritance and member accessibility, constructors in derived classes, destructors in derived classes, constructors invocation and data members initialization, overloaded member functions, multilevel inheritance, multiple inheritance, hierarchical inheritance, multipath inheritance and virtual base classes, hybrid inheritance.

**UNIT IV**

**Virtual Functions and Classes:** Introduction, need for virtual functions, static and dynamic binding, pointer to derived class objects, definition of virtual functions, pure virtual functions, abstract classes, virtual destructors.

**Generic Programming with Templates:** Introduction, function templates, overloaded function templates, multiple arguments function templates, user defined template arguments,class templates.

**UNIT V**

**Stream Computation with Files:** Introduction, hierarchy of file stream classes, opening and closing of files, file modes, file pointers, sequential access to a file, saving and retrieving of objects, file input/output with stream class.

**Exception Handling:** Introduction, error handling, exception handling model, exception handling constructs.

**Course Outcomes:**

- Specify simple abstract data types and design implementations, using abstraction functions to document them.
- Recognize features of object-oriented design such as encapsulation, polymorphism, Inheritance.
- Name and apply some common object-oriented design patterns and give examples of their use.
- Prepare for competitive programming by implementing the concepts learned.

**Text Books:**

1. E. Bala guru samy, Object Oriented Programming with C++, TMH
2. R. Lafore, Object Oriented Programming using C++, Galgotia

**References:**

1. S. B .Lippman & J. Lajoie, C++ Primer, Addison Wesley
2. G. Booch, Object Oriented Design & Applications, PHI.

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# INTRODUCTION TO AI
# BCE-O 534

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To provide insight into fundamentals of Artificial Intelligence Techniques to the students.
- To convey application of Artificial Intelligence techniques in power system.

## UNIT I

**Introduction:** Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence, - Formulating problems, problem types, states and operators, state space, search strategies, AI and Industry, AI and the world, Role of Intelligent Systems, Fundamentals of various IS, Comparisons with conventional programs.

## UNIT II

**Artificial Neural Network:** Introduction, difference between human machine and intelligence, biological neural network, artificial neuron model, Concept of Perceptron, ADALINE, Feedback in Neural Network, Neural Network Architectures: Neural Learning, Application of Neural Network in Electrical System.

## UNIT III

**Fuzzy Logic:** Introduction, Foundation of Fuzzy Systems, Representing Fuzzy Elements, Basic Terms and Operations, Properties of Fuzzy Sets, Fuzzification, Arithmetic Operations of Fuzzy Numbers, The alpha cut method, The extension method, Linguistic Descriptions and their Analytical Forms, Fuzzy Linguistic Descriptions, Fuzzy Relation Inferences, Fuzzy Implication and Algorithms, Defuzzification Methods, Centre of Area Defuzzification, Centre of Sums Defuzzification.

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## UNIT IV

**Genetic Algorithms and Evolutionary Programming:** Introduction, Genetic Algorithms, Procedure of Genetic Algorithms, Genetic Representations, Initialization and Selection, Genetic Operators, Mutation, the Working of Genetic Algorithms, Evolutionary Programming, the Working of Evolutionary Programming

## UNIT V

**Application of AI in Electrical:** Application of Neural Network and Expert Systems in Voltage Control, Application of ANN for security assessment, Schedule Maintenance of Electrical Power Transmission Networks using Genetic Algorithm, Intelligent Systems for Demand Forecasting.

**Course Outcomes:**

- After completing the course, the students shall be able to understand concepts of Artificial Intelligence and their role in optimization.

**Text Books:**

1. Artificial Intelligence and Intelligent Systems, OXFORD University Press, New Delhi, 2005- N. P. Padhy.
2. Understanding Neural Networks and Fuzzy Logic: Basic concepts and Applications, Prentice Hall India Private Limited, New Delhi,2002- Stamations V. Kartalopoulos.
3. Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series, UK, 1997- Kevin Warwick, Arthur Ekwue and Raj Aggarwal.
4. Intelligent Systems and Signal Processing in Power Engineering, Springer Berlin Heidelberg, New York- AbhisekUkil.

**References Books:**

1. Stuart Russe; Peter Norvig, Artificial intelligence: A Modern Approach, Prentice Hall,Fourth edition, 2020.
2. Judea Pearl, Heuristics: Intelligent Search Strategies for Computer Problem Solving,Addison-Wesley Publishing Company, 1984.
3. Nils J. Nilsson, Artificial Intelligence: A New Synthesis, Morgan-Kaufmann, 1998.

Revised Syllabus (Effective from the session 2021-22)

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# INDUSTRIAL ELECTRICAL SYSTEMS
# BEE-O 517

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course objectives:**

- Understand the electrical wiring systems for residential, commercial and industrial consumers, representing the systems with standard symbols and drawings, SLD.
- Understand various components of industrial electrical systems.

## UNIT I

**Electrical System Components:** LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current, Characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

## UNIT II

**Residential and Commercial Electrical Systems:** Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps,

## UNIT III

**Industrial Electrical Systems I:** HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction kVAR calculations, type of compensation.

## UNIT IV

**Industrial Electrical Systems II:** Introduction to PCC, MCC panels. Specifications of LT Breakers, MCB and other LT panel components, DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

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## UNIT V

**Industrial Electrical System Automation:** Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

**Course Outcomes:** At the end of this course, students will demonstrate the ability to

- The Student Analyze and select the proper size of various electrical system components
- Will have knowledge of electrical wiring systems for residential, components of industrial electrical systems.

**Text Books:**

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008.

**Reference Books:**

1. Soni A. Chakrabarti, M. L .Soni, P. V. Gupta, U. S. Bhatnagar, “ A text book on Power System Engineering”, Khanna Publishers, 2000.
2. Open Shaw Taylor, "Utilization of Electrical Energy", Oriented ongmans Limite (Revised in SI Units), 1971.
3. A. I. Starr, “Generation, Transmission and Utilization of Electric Power”, ELBS, 1978.

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# POWER SYSTEMS- I LABORATORY
# BEE-C 561

**MM: 50** **Sessional: 15**
**Time: 2 Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

**LIST OF EXPERIMENTS**

1. To study the performance of a long transmission line under no load & light load conditions.
2. To study phase displacement between the current & voltage at input of line using transmission line trainer kit.
3. Measurement of input impedance and attenuation of transmission line using transmission line trainer kit.
4. Measurement of characteristics of transmission using transmission line trainer kit.
5. To find the resistivity of the earth using a hand driven earth tester.
6. To study the performance characteristics of a typical D.C. distribution system (Radial Configuration).
7. To determine the ABCD parameters of transmission line.
8. To determine the h parameters and Image parameters of transmission line.
   i) To plot the equipotential line of paper model of multiple layer cable.
   ii) To plot electric stress distribution in a paper model of multiple layer cable.
9. To determine the voltage distribution across a string insulator and calculate string efficiency.
10. To test the breakdown voltage of the transformer oil by transformer oil testing set.

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# CONTROL SYSTEMS LABORATORY
# BEE-C 562

**MM: 50** **Sessional: 15**
**Time: 2Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

**LIST OF EXPERIMENTS**

1. To study potentiometer based error detector and to draw its characteristics.
2. To study speed control and reversal of stepper motor using microprocessor.
3. To study synchro transmitter – receiver pair and its operation as an error detector.
4. Study of two phase AC servo motor and draw its speed torque characteristics.
5. To study voltage sensitive bridge and to analyze its sensitivity and linearity.
6. To study D.C. position control system and to execute position control through continuous and step command.
7. To design, implement and study the effects of different cascade compensation networks for a given system.
8. To study the Digital control system and to implement digital PID control for a modeled process.
9. To study relay as nonlinear element and effect of dead-zone and hysteresis on the controlled process.
10. To study speed control of DC Servomotor using PID controller.
11. To study magnetic amplifier and to plot control current versus load current characteristics for series, parallel and self saturation mode configuration.
12. To study and perform simple two step open loop control and proportional control on process control simulator kit.

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# ELECTRIC DRIVES LABORATORY
# BEE-C 563

**MM: 50** **Sessional: 15**
**Time: 2 Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

## LIST OF EXPERIMENTS

1. Performance & speed control of D.C. drive using 3-phase full Converter.
2. To perform speed control of separately excited dc motor using chopper
3. Speed control of dc motor using closed loop and open loop.
4. Study and analyze the performance of four quadrant operation of chopper fed dc motor drive at different firing angles
5. Determination of speed and output voltage of 3-phase A.C. Voltage controller fed induction motor drive.
6. Performance & speed control of 3-phase slip ring Induction motor by Static Rotor Resistance controller.
7. DSP based V/F Control of 3-phase Induction motor.
8. DSP based Speed control of BLDC motor
9. Study of Chopper fed DC Drive.
10. Study of AC Single phase motor-speed control using TRIAC.

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# POWER SYSTEMS – II
# BEE-C 611

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The Symmetrical components, Symmetrical fault analysis, Unsymmetrical faults,
- Load Flow Studies
- Stability in Power System,
- Overview of Energy Control Centre Functions.

## UNIT I

**Representation of Power System Components:** Synchronous machines, Transformers, Transmission lines, Impedance and reactance diagram. Per Unit System, Changing the base of per unit quantities, Advantages of per unit system.

**Symmetrical components:** Symmetrical Components of unbalanced pharos, power in terms of symmetrical components, sequence impedances and sequence networks.

## UNIT II

**Symmetrical fault analysis:** 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.

**Unsymmetrical faults:** 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.

## UNIT III

**Load Flows:** Introduction, bus classifications, Bus admittance matrix (Y Bus), development of load flow equations, load flow solution using Gauss Seidel and Newton-Raphson method, approximation to N-R method, line flow equations and fast-decoupled method, Economic dispatch and optimal power flow.

## UNIT IV

**Stability in Power System:** Stability and Stability limit, Steady state stability study, Swing Equations of a synchronous machine, Power angle curve, and equal area criterion, transient stability study by equal area

criterion and step-by- step method. Factors affecting steady state and transient stability and methods of improvement.

**UNIT V**

**Travelling Waves in Power System:** Wave equation for uniform Transmission lines, velocity of propagation, Lightning and switching surges, surge impedance, reflection and transmission of traveling waves under different line loadings. Bewley lattice diagram, protection of equipment and line against traveling waves.
**Overview of Energy Control Centre Functions:** SCADA systems, Preventive Control and Emergency Control.

**Course Outcomes:**

- To introduce the students to Representation of Power System Components and Symmetrical components.
  Symmetrical fault and Unsymmetrical faults.
- Study and learn to prepare Bus admittance matrix.
- Load flow solution using Gauss Seidel and Newton-Raphson method.
- Understand the Stability in Power System and Travelling Waves in Power System.
- Understand SCADA systems, Preventive Control and Emergency Control.

**Text Books:**

1. W. D. Stevenson, "Elements of Power System Analysis", McGraw Hill.
2. C. L. Wadhwa, Electrical Power Systems, New age international Ltd. Third Edition
3. J. Wood & B.F. Wollen burg, "Power Generation, Operation and Control" John Wiley & Sons.
4. S. S. Rao, "Switchgear and Protection", Khanna Publishers.
5. B. Ravindranath and M. Chander, Power system Protection and Switchgear, Wiley Eastern Ltd.
6. P.S.R. Murthy, "Operation and control in Power Systems" B.S. Publications.

**Reference Books:**

1. O.I. Elgerd, "Electric Energy System Theory" McGraw Hill.
2. P. Kundur, "Power System Stability and Control McGraw Hill.
3. T. K. Nagsarkar & M.S. Sukhija,' Power System Analysis' Oxford University Press.
4. Hadi Sadat, "Power System Analysis", McGraw Hill.
5. B. Ram and D. N. Vishwakarma, "Power System Protection and Switchgear", McGraw Hill
6. D.P. Kothari & I.J. Nagrath, "Modern Power System Analysis" McGraw Hill, 3rd Edition.

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# COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES
# BEE-C 612

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The objective of the course is to provide the concept of machine design like transformer design, rotating machine design, computer aided design.

## UNIT I

**Basic Considerations:** Basic concept of design, limitation in design, standardization, modern trends in design and manufacturing techniques. Classification of insulating materials. Modes of heat dissipation & temperature rise-time curves. Methods of cooling ventilation (induced & forced, radial & axial), direct cooling & quantity of cooling medium. Calculation of total mmf and magnetizing current. Specific permeance and leakage reactance.

**Electrical Materials: C**rystal structures and defects, ceramic materials, insulating materials, magnetic materials – basics, properties and applications; ferrites, Ferro-magnetic materials and components; Basics of Nano materials and Superconductors.

## UNIT II

**Transformer Design:** Output equation design of core, yoke and windings, overall dimensions, Computation of no-load current to voltage regulation, efficiency and cooling system designs.

## UNIT III

**Design of Rotating Machines – I:** Output equations of rotating machines, specific electric and magnetic loadings, factors affecting size of rotating machines, separation of main dimensions, selection of frame size. Core and armature design of dc and 3-phase AC machines.

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## UNIT IV

**Design of Rotating Machines – II:** Rotor design of three phase induction motors. Design of field system of DC machine and synchronous machines. Estimation of performance from design data.

## UNIT V

**Computer Aided Design:** 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 for the design of transformer, dc machine, three-phase induction and synchronous machines.

**Course Outcomes:** On completion of course, student will be able to:

- Basic concept of design and its limitations.
- Transformer design.
- Rotating Machines design
- Computer Aided design and flow charts.

**Text Book:**

1. Veinott C. G., "Computer Aided Design of Electrical Machinery", MIT Press.
2. A. K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai & Sons.
3. M.G. Say, The Performance and Design of AC Machines, Pitman & Sons.
4. S.K. Sen, Principle of Electrical Machine Design with Computer Programming, Oxford and IBM Publications.

**Reference Books:**

1. A.E. Clayton and N.N. Hancock, "The Performance and Design of D.C. Machines" Pitman & Sons.
2. Siskind – Electrical Machine Design Mcgraw Hill.
3. Vlado Ostovic „Computer-Aided Analysis of Electric Machines: A Mathematical Approach", Prentice Hall.
4. Ramamoorthy M., "Computer Aided Design of Electrical Equipment", East West Press

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## MICROPROCESSORS AND INTERFACING
## BET-C 613

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

Course objectives: This subject deals about the basic 16-bit processor and an 8-bit controllers, their architecture, internal organization and their functions, interfacing an external device with the processors/ controllers.

### UNIT-I

Introduction to Microprocessors and assembly language, 8085 architectures, addressing modes of 8085, 8085 instruction set and programming techniques, timing diagrams, Counters & time delays.

### UNIT-II

Stacks and subroutines, basics of memory interfacing. Interfacing I/O Devices, programming of basic arithmetic operations: addition, subtraction, multiplication, division, code conversion etc, Interrupts
.

### UNIT-III

Programmable Peripheral Interface (PPI) (8255), Programmable Interval Timer (8254), Programmable interrupt controller (8259), DMA & DMA controller (8237), ADC / DAC interfacing.

### UNIT-IV

8086 Processor: 8086 architectures, Pin configuration, 8086 in min/max mode, addressing modes, Instruction set of 8086, Assembler directives, basic assembly language programming.

### UNIT-V

Overview of Advanced Microprocessors- 80186,286,386,486, Pentium – I, Pentium – II, Pentium – III, Pentium – IV.

**Course Outcomes:** At the end of this course students will demonstrate the ability to

- Do assembly language programming
- Do interfacing design of peripherals like, I/O, A/D, D/A, timer etc.

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**Text Books:**

1. The 8051 Microcontroller ,Architecture Programming and Applications by K.J Ayala
2. Microprocessors and interfacing: by Douglas hall and S S S P Rao.
3. Microprocessor, architecture, programming and applications with the 8085 by R.S Gaonkar.

**Reference Books:**

1. J.H. Hennessy, and D.A. Patterson, Computer Architecture: A Quantitative Approch, Morgan Kaufmann Publishers, Fourth Edition, 2006.
2. Kenneth J. Ayala, The 8051 Microcontroller, Architecture, Programming and Applications, Penram International Publishing, 1996.
3. Hall D.V.,"Microprocessor and Interfacing-Programming and Hardware", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, 2008.

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# SPECIAL ELECTRICAL MACHINES
# BEE-P 614

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course objectives:**

- Describe the working principle, Constructional Features of different types of electrical machines including the fractional kilowatt machines.
- Analyze torque- speed characteristics of different electrical machines and interpret their performance and identify the suitable machine for an operation.
- Study different types of control techniques for a machine and identify the best control strategy based upon different constraints.
- Illustrate the use of stepper, BLDCs, SRM, and other special machines in the area of the various industrial and domestic as well as commercial applications of various fractional kilowatt machines.

## UNIT I

**Induction Machines:** Concept of constant torque and constant power controls, SEIG, DFIG: Operating Principle, Equivalent Circuit, Characteristics, Applications, and Linear Induction Motors. Construction, principle of operation, linear force, and applications. Two Phase AC Servomotors: Construction, torque-speed characteristics, performance and applications.

## UNIT II

**Stepper Motors:** Constructional features, Principle of operation, Variable reluctance motor, Hybrid motor, Single and multi-stack configurations, Torque equations, Characteristics, Drive circuits, Microprocessor control of stepper motors, Closed loop control, Applications.

## UNIT III

**Switched Reluctance Motors:** Constructional features, Rotary and Linear SRM, Principle of operation, Torque production, performance characteristics, Methods of Rotor position sensing, Sensor less operation, Closed loop control and Applications

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## UNIT IV

**Permanent Magnet Machines:** Permanent Magnet synchronous generator Operating Principle, Equivalent Circuit, Characteristics, Permanent magnet DC motors, sinusoidal PMAC motors, their important features and applications, PCB motors, Permanent Magnet Brushless D.C. Motors: Principle of operation, Types, Magnetic circuit analysis, EMF and torque equations, Commutation, Motor characteristics and control, Applications.

## UNIT V

**Single-phase synchronous motor:** construction, operating principle and characteristics of reluctance and hysteresis motors. Single Phase Commutator Motors: Construction, principle of operation, characteristics of universal and repulsion motors.

**Course Outcomes:**

- Compare accepted standards and guidelines to select appropriate electrical machines to meet specified performance requirements.
- Demonstrate an understanding of the fundamental control practices associated with rotating machines (starting, reversing, braking, speed control etc.).
- Set up testing strategies to evaluate performance characteristics of electrical machines. Design of autonomous systems using special electrical machines. Justify contemporary issues within and outside the electrical engineering profession.

**Text Books:**

1. R. Krishnan, Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application, CRC Press, New York, 2001.
2. T. Kenjo and S. Nagamori, Permanent Magnet and Brushless DC Motors, Clarendon Press, London, 1988.
3. T. J.E.Miller,Brushless Permanent-Magnet and Reluctance Motor Drives, Oxford University Press, 1989.
4. R. Srinivasan, Special Electrical Machines, Lakshmi Publications, 2013
5. J. ARRILLACA, D. BRADLEY, and P. BODGER, Power System Harmonics, New York: John Wiley Sons, 1985.

**Reference Books:**

1. K. Venkataratnam, Special Electrical Machines, Universities Press (India) Private Limited, 2008.
2. T. Kenjo, Stepping Motors and Their Microprocessor Controls, Clarendon Press London, 1984
3. E.G. Janardanan, Special electrical machines, PHI learning Private Limited, Delhi, 2014.
4. M.G. Say "Alternating current Machines" Pitman & Sons.

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# ADVANCED ELECTRIC DRIVES
# BEE-P 615

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To impart knowledge about fundamentals of Electric drives and control, operational strategies of dc and ac motor drives as per different quadrant operations and to discuss.

## UNIT I

**Power Converters for AC drives**: PWM control of inverter, selected harmonic elimination, space vector modulation, current control of VSI, three level inverter, Different topologies, SVM for 3 level inverter, Diode rectifier with boost chopper, PWM converter as line side rectifier, current fed inverters with self-commutated devices. Control of CSI, H Bridge as a 4-Q drive.

## UNIT II

**Induction motor drives:** Different transformations and reference frame theory, modeling of induction machines, voltage fed inverter control-v/f control, vector control, direct torque and flux control (DTC).

## UNIT III

**Synchronous motor drives:** Modeling of synchronous machines, open loop v/f control, vector control, direct torque control, CSI fed synchronous motor drives.

## UNIT IV

**Permanent magnet motor drives:** Introduction to various PM motors, BLDC and PMSM drive configuration, comparison, block diagrams, Speed and torque control in BLDC and PMSM.

## UNIT V

**Switched reluctance motor drives:** Evolution of switched reluctance motors; various topologies for SRM drives, comparison, closed loop speed and torque control of SRM.

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**Course Outcomes:**

- On the completion of the course, the student will be able
- To acquire the knowledge of selection of drives as per practical operational industrial requirement.
- To apply their knowledge to prepare control schemes as per different types of motors used in industries.
- To estimate & solve harmonic and power factor related problems in controlling AC and DC drives.

Text Books:

1. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.
2. P. C. Krause, O. Wasynczuk and S. D. Sudhoff, "Analysis of Electric Machinery and Drive Systems", John Wiley & Sons, 2013.
3. Advanced Electric Drives: Analysis, Control and Modeling Using Simulink" by Ned Mohan, Mnpere
4. Electric Drives" by Vedam Subramaniam, McGraw Hill Education.

Reference Books:

1. Electric Drives" by Ion Boldea and Syed A Nasar, CRC Press.
2. Electric Motor Drives: Modeling, Analysis, and Control" by R Krishnan, Prentice Hall IndiaLearning Private Limited.
3. Control of Electrical Drives" by W Leonhard, Springer (India) Pvt. Ltd.
4. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC motor Drives", CRC Press, 2009.

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**Electrical Engineering**

# Fundamentals of IOT and its Application
# BET-O 616

**MM: 100** **Sessional: 30**
**Time: 3 hrs** **ESE: 70**
**L T P** **Credits: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The Internet is evolving to connect people to physical things in real time. It's becoming the Internet of Things (IoT).
- The course enables student to understand the basics of Internet of things and protocols.
- It introduces some of the application areas where Internet of Things can be applied.
- Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things.

## UNIT I

**IOT**: What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

## UNIT II

**IOT PROTOCOLS**: Protocol Standardization for IoT – Efforts – M2M and WSN Protocols-SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BAC Net Protocol– Modbus – KNX – Zig bee– Network layer – APS layer-Security.

## UNIT III

**IOT ARCHITECTURE** : IoT Open-source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview-IoTivity stack architecture- Resource model and Abstraction.

## UNIT IV

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**WEB OF THINGS** : Web of Things versus Internet of Things – Two Pillars of the Web Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence.

**UNIT V**

**IOT APPLICATIONS**: IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

**Course outcomes:** On completion of course, student will be able to:

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connectthem to network.
- Appraise the role of IoT protocols for efficient network communication.
- Elaborate the need for Data Analytics and Security in IoT.
- Illustrate different sensor technologies.

**Text Books:**

1. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1stEdition, Academic Press, 2014.
2. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT,2014.
3. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013.

**Reference Books:**

1. Cuno Pfister, Getting Started with the Internet of Things, O" Reilly Media, 2011, ISBN: 978-1-4493-9357-1.
2. Dr. Guillaume Girardin , Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024',Yole Development Copyrights , 2014.
3. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015.

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# DIGITAL SIGNAL PROCESSING
# BET-O 612

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- Understand the concepts of Digital signals with the help of DFT and Z transform etc.
- Analyse systems in complex frequency domain.
- Understand various digital filtering technique and their implications.

## UNIT I

Discrete Fourier Transform: Frequency Domain Sampling: The Discrete Fourier Transform Frequency- Domain ,Sampling and Reconstruction of Discrete-Time Signals. The Discrete Fourier Transform (DFT). The DFT as a linear, Transformation. Relationship of the DFT to Other Transforms. Properties of the DFT. Periodicity, Linearity, and Symmetry Properties. Multiplication of two DFTs and Circular Convolution. Additional DFT Properties. Frequency analysis of signals using the DFT.

## UNIT II

Efficient Computation of DFT: Efficient Computation of the DFT: FFT Algorithms, Direct Computation of the DFT. Radix-2 FFT algorithms. Efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of a 2NPointreal sequences, Gortezel Algorithm, Chirp Z-transform algorithm.

## UNIT III

Basic IIR Filter Structures: Direct forms (I & amp; II), cascade and parallel realizations. Signal flow graph, Transposed structure, Basic FIR filter structures-. Direct form structure, frequency sampling structure, Lattice structure, Linear phase FIR structure. FIR structures.

## UNIT IV

Symmetric and Anti-symmetric FIR Filters, Design of Linear-Phase FIR Filters Using Windows, Design of Linear- Phase FIR Filters by the Frequency Sampling Method, Design of FIR, Equi-ripple filter design Differentiators. Design of Hilbert Transformers

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## UNIT V

Design of IIR Filters from Analog Filters: IIR Filter Design by Approximation of Derivatives, IIR Filter Design by Impulse Invariance. IIR Filter Design by the Bilinear Transformation. The Matched-z Transformation, Characteristics of Commonly Used Analog Filters. Application of above technique to the design of Butterworth & Chebyshev filters. Introduction to STFT, wavelets multirate Signal Processing architecture of DSP processor and application.

**Course Outcomes:** At the end of this course, students will demonstrate the ability to

- Represent signals mathematically in continuous and discrete time and frequency domain
- Get the response of an LSI system to different signals
- Design of different types of digital filters for various applications

**Text Book:**

1. Proakis, J.G & Manolakis, D.G., “Digital Signal Processing: Principles Algorithms and Applications”, Prentice Hall (India).

**Reference Books:**

1. Sanjit K. Mitra, “Digital Signal Processing”, Third Edition, TMH, 2005.
2. Oppenheim A.V. & Schafer, Ronald W., “Digital Signal Processing”, Pearson Education.

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# POWER SYSTEMS – II LABORATORY
# BEE-C 661

**MM: 50** **Sessional: 15**
**Time: 2Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

**LIST OF EXPERIMENTS**

**Note:** Experiments on software platforms preferably on PSCAD/MATLAB/Sci lab or any software.

1. To locate the faulted point on the cable using cable fault locator.
2. To study single line to ground fault as practical application in transmissions lines.
3. To study three phase fault as practical application in transmission lines.
4. To develop a computer program for Y-bus.
5. To develop a computer program for Z-bus.
6. To develop a computer program for Gauss-Seidel method.
7. To develop a computer program for Newton-Raphson method.
8. To develop a computer program to analyze L-G faults.
9. To develop a program for L-L fault in the power transmission line
10. To develop a program for L-L-L fault in the power transmission line.

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# MICROPROCESSORS LABORATORY
# BET-C 666

**MM: 50** **Sessional: 15**
**Time: 2Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

## LIST OF EXPERIMENTS

1. Addition of 8 bit hexadecimal numbers without carry.
2. Addition of 8 bit hexadecimal numbers with carry.
3. To calculate 2"s compliments of a 8 bit number.
4. Subtraction of two 8 bit hexadecimal number.
5. Interfacing with 8255 in I/O mode & BSR mode.
6. Verification of all interrupts.
7. Multiplication of 8 bit hexadecimal number by 2.
8. Division of 8 bit hexadecimal numbers.
9. Addition of two 8 bit decimal numbers.
10. Transfer the block from one memory location to another.

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# COMPUTER AIDED DESIGN OF ELECTRICAL MACHINES LABORATORY

## BEE-C663

**MM: 50** **Sessional: 15**
**Time: 2Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

**LIST OF EXPERIMENTS**

1. To develop a computer program to design single phase core type transformer.
2. To develop a computer program to design single phase shell type transformer.
3. To develop a computer program to design three phase core type transformer.
4. To develop a computer program to design three phase shell type transformer.
5. To develop a computer program to design three phase squirrel cage Induction motor.
6. To develop a computer program to design three phase slip ring Induction motor.
7. To develop a computer program to design a D. C. series motor.
8. To develop a computer program to design a synchronous machine.
9. To develop a computer program to design a DC shunt motor.
10. To develop a computer program to design a DC generator.

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**7f15ff21-dc67-42f8-9f7f-e731d93318f5**

Encourage Colleagues & students of your department to become the member of NDLI Club Gurukul Kangri Vishwavidyalaya, Haridwar.

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# SWITCHGEAR AND PROTECTION
# BEE-C 711

**MM:100** **SESSIONAL:30**
**TIME: 3 Hrs** **ESE: 70**
**L T P** **CREDITS: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The objective of the course is to provide the fundamental of power system protection and its elements.
- To provide knowledge about Circuit breaker, Relays and Relay Characteristics and Relaying Schemes, Distance Protections, Apparatus and Line Protection, System Protection and applications of wide-area Measurement Systems (WAMS).

## UNIT I

**Introduction to Protection System:** Introduction and Fundamental of power system protection and its elements, protective zones, primary and backup protection, basic terminology, Instrument Transformer.

**Theory of Arc Quenching:** Arcing phenomena and arc quenching – circuit breaker rating – RRRV – current chopping and capacitance current breaking – characteristics of HRC fuses – d.c. circuit breaking.

**Circuit Breakers:** Bulk oil and oil minimum circuit breakers – air blast circuit breakers – vacuum and SF6 circuit breaker – Rating, speed of operation, selection and testing of circuit breakers.

## UNIT II

**Relays and Relay Characteristics and Relaying Schemes:** Basic ideas of short circuit currents and concepts of relay protection – basic terminology- essential qualities of a protective relay – classification of protective relays and protective schemes-operation relays-directional overcurrent relays, distance relays-differential relays-negative sequence relays-earth fault protection –reverse power protection – electromagnetic and solid-state relays.

## UNIT III

**Distance Protection:** Introduction, impedance relay, operating principle and characteristics of an impedance relay, protective scheme using impedance relay, Reactance relay: electromagnetic reactance relay, static reactance relays, Admittance relay: Electromagnetic

MHO relay, static MHO relays, sampling comparator, effect of arc resistance and power surges on distance relay. Principle of out of step tripping, effect of line length and source impedance on distance relays, selection of distance relay.

## UNIT IV

**Apparatus and Line Protection:** Application of over current relays and distance relays to feeder protection–ring main protection- busbar protection-carrier current protection of transmission lines-protection of generators and transformers.

**System Protection:** Wide Area Protection, Effect of Power Swings on Distance Relaying. System Protection Schemes. Under-frequency, under-voltage and df/dt relays, Out-of-step protection, Synchro-phasors, Phasor Measurement Units and Wide-Area Measurement Systems (WAMS). Application of WAMS for improving protection systems.

## UNIT V

**Protection Against Over Voltages:** Over voltages due to Lightning and switching – arcing grounds – Peterson Coil – methods of protection against over voltages – ground wires-surge absorber and diverters – Power System earthing – Earth resistance – Neutral Earthing-basic ideas of insulation coordination.

**Course Outcomes:**

- Identify the challenges to power system protection problems.
- Select the appropriate protection schemes for various applications.
- Gain knowledge about different types of power system protection.
- Understand the functions and application of wide-area Measurement Systems (WAMS).

**Text Books:**

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. Ram and D. N. Vishwakarma, “Power System Protection and Switchgear”, Mc. Graw Hill
4. Y. G.Paithankar and S. R. Bhide, “Fundamentals of power system protection”, Prentice Hall, India, 2010.

**Reference Books:**

1. Y. G. Paithankar and S R Bhide, “Fundamentals of Power System Protection”, Prentice Hall of India.
2. T.S.M Rao, “Power System Protection: Static Relays with Microprocessor Applications” Tata Mcgraw Hill”.
3. A.R. Van C. Warrington,“Protective Relays- Their Theory and Practice, Vol. I & II” John Willey & Sons.
4. D. Reimert, “Protective Relaying for Power Generation Systems”, Taylor and Francis, 2006.

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# HIGH VOLTAGE ENGINEERING
# BEE-P 712

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- Understand the basic physics related to various breakdown processes in solid, liquid and gaseous insulating materials.
- Knowledge of generation and measurement of D. C., A.C., & Impulse voltages.
- Knowledge of tests on H. V. equipment and on insulating materials, as per the standards.

## UNIT I

**Breakdown Mechanism of Gaseous Liquid and Solid Insulating Materials:** Introduction, Mechanism of breakdown in gases, Townsend's first ionization coefficient, cathode processes, secondary effects, Townsend's second ionisation coefficient, Town send breakdown mechanism, streamer or kanal mechanism of spark, Paschen's law, Penning effect, Breakdown in non-uniform fields, principles of breakdown in solid and liquid dielectrics, Applications of gas, liquid and solid dielectrics.

## UNIT II

**Generation of High Voltages:** Generation of high voltages, generation of high D. C. and A.C. voltages, generation of impulse voltages, generation of impulse currents, tripping and control of impulse generators.

## UNIT III

**Measurements of High Voltages and Currents:** Peak voltage, impulse voltage and high direct current measurement method, cathode ray oscillographs for impulse voltage and current measurement, measurement of dielectric constant and loss factor, partial discharge measurements.

## UNIT IV

**High Voltage Testing of Electrical Equipment:** Testing of overhead line insulators, testing of cables, Testing of Bushings, testing of power capacitors, testing of power transformers, Testing of circuit breakers. IEC, ANSI, IEEE and Indian standards for Testing electrical equipment.

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## UNIT V

**Non-Destructive Test Techniques:** Measurement of resistance, measurement of dielectric constant and loss factor, High voltage Schering Bridge, measurement of large capacitances, partial discharges measuring and diagnostic techniques. Time domain and Frequency domain analysis of dielectric materials subjected to an electric field.

**Course Outcomes:**

- Design the insulation of HV power equipment.
- Estimate electric field intensity of different electrode configurations.
- Understand the testing methods of high voltage equipment
- Understand the Breakdown mechanism of Gas, Liquid and solid insulation

**Text Books:**

1. M. S. Naidu and V. Kamaraju, "High Voltage Engineering", McGraw Hill Education, 2013.
2. C. L. Wadhwa, "High Voltage Engineering", New Age International Publishers, 2007.
3. D. V. Razevig (Translated by Dr. M. P. Chourasia), "High Voltage Engineering Fundamentals", Khanna Publishers, 1993.
4. R. Arora and W. Mosch "High Voltage and Electrical Insulation Engineering", John Wiley & Sons, 2011.

**Reference Books:**

1. High Voltage Engineering Fundamentals E. Kuffel, W.S. Zaengl, J. Kuffel Newnes 2nd Edition, 2000.
2. High-Voltage Test and Measuring Techniques Wolfgang Hauschild.
3. Eberhard Lemke Springer 1st Edition2014.
4. High Voltage Engineering Farouk A.M. Rizk CRC Press 1st Edition2014.

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# ELECTRICAL STANDARDS AND ENGINEERING PRACTICES
# BEE-P 713

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- Interpret different National & International Electrical Standards in practice.
- Understand Indian standards for cables, lighting and motors.

## UNIT I

**Introduction of Standards and Design Practices:** Different Electrical standards & codes, overview of Indian Standards and International Standards (IS, IEC, IEEE, NEMA and Building codes etc.).
General engineering design practices, selection of voltage level, role of electrical studies and design calculations (load flow, fault level calculation, earthing and lightning calculation, voltage drop) in distribution system planning. Feasibility study, thermal and electrical resistivity of soil, Study of electrical drawings/layouts and cost estimation.

## UNIT II

**Electrical Standards-I:** Overview of IS standards for cables (IS-7098 IS-8130, IS-10810, IS-1554, IS-1255), IS standards for lighting (IS-3646, IS-10322, IS-6665) and IS standards for motors (IS-325, IS 900, IS-2253, IS-4029, IS-15999) -basic terminologies, type test and routine tests. Efficiency class of motors as per IS/IEC standard.

## UNIT III

**Electrical Standards-II:** Transformer types, overview of IS standards for transformer (IS-2026, IS-6600 IS-10028, IS-11171), IS standards for LV & HV switchgears (IS-8623, IS/IEC-60898, IS/IEC-62271, IS-3427, IS-9920, IS-12729) -basic terminologies, type test and routine tests. Instrument transformers (CT & PT), Instrument safety factor, VA burden, knee point voltage and accuracy classes.

## UNIT IV

**National Codes and Design Practices:** Overview of National electrical code, National Building Code of India, Cable types, installation practices, derating factors and bonding methods, Earthing and lightning protection system, touch and step potentials, Hazardous area classification, electrical equipments for different hazardous zones.

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## UNIT V

**Equipment Sizing & Selection, CEA Regulations** Load estimation, sizing and selection of transformers, cables and switchgears, CEA Regulations 2010 and amendments, safety and installation guidelines.

**Course Outcomes:**

- Basic concepts of standards and design practices
- Overview of IS standards for cables, motors, and transformers
- Overview of National electrical code and design practices
- Concept of equipment sizing & selection

**Text Books:**

1. Robert Alonzo, "Electrical Codes, Standards, Recommended Practices and Regulations 1st Edition", Elsevier Inc.
2. Mohamed A El-Sharkawi, "Electric safety: practice and standards", CRC Press.
3. Central Electricity Authority Regulations and Amendments.

**Reference Books:**

1. B. C. Johnson, D. G. Dunn, and R. Hulett, "Seeking global harmony in standards," *IEEE Industry Applications Magazine,* Jan./Feb. 2004, pp.14-23.
2. F. Coallier, "Standards, Agility, and Engineering," *Computer,* Sept.2007, pp.100-102.
3. S. Kunst and J. R. Godberg, "Standards Education in Senior Design Courses," *IEEE Engineering in Medicine and Biology Magazine*, pp. 114 – 117, July/August 2003.

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# UTILIZATION OF ELECTRICAL ENERGY & TRACTION
# BEE-P 714

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The course provides basic understanding of proper utilization of energy in traction system.
- As the consumption of energy is increasing day by day, one way to cope up with the increase in energy demand is to increase the production of energy which demands more investment.
- Focus is also given on how to conserve the energy as energy conserved/saved is twice the energy generated.

## UNIT I

**Electric Drives and Control:** Electric drives -Group drive -Individual drive -selection of motors -starting characteristics - Running characteristics -mechanical features of electric motors -Electric drives for general factory, textile mills -printing press, mines, hoists, lifts, conveyers, pumps, blowers, and ship propulsion -choice of drives -calculation of power requirement power factor improvement.

## UNIT II

**Electric Traction**: Traction system -series, parallel control of D.C. motors, open circuited, shunt and bridge transition -tractive effort calculations -electric braking -control. wire -A.C. traction -recent trend in electric traction.

## UNIT III

**Illumination:** Production of light -lighting calculations -determination of MHCP and MSCP -Polar curves of different types of sources -Roasseau's construction -photometers -interior and exterior illumination systems -lighting schemes -Design of lighting schemes -factory lighting -flood lighting - electric lamps -gaseous discharge lamp-high pressure and low-pressure neon signs- light frequency, low pressure discharge tubes.

## UNIT IV

**Electric Furnaces and Welding:** Resistance, inductance and Arc Furnaces -Construction and fields of application -control equipment, efficiency and losses -high frequency dielectric heating, resistance -welding equipment -mechanical, thyratron, current and energy actuated

control devices -characteristics of carbon and metallic arc welding -butt welding –spot welding.

**UNIT V**

**Refrigeration and Air-Conditioning:** Control of temperature -protection of motors -basic wiring diagram - simple heat load and motor calculations. Air-conditioning -function of complete air conditioning system-type of compressor motor and fan motor-wiring diagram for a typical air conditioning unit- estimation of tonnage capacity and motor power.

**Course Outcomes:**

- Assess the energy conservation/saving opportunities in different electric traction system.
- Identify and assess energy conservation opportunities in electric furnace and welding system.

**Text Books:**

1. Uppal, S.L., Electrical Power, Khanna publishers, New Delhi, 1992.\
2. Gupta, J.B., Utilization of Electrical Energy and Electric, Traction', S.K. Kataria and sons, 1990.
3. Partab, H., Art and Science of Utilization of Electrical Energy, Dhanpat Rai and Sons, 65 New Delhi, 1986.

**Reference Books:**

1. Generation Distribution and Utilization of Electrical Energy" by C L Wadhwa. New Age International Private Limited.
2. Generation and Utilization of Electrical Energy" by Sivanagaraju.
3. Utilization Generation and Conservation of Electrical Energy" by Sunil S Rao. KHANNA PUBLISHERS.

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# DIGITAL CONTROL SYSTEMS
# BEE-P 715

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives**:

- To provide sound knowledge in designing and control of Computer Controlled Systems.
- To get an insight to the practical useful tools and techniques for controlling multivariable processes using microcomputers and validation of the computer-controlled system design through simulation studies.

## UNIT I

**Discrete Representation of Continuous Systems:** Basics of Digital Control Systems. Discrete representation of continuous systems. Sample and hold circuit. Mathematical Modelling of sample and hold circuit. Effects of Sampling and Quantization. Choice of sampling frequency. ZOH equivalent.

## UNIT II

**Discrete System Analysis:** Z-Transform and Inverse Z Transform for analyzing discrete time systems. Pulse Transfer function. Pulse transfer function of closed loop systems. Mapping from s-plane to z plane. Solution of Discrete time systems. Time response of discrete time system.

## UNIT III

**Stability of Discrete Time System:** Stability analysis by Jury test. Stability analysis using bilinear transformation. Design of digital control system with dead beat response. Practical issues with dead beat response design.

## UNIT IV

**State Space Approach for Discrete Time Systems:** State space models of discrete systems, State space analysis. Lyapunov Stability. Controllability, reach-ability, Reconstructibility and observability analysis. Effect of pole zero cancellation on the controllability &observability.

## UNIT V

**Design of Digital Control System:** Design of Discrete PID Controller, Design of discrete state feedback controller. Design of set point tracker. Design of Discrete Observer for LTI System. Design of Discrete compensator.

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**Course Outcomes:**

- Obtain discrete representation of LTI systems.
- Analyze stability of open loop and closed loop discrete-time systems.
- Design and analyze digital controller.

**Text Books:**

1. K. Ogata, "Digital Control Engineering", Prentice Hall, EnglewoodCliffs,1995.
2. M. Gopal, "Digital Control Engineering", WileyEastern,1988.
3. B.C. Kou, "Digital Control System", Holt, RinehartandWinston,1980.

**Reference Books:**

1. J. R. Leigh, Applied Digital Control, Prentice Hall, International.
2. C. H. Houpis and G. B. Lamont, Digital Control Systems; Theory, Hardware, Software, McGraw Hill.
3. G. F. Franklin, J. D. Powell and M. L. Workman, "Digital Control of Dynamic Systems", Addison-Wesley,1998.

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# POWER SYSTEM RESTRUCTURING AND DEREGULATION
# BEE-P 716

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To impart knowledge about the restructuring and deregulation of power sector.
- To introduce the fundamental concepts relevant to OASIS, congestion management etc.
- To enable the students to understand the factors related with deregulation of power industry in different countries.

## UNIT I

**Introduction:** Basic concept and definitions, Privatization, Restructuring, Transmission open access, Wheeling, Deregulation, Components of deregulated system, advantages of competitive system.

**Power System Restructuring:** An overview of the restructured power system, Difference between integrated power system and restructured power system -explanation with suitable practical examples.

## UNIT II

**Deregulation of Power Sector:** Benefits of deregulation, Overview of deregulated industry, Separation of ownership and operation, Deregulated models, pool model, pool and bilateral trades model, Multilateral trade model, independent system operator (ISO) - functions and responsibilities, classification of ISO types, retail electric providers.

## UNIT III

**Competitive Electricity Market:** Independent System Operator (ISO) activities in pool market, Wholesale electricity market characteristics, Central auction, single auction power pool, Double auction power pool, Market clearing and pricing, Market Power and its Mitigation Techniques, Bilateral trading, Ancillary services.

## UNIT IV

**Open Access Same Time Information System (OASIS):** Introduction, structure, functionality, implementation, posting of information, uses.

**Congestion Management:** Congestion management in normal operation, explanation with suitable example, total transfer capability (TTC), Available transfer capability (ATC), Transmission Reliability Margin (TRM), Capacity Benefit Margin (CBM), Existing Transmission Commitments (ETC).

## UNIT V

**Different Experiences in Deregulation:** U.S.A, Canada, U.K, Japan, Switzerland, Australia, Sweden, Germany and Indian power system.

**Course Outcomes:**

- Identify various concepts of restructuring and deregulation of power sector.
- Describe important concepts related with deregulation like market power, OASIS, congestion management etc.
- Apply principal to explain various problems related with deregulation of power sector.
- Assess the results obtained by solving above problems.

**Text Books:**

1. Power System Restructuring and Deregulation by Loi Lei Lai, John Wiley & Sons Ltd.
2. Understanding Electric Utilities and Deregulation by Lorrin Philipson and H. Lee Willis, Marcel Dekker Inc, New York, CRC Press.
3. Power System Restructuring Engineering & Economics by Marija llic by Francisco Galiana and Lestor Fink, Kulwer Academic Publisher, USA.

**Reference Books:**

1. M. Shahidehpour, H. Yamin and Z Li "Market Operations in Electrical Power System" New york, IEEE/ Wiley Inter science, 2002.
2. D. S. Kirschen and G. Strbac, Fundamentals of Power System Economics, John Wiley & Sons, 2004.
3. Geoffrey Rothwell, Tomas Gomez (Eds.), "Electricity Economics Regulation and Deregulation", IEEE Press Power Engineering Series, John Wiley & Sons, 2003.

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# SWITCH MODE POWER SUPPLY
# BEE-P 717

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives**:

- To understand various modes of operation of DC-DC Converter.
- To analyze control aspects of converter.
- To design various Switched Mode Power Supply components.
- To get awareness on EMI, Protection of converter system.

## UNIT I

**Basic Converter Circuits:** Buck Regulator, Buck- Boost Regulator, Boost Regulator, Cuk Converters and Resonant Converters. Choice of switching frequency.

## UNIT II

**Isolated SMPS**: Fly back Converter, Forward Converter, Half-Bridge and Full Bridge Converters, Push-Pull Converter and SMPS with multiple outputs. Choice of switching frequency.

## UNIT III

**Control Aspects:** WM Controllers, Isolation in feedback loop, Power Supplies with multiple output. Stability analysis using Bode Diagrams.

## UNIT IV

**Design Considerations:** Selection of output filter capacitor, Selection of energy storage inductor, Design of High Frequency Inductor and High frequency Transformer, Selection of switches. Snubber circuit design, Design of driver circuits.

## UNIT V

**Electro Magnetic Interference (EMI):** EMI Filter Components, Conducted EMI suppression, Radiated EMI suppression, Measurement. Protection: Over current protection, over voltage protection, Inrush current protection. Thermal Model: Thermal Resistance, Cooling Considerations, Selection of Heat sinks, Simple Heat sink calculations.

**Course Outcomes:**

- Obtain discrete representation of LTI systems.
- Analyse stability of open loop and closed loop discrete-time systems.
- Design and analyse digital controller.

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**Text Books:**

1. Switched Mode Power Supplies, Design and Construction, H. W. Whittington, B. W. Flynn and D. E. MacPherson, Universities Press, 2009 Edition.
2. Mohan N. Undeland. T & Robbins W., Power Electronics Converters, Application and Design. John Wiley, 3rd edition, 2002
3. Umanand L., Bhat S.R., Design of magnetic components for switched Mode Power Converters., Wiley Eastern Ltd.,1992

**Reference Books:**

1. Krein P. T. Elements of Power Electronics., Oxford University Press
2. M. H. Rashid, Power Electronics. Prentice-Hall of India.
3. Robert. W. Erickson, D. Maksimovic. Fundamentals of Power Electronics., Springer International Edition, 2005.

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# SENSORS AND TRANSDUCERS
# BEE-O 718

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives**:

- Introduction of different sensors
- Introduction of transducers
- Telemetry & Data Acquisition System
- Recent Trends and Developments

## UNIT I

**Sensor:** Introduction of sensor, Definition, principle of sensing, its classification. **Mechanical and Electromechanical Sensor**: Strain gauge, Resistive Sensors: material, accuracy, sensitivity, Inductive sensor: common types, material, construction and input output variable, LVDT: Construction, material, output input relationship, I/O curve, Proximity Sensors.**Capacitive sensors**: Its type and calculation of sensitivity, ultrasonic sensors.

## UNIT II

**Sensor (Continue) Thermal sensors:** Material expansion type: solid, liquid, gas & vapor, Resistance change type: RTD materials, Thermistor material, shape, ranges and accuracy specification, Junction semiconductor type IC and PTAT type, Pyroelectric type, Radiation sensor: types, characteristics and comparisons, Thermoemf sensor.**Magnetic sensors:** Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors,Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive celltypes, materials, construction, response.Pneumatic Sensors, Light Sensors, Tactile Sensors, acoustic, optical sensors, and digital sensors.

## UNIT III

**Transducers:** Introduction, Classification of Transducers, Advantages and Disadvantages of Electrical Transducers, Transducers Actuating Mechanisms, Resistance Transducers, Variable Inductance Transducers, Strain gauges, Resistance thermometer, LVDT, RVDT, Capacitive, Piezoelectric Hall effect and opto-electronic transducers, Thermocouples, Thermoelectric Transducers, Photoelectric Transducers, Digital Transducers, Pyro-electric transducers and their applications. Measurement of motion, Force pressure, Temperature, Flow and liquid level.

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## UNIT IV

**Telemetry & Data Acquisition System:** General telemetry system, land line and radio frequency telemetering system, transmission channel and media, receiver and transmitter. Data Acquisition System, Various types of data acquisition systems, method of data transmission, Analog data acquisition system, Modern digital data acquisition system.

## UNIT V

**Display Devices and Recorders:** Display devices, storage oscilloscope, spectrum analyzer, strip chart and X-Y recorders, magnetic tape and digital tape recorders.

**Recent Trends and Developments:** Computer aided measurements, fibre optic transducers, microprocessors, and smart. Recent trends in sensor technology, Introduction to smart sensors, basic building blocks of smart sensors, industrial applications of sensors.

**Course Outcomes:**

- Understanding the classification of sensors
- To understand the different transducers
- Able to learn the Telemetry & Data Acquisition System
- Able to learn Recent Trends and Developments with industrial applications

**Text Books:**

1. B. C. Nakara and K. Chaudhary, Instrumentation, measurement and analysis, Tata Mc Graw Hill 2nd Edition.
2. Curtis Johns, Process Control Instrumentation, Prentice Hall.
3. A.K. Sawhney, Advance measurement and instrumentation, Dhanpat Rai & Sons.
4. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, New Delhi.

**Reference Books:**

1. Patranabis D, Sensors and Transducers, 2nd Edition, PHI, New Delhi, 2010.
2. John Turner and Martyn Hill, Instrumentation for Engineers and Scientists, Oxford Science Publications, 1999.
3. Richard Zurawski, Industrial Communication Technology Handbook 2nd edition, CRC Press, 2015.
4. Doebelin E.O, "Measurement Systems - Application and Design", 4th Edition, McGraw-Hill, New York, 2003.

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# INTRODUCTION TO PLC AND SCADA SYSTEMS
# BEE-O 719

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- The objective of the course is to provide the Introduction of Automation system, PLC and I/O processing, Programming of PLC, PLC interface to various circuits, SCADA Systems

## UNIT I

**Introduction of Automation System:** Introduction to Industrial Automation, Requirement of automation systems, Application areas, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial communication protocols: modbus & profibus.

## UNIT II

**PLC and I/O Processing:** Programmable Logic Controller basics, overview of PLC systems – Architecture of PLC, Principle of Operation, input/output Units – power supplies and isolators, current sinking and current sourcing, types of PLC memory, fundamental PLC wiring diagram, relays, switches, transducers, sensors –seal-in circuits. Input/output units Signal conditioning. Remote connections Networks Processing inputs I/O addresses.

## UNIT III

**Programming of PLC:** Fundamentals of logic, PLC programming languages. Ladder diagrams, Ladder Diagram Instruction, Logic functions, Latching, Multiple outputs. Timer and counter- types along with timing diagrams, shift registers, sequencer function, latch instruction; Arithmetic and logical instruction with various examples. ON/OFF switching devices, I/O analog devices, Analog PLC operation, PID control of continuous processes, simple closed loop systems, closed loop system using Proportional, Integral & Derivative (PID), PLC interface, and Industrial process example.

## UNIT IV

**PLC Interface to Various Circuits:** Encoders, transducer and advanced sensors. Measurement of temperature, flow, pressure, force, displacement, speed, level. Developing a ladder logic for Sequencing of motors, Tank level control, ON-OFF temperature control, elevator, bottle filling plant, car parking etc. Motors Controls: AC Motor starter. AC motor

overload protection, DC motor controller, Variable speed (Variable Frequency) AC motor Drive.

## UNIT V

**SCADA Systems:** Introduction, Communication requirements, Desirable Properties of SCADA system, features, advantages, disadvantages and applications of SCADA. SCADA Architectures (First generation - Monolithic, second generation - Distributed, Third generation – Networked Architecture), SCADA systems in operation and control of interconnected power system, Power System Automation (Automatic substation control and power distribution). Open systems interconnection (OSI) Model, Process Field bus (Profibus). Interfacing of SCADA with PLC.

**Course Outcomes:**

- Learn the Introduction of Automation system.
- PLC and I/O processing.
- Programming of PLC
- PLC interface to various circuits SCADA Systems

**Text Books:**

1. Gary Dunning, "Introduction to Programmable Logic Controllers", Thomson, 2nd Edition.
2. John R. Hackworth, Frederick D., Hackworth Jr., "Programmable Logic Controllers Programming Methods and Applications", PHI Publishers.
3. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Application", PHI Learning, New Delhi, 5th Edition.
4. L.A. Bryan, E. A. Bryan, "Programmable Controllers Theory and Implementation" Industrial Text Company Publication, Second Edition.

**Reference Books:**

1. Stuart A. Boyer: "SCADA- Supervisory Control and Data Acquisition", Instrument Society of America Publications, USA, The Instrumentation system and Automation Society, 4th Edition, 2010.
2. Gordon Clarke, Deon Reynders" Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes an imprint of Elsevier Publications, 1st Edition, 2004
3. Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition.
4. P. K. Srivstava, "Programmable Logic Controllers with Applications", BPB Publications.

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# ROBOTICS ENGINEERING
# BEE-O 720

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To understand the importance of robotics in scientific and industrial domains
- To introduce mathematical aspects of robotics such as spatial transformations, kinematics, dynamics, trajectory generation, actuators and control

## UNIT I

**Introduction:** Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical Grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

## UNIT II

**Drive systems and Sensors:** Drive system- hydraulic, pneumatic and electric systems, Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

## UNIT III

**Kinematics and Dynamics of Robots:** 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

## UNIT IV

**Robot Control, Programming and Applications:** Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control, Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting.

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## UNIT V

**Introduction of Mobile Robotics, Mechanics and Locomotion:** A brief history of mobile robotics, Recent advances in the mobile robotics for RISE (Risky Intervention and Surveillance Environment) applications, Locomotion, Key issues in locomotion, legged, wheeled and aerial mobile robots.

**Mobile Robot Kinematics:** Introduction, kinematic models and constrains, mobile robot workspace, beyond basic kinematics, motion control (kinematic control).

**Courses Outcomes:**

- Understand the basic terminology used in introducing robotics.
- Understand the 2-D and 3-D transformation and basic trajectory planning.
- Understand the programming and controlling of robots with applications.
- Understand the new development and trending concept of mobile robotics.

**Text Books:**

1. Bruno S and Sciavicco L, Robotics: Modelling, Planning and Control, Springer (2009).
2. John J C, Introduction to Robotics: Mechanics and Control, Addison-Wesley (1989).
3. Fu K S, Ralph G and Lee C S G, Robotics: Control Sensing. Vision, and Intelligence, Tata McGraw-Hill (1987).
4. Mukhopadhyay S, Sen S and Deb A K, Industrial Instrumentation, Control and Automation, Jaico (1999).

**Reference Books:**

1. R M Murray, Z. Li and SS Sastry, “A Mathematical Introduction to Robotic Manipulation”, CRC Press, 1994.
2. J J Craig, “Introduction to Robotics: Mechanics and Control”, Prentice Hall, 2004.
3. J J E Slotine and W Li, “Applied Nonlinear Control”, Prentice Hall, 1991.
4. Sebastian Thrun, Wolfram Burgard, Dieter Fox, “Probabilistic Robotics”, MIT Press, 2005. 5. Carlos, Bruno, Georges Bastin, “Theory of Robot Control”, Springer, 2012.

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# RELIABILITY ENGINEERING
# BEE-O 721

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives:**

- To introduce the basic concepts of reliability, various models of reliability
- To analyze reliability of various systems
- To introduce techniques of frequency and duration for reliability evaluation of repairable systems.

## UNIT I

**Basic Probability Theory:** Elements of probability, probability distributions, Random variables, Density and Distribution functions- Binomial distribution- Expected value and standard deviation – Binomial distribution, Poisson distribution, normal distribution, exponential distribution, Weibull distribution. Definition of Reliability: Definition of terms used in reliability, Component reliability, Hazard rate, derivation of the reliability function in terms of the hazard rate. Hazard models – Bath tub curve, Effect of preventive maintenance. Measures of reliability: Mean Time to Failure and Mean Time Between Failures.

## UNIT II

**Network Modeling and Evaluation of Simple Systems**: Basic concepts- Evaluation of network Reliability / Unreliability – Series systems, Parallel systems- Series-Parallel systems Partially redundant systems- Examples.

## UNIT III

**Network Modeling and Evaluation of Complex Systems:** Conditional probability method tie set, Cutset approach- Event tree and reduced event tree methods- Relationships between tie and cutsets- Examples.

## UNIT IV

**Time Dependent Probability:** Basic concepts- Reliability function f(t). F(t), R(t) and h(t) – Relationship between these functions. Network Reliability Evaluation Using Probability Distributions: Reliability Evaluation of Series systems, Parallel systems – Partially redundant systems- determination of reliability measure- MTTF for series and parallel systems – Examples.

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## UNIT V

**Reliability Testing Design for Reliability and Maintainability**: Applications of fuzzy theory and neural networks to reliability engineering Typical reliability case studies.

**Course Outcomes:**

- model various systems applying reliability networks
- evaluate the reliability of simple and complex systems
- estimate the limiting state probabilities of repairable systems
- apply various mathematical models for evaluating reliability of irrepairable systems.

**Text Books:**

1. Roy Billinton and Ronald N Allan, Reliability Evaluation of Engineering Systems, Plenum Press, 1983.
2. E. Balagurusamy, Reliability Engineering by Tata McGraw-Hill Publishing Company Limited, 2002.

**Reference Books:**

1. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.
2. Probability concepts in Electric Power system – G.J.Anders- 1st edition –1990 – John Wiley & sons.

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# TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENT
# BEE-O 722

**MM: 100** **Sessional: 30**
**Time: 3 Hr** **ESE: 70**
**L T P** **Credit: 3**
**3 0 0**

**NOTE:** The question paper shall consist of two sections (Sec.-A and Sec.-B). Sec.-A shall contain ten questions of six marks each and student shall be required to attempt five questions Sec.-B shall contain eight descriptive type questions of ten marks each and students shall be required to attempt any four questions. Question shall be uniformly distributed from the entire syllabus. The previous year paper /model paper can be used as a guideline and the following syllabus should be strictly followed while setting the question paper.

**Course Objectives**:

- To provide the installation, commissioning, testing and maintenance procedures of large rating transformers, induction machines and synchronous machines.

## UNIT I

**Electrical Tools, Accessories:** Tools, Accessories and Instruments required for Installation, Maintenance and Repair Work, India Electricity Rules, Safely Codes Causes and Prevention of Accidents, Artificial Respiration, Workmen's Safety Devices.
**Transformers:** Installation, Location Site Selection, Foundation Details, Code of Practice for Terminal Plates, Polarity and Phase Sequence, Oil Tanks, Drying of Winding sand General Inspection. Commissioning Tests as Per National and International Standards-Volts Ratio Earth Resistance, Oil Strength, Insulation Tests, Impulse Tests Polarizing Index, Load Temperature Rise Tests. Specific Tests for Determination of Performance Curves like Efficiencies, Regulation Etc.,

## UNIT II

**Synchronous Machines:** Specifications as per BIS Standards. Installation-Physical Inspection, Foundation Details, Alignments, Excitation Systems, Cooling and Control Gear, Drying Out. Commissioning Tests-Insulation, Resistance Measurement of Armature and Field Windings, Wave Form and Telephone Interference Tests, Line Charging Capacitance. Performance Tests -Various Tests to Estimate the Performance of Generator Operations, Temperature Rise Test, and Retardation Tests.

## UNIT III

**Laying of Underground Cables:** Inspection, Storage, Transportation and Handling of Cables, Cable Handing Equipment, Cable Laying Depths and Clearances from other Services such as Water Sewerage, Gas, Heating and other Mains, Series of Power and Tele-communication Cables and Coordination with these Services, Excavation of Trenches, Cable Jointing and Terminations Testing and Commissioning. Location of Faults using Megger, Effect of Open or Loose Neutral Connections, Provision of Proper Fuses on Service Lines and Their Effect on System, Causes and Dim, and Flickering Lights.

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## UNIT IV

**Induction Machines:** Rating and name plate data, installation and foundation, types of coupling, pre and post commissioning checks, Routine tests and type tests, resistance measurement, no load and blocked rotor test, load test, temperature rise test, high voltage test, Shaft alignment, drying of windings, mechanical tests, air gap symmetry, insulation test, speed and load test, codes of practice, maintenance schedule.

## UNIT V

**Switchgear and Protective Devices:** Standards, Types, Specification, Installation, Commissioning Tests, Maintenance Schedule, Type and Routine Tests. Domestic Installation: Introduction, Testing of Electrical Installation of a Building, Testing of Insulation Resistance to Earth, Testing of Insulation and Resistance between Conductors Continuity or Open Circuit Test, Short Circuit Test, Testing of Earthing Continuity, Location of Faults, IE Rules for Domestic Installation.

**Course Outcomes:**

- Learn about the testing of main electrical equipment used in electrical system.
- Understand the different tests performed in all the equipments.

**Text Books:**

1. Testing, Commissioning, Operation and S. Rao Khanna Publishers 6th Edition, 19th Reprint, 2015
2. Testing and Commissioning of Electrical R.L.Chakrasali Prism Books Pvt Ltd 1st' Edition,2014
3. Preventive Maintenance of Electrical Apparatus, S.K.Sharotri, Katson Publishing House 1st Edition, 1980
4. Handbook of Switchgears BHEL McGraw Hill 1st Edition, 2005

**Reference Books:**

1. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi
2. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, 2008.
3. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
4. Philip Kiameh, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGraw-Hill, 2003.

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# SWITCHGEAR AND PROTECTION LABORATORY
# BEE-C 761

**MM: 50** **Sessional: 15**
**Time: 2Hr** **ESE: 35**
**L T P** **Credit: 1**
**0 0 2**

## LIST OF EXPERIMENTS

1. To study the construction of under voltage relay and draw it's time vs. voltage characteristics.
2. To study the construction of over voltage relay and draw the following characteristics
   (a) Operating current & de-operating voltage of disc.
   (b) Voltage & operating time.
3. To study the construction of thermal relay and determine
   (a) Operational characteristics of the relay.
   (b) Time current characteristics of given fuse.
4. To study the construction of I.D.M.T. relay and determine
   (a) Operational characteristics of the relay for two time & current setting.
   (b) Reset ratio.
5. To study the construction of instantaneous over current relay and draw the following characteristics
   (a) Operating & de-operating current of the relay.
   (b) Current vs. time characteristics.
6. To study the construction of earth fault relay and determine operational characteristics of the relay for time & current setting.
7. To study the construction of percentage differential relay and determine
   (a) Operational characteristics of the relay.
   (b) Percentage bias & minimum operating current.
8. To study the different parts of Circuit Breaker.
9. To study performance of the different types of fuses.
10. To study performance of miniature circuit breaker (MCB).

**Revised Syllabus (Effective from the session 2022-23**
**Gurukula Kangri (Deemed to be University), Haridwar**
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# BEE-P861
# Project Stage II

**MM : 400** **Sessional : 100**
**Time : 8 Hr** **ESE : 300**
**L T P**
**0 0 8**
**Credits 8**

Each student shall be assigned a Major Project by departmental committee. The student shall be required to perform his project work under the supervision of the supervisor(s). There shall be a seminar on the project work of the student to be evaluated by a departmental committee chaired by H.O.D. The student shall be required to submit his project report in the form of dissertation 15 days before the end of VIII semester. The student shall be required to submit three copies of the project work with certificate from the supervisor(s) that the work is authentic record of the work performed by him. The report shall be forwarded by H.O.D. The report of the project work shall be evaluated by the external examiner(s). The same external examiner(s) shall hold the viva-voce examination.

THE DISTRIBUTION OF MARKS FOR THE MAJOR PROJECT SHALL BE AS FOLLOWS:

| **MAJOR PROJECT** | |
|---|---|
| Project** | 200 |
| Viva-voce/Presentation** | 100 |
| Seminar (Internal)*** | 100 |
| Total | 400 |

** - Marks for the project work shall be awarded jointly by the external and internal examiners after viva-voce examination.

*** - There shall be a seminar on the project work of the student to be evaluated by the departmental committee chaired by H.O.D.