## College of Technology and Engineering

# REGULATIONS
# AND
# COURSE DESCRIPTION

## BACHELOR OF TECHNOLOGY

## Electrical Engineering

**Effective from 2019–20**

**Maharana Pratap University of Agriculture and Technology, Udaipur (Raj.) – 313 001**

## VISION OF ELECTRICAL ENGINEERING DEPARTMENT

The Electrical Engineering Department was established with a vision of making it a centre for imparting technical education of high standards and conducting research at the cutting edge of technology to meet the current and future challenges of technological development.

## MISSION OF ELECTRICAL ENGINEERING DEPARTMENT

- To offer high quality graduate and post graduate programs in Electrical Engineering.
- To prepare students for professional career or higher studies.
- The department promotes excellence in teaching, research, collaborative activities and positive contributions to society.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

**PEO I:**

Our graduates will be productive in the professional practice of electrical engineering, related fields and higher education.

**PEO II:**

They will obtain employment appropriate to their background, interests, and education and will advance in their career.

**PEO III:**

Have the mathematical and scientific knowledge to analyze and solve emerging real world problems related to power system, control systems, power electronics, measurement and instrumentation system.

**PEO IV:**

They possess the necessary communication, organization and teamwork skills for bridge the divide between advanced technology and end users in the practice of electrical engineering.

**PEO V:**

Exhibit professionalism, ethical attitude, sense of responsibility in their profession and adapt to current trends by engaging in lifelong learning or in service to society.

## PROGRAMME OUTCOME (POs)

- An ability to apply knowledge of engineering, mathematics, science appropriate to the discipline.
- An ability to analyze a problem, and identify and formulate the engineering requirements appropriate to its solution.
- An ability to design, implement, and evaluate an Electrical Engineering system to meet desired needs with appropriate consideration for public health and safety, societal and environmental considerations.
- An ability to design and conduct experiments, as well as to analyze and interpret data.
- An ability to use current techniques, skills, and modern tools necessary for Electrical Engineering practice.
- An ability to analyze the local and global impact of computing on individuals, organizations, and society.
- Knowledge of contemporary issues for and an ability to engage in continuing professional development.
- .An understanding of professional, ethical, legal, security and social issues and responsibilities and an ability to communicate effectively with a range of audiences
- An ability to function effectively individually and on teams, including diverse and multidisciplinary, to accomplish a common goal.

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# ACADEMIC REGULATIONS
## (UNDER-GRADUATE COURSES)

## SCHEME OF TEACHING AND EXAMINATION
## (Electrical Engineering)
## First Year B.Tech. (Common for All Branches)

# I-SEMESTER

| S. N. | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1 | BSC | BS 111 (BSC) | Mathematics -I | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 0 | 20 |
| 2 | ESC | ME 112 (ESC) | Mechanical Engineering | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 0 | 20 |
| 3. | ESC | ME 113 (ESC) | Workshop Practice | 0 | 0 | 1.5 | 0 | 0 | 3 | 0 | 80 | 20 |
| 4 | ESC | CE 114 (ESC) | Engineering Drawing | 0 | 0 | 1.5 | 0 | 0 | 3 | 0 | 80 | 20 |
| | | | NCC/NSS/NSO/ Yoga/Scout | - | - | - | 0 | 0 | 2 | - | - | - |
| | | | **Total** | **5** | **1** | **3** | **5** | **1** | **8** | | | |
| | | | **GROUP I** | | | | | | | | | |
| 5. | BSC | BS 100P (BSC) | Engineering Physics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 6. | ESC | CE 100 (ESC) | Engineering Mechanics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 7. | ESC | EE 100 (ESC) | Electrical Engineering | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 8. | HSMC | REE100 (HSM) | Environmental Studies and Disaster Management | 2 | 0 | 0 | 2 | 0 | 0 | 80 | 0 | 20 |
| | | | **Total** | **9** | **0** | **3** | **9** | **0** | **6** | | | |
| | | | **GROUP II** | | | | | | | | | |
| 5 | BSC | BS 100C (BSC) | Engineering Chemistry | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 6. | ESC | EC 100 (ESC) | Electronics and Instrumentation | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 7. | ESC | CS 100 (ESC) | Computer Programming for Problem Solving | 0 | 1 | 2 | 0 | 1 | 4 | 0 | 80 | 20 |
| 8. | HSMC | BS100E (HSM) | Communication Skills and Personality Development | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| | | | **Total** | **6** | **1** | **5** | **6** | **1** | **10** | | | |
| | | | **Total Credits** | **21** | | | | | | | | |

**Note :** 1. NCC/NSS/NSO/YOGA/SCOUT is compulsory non credit course and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.

2. The courses BS 100P, CE 100, EE 100, REE 100, BS 100C, EC 100, CS 100 and BS 100E shall be offered in both the semesters. The students will be divided in two groups in I semester itself and shall remain in the same group in II semester as well. However, they have to opt all the eight courses in first year.

# II-SEMESTER

| S. N. | Cate-gory | Course Code | Course title | Credits | | | Hrs/ week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1 | BSC | BS 121 (BSC) | Mathematics -II | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 0 | 20 |
| 2 | ESC | CE 122 (ESC) | Civil Engineering | 1 | 0 | 1 | 1 | 0 | 2 | 50 | 30 | 20 |
| 3. | ESC | ME 123 (ESC) | Mechanical Drawing | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 80 | 20 |
| 4 | ESC | ME 124 (ESC) | Workshop Technology | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| | | | NCC/NSS/NSO/ Yoga/ Scout | - | - | - | 0 | 0 | 2 | - | - | - |
| | | | **Total** | **5** | **1** | **3** | **5** | **1** | **8** | | | |
| **GROUP I** | | | | | | | | | | | | |
| 5 | BSC | BS 100C (BSC) | Engineering Chemistry | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 6. | ESC | EC 100 (ESC) | Electronics and Instrumentation | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 7. | ESC | CS 100 (ESC) | Computer Programming for Problem Solving | 0 | 1 | 2 | 0 | 1 | 4 | 0 | 80 | 20 |
| 8. | HSMC | BS100E (HSM) | Communication Skills and Personality Development | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| | | | **Total** | **6** | **1** | **5** | **6** | **1** | **10** | | | |
| **GROUP II** | | | | | | | | | | | | |
| 5. | BSC | BS 100P (BSC) | Engineering Physics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 6. | ESC | CE 100 (ESC) | Engineering Mechanics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 7. | ESC | EE 100 (ESC) | Electrical Engineering | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 8. | HSMC | REE100 (HSM) | Environmental Studies and Disaster Management | 2 | 0 | 0 | 2 | 0 | 0 | 80 | 0 | 20 |
| | | | **Total** | **9** | **0** | **3** | **9** | **0** | **6** | | | |
| | | | **Total Credits** | **21** | | | | | | | | |

**Note :**

1. NCC/NSS/NSO/YOGA/SCOUT is compulsory non credit course and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.
2. Students have to undergo in house practical summer training [Branch Code 239 (PSI)] of 15 days at the end of II semester and will be assessed in III semester.

# SECOND YEAR B.Tech.

## III-SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1. | BSC | BS 231 (BSC) | Mathematics–III | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 0 | 20 |
| 2. | HSMC | BS 232 (HSM) | Human Values | 2 | 0 | 0 | 2 | 0 | 0 | 80 | 0 | 20 |
| 3. | ESC | CE 233 (ESC) | Strength of Materials | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 4. | ESC | EC 234 (ESC) | Basic Electronics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 5. | PCC | EE 235 (PCC) | Circuit Theory – I | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 7. | PCC | EE 236 (PCC) | Electrical Measurements & Instruments | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 6. | PEC | EE 237 (PEC) | Electrical Estimation & Costing | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 80 | 20 |
| 8. | PSI | EE 239 (PSI) | Training –I | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | | NCC/NSS/NSO/ Yoga/ Scout | - | - | - | 0 | 0 | 2 | - | - | - |
| | | | **Total Credits** | **21** | | | | | | | | |

## IV-SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1. | BSC | BS 241 (BSC) | Mathematics–IV | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 0 | 20 |
| 2. | ESC | EC 242 (ESC) | Fundamentals of Digital Electronics | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 3. | ESC | ME 243 (ESC) | Mechanical Engineering-II | 2 | 0 | 1 | 2 | 0 | 2 | 50 | 30 | 20 |
| 4. | PCC | EE 244 (PCC) | Circuit Theory–II | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 5. | PCC | EE 245 (PCC) | Power System– I | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 6. | PCC | EE 246 (PCC) | Electrical Machines–I | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 7. | PEC | EE 247 (PEC) | Microprocessor | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 8 | PEC | EE 248 (PEC) | Electrical Engineering Materials | 2 | 0 | 0 | 2 | 0 | 0 | 80 | 0 | 20 |
| | | | NCC/NSS/NSO/ Yoga/ Scout | - | - | - | 0 | 0 | 2 | - | - | - |
| | | | **Total Credits** | **27** | | | | | | | | |

NCC/NSS/NSO/YOGA/SCOUT is compulsory non-credit course and the student will be assessed as satisfactory/ unsatisfactory at the end of IV semester.

**Note:** Students have to undergo a Practical Training-II of 30 days (In house/ Field) at the end of IV Semester for which assessment will be made at the beginning of next semester as EE 359 (PSI)

# THIRD YEAR B.Tech.

## V-SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1 | BSC | BS351 (BSC) | Mathematics-V | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 00 | 20 |
| 2. | PCC | EE 352 (PCC) | Power System–II | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 3. | PCC | EE 353 (PCC) | Power Electronics– I | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 4. | PCC | EE 354 (PCC) | Electrical Machines–II | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 5. | PCC | EE 355 (PCC) | Control System–I | 3 | 1 | 1 | 3 | 1 | 2 | 50 | 30 | 20 |
| 6. | PSI | EE 359 (PSI) | Training–II | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 100 | 0 |
| | | | **Total Credits** | **23** | | | | | | | | |

## VI- SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1. | BSC | BS361(BSC) | Mathematics-VI | 2 | 1 | 0 | 2 | 1 | 0 | 80 | 00 | 20 |
| 2. | PEC | EE 362 (PEC) | Electromagnetic & Field Theory | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 0 | 20 |
| 3. | PCC | EE 363 (PCC) | Power Electronics–II | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 4. | PCC | EE 364 (PCC) | Instrumentation | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 5. | PCC | EE 365 (PCC) | Control System–II | 3 | 1 | 1 | 3 | 1 | 2 | 50 | 30 | 20 |
| 6. | PEC | EE 366 (PEC) | Generation of Electrical Power | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 0 | 20 |
| 7. | PEC | EE 367 (PEC) | Electric Energy Systems Theory | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 0 | 20 |
| 8. | PEC | EE 368 (PEC) | System Design & Simulation Lab | 0 | 1 | 1 | 0 | 1 | 2 | 0 | 80 | 20 |
| | | | **Total Credits** | **27** | | | | | | | | |

**Note:** Students have to undergo a Practical Training-III of 30 days (In house/ Field) at the end of VI Semester for which assessment will be made in the next semester as EE 479 (PSI).

# FOURTH YEAR B.Tech.

## VII-SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1. | PCC | EE 471 (PCC) | Electrical Machine Design | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 00 | 20 |
| 2. | PCC | EE 472 (PCC) | Electric Drives And Control | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 3. | PEC | EE 473 (PEC) | Advanced Power Systems | 3 | 0 | 0 | 3 | 0 | 0 | 80 | 00 | 20 |
| 4. | PEC | EE 474 (PEC) | Neural & Fuzzy Based Control System | 3 | 0 | 1 | 3 | 0 | 2 | 50 | 30 | 20 |
| 6. | PEC | EE 475 (PEC) | Utilization of Electrical Power | 2 | 0 | 0 | 2 | 0 | 0 | 80 | 00 | 20 |
| 5. | **OE** | **___ 478 (OE)** | **Open Elective*** | 3/2 | 0 | 0/1 | 3/2 | 0 | 0/2 | 80/50 | 0/30 | 20 |
| 6. | PSI | EE 479 (PSI) | Training –III | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 100 | 00 |
| | | | **Total Credits** | **23** | | | | | | | | |

****OPEN ELECTIVE**

**Note:** The students have to take one open elective out of the list given below:

| Offering Department | Course Code | Course Title | Credit | | |
|---|---|---|---|---|---|
| | | | Th. | T | P |
| Civil Engineering | CE478a (OE) | Urban Waste Management | 2 | 0 | 1 |
| | CE478b (OE) | Ground Improvement Techniques | 2 | 0 | 1 |
| Computer Sc. Engg | CS 478 (OE) | Introduction To Cyber Security | 3 | 0 | 0 |
| Mining Engineering | MI 478 (a) (OE) | Engineering Geology | 2 | 0 | 1 |
| | MI 478 (b) (OE) | Earth Moving Machinery | 2 | 0 | 1 |
| | MI 478 (c) (OE) | Tunnelling Engineering | 2 | 0 | 1 |
| Mechanical Engineering | ME 478(a) (OE) | Entrepreneurship And Industrial Management | 2 | 0 | 1 |
| | ME 478(b) (OE) | Bio Energy System Design | 2 | 0 | 1 |
| | ME 478(c) (OE) | Energy Conservation And Management | 2 | 0 | 1 |
| Electronics & Comm. Engg. | EC 478(a )(OE) | Intellectual Property Rights | 3 | 0 | 0 |
| | EC 478(b) (OE) | E-Commerce | 3 | 0 | 0 |
| Renewable Energy Engineering | REE 478(OE) | Renewable Energy Technologies | 2 | 0 | 1 |
| Soil & Water Engineering | SWE 478(OE) | Aerial Photography, RS and GIS | 2 | 0 | 1 |
| Farm Machinery & Power Engineering | FMP 478(OE) | Machinery For Land Development | 2 | 0 | 1 |
| Processing & Food Engineering | PFE 478(OE) | Packaging Materials And Methods | 2 | 0 | 1 |

## VIII-SEMESTER

| S. N | Cate-gory | Course Code | Course title | Credits | | | Hrs/week | | | Marks allotted | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | L | T | P | L | T | P | Th. | Pr. | MT |
| 1. | PSI | EE 481 (PSI) | Seminar | 0 | 0 | 3 | 0 | 0 | 6 | 0 | 100 | 0 |
| 2. | PSI | EE 482 (PSI) | Project | 0 | 0 | 15 | - | - | - | 0 | 100 | 0 |
| | | | **Total Credits** | **18** | | | | | | | | |

# COURSE CONTENT

## FIRST YEAR B.TECH. (I SEMESTER)

## BS 111 MATHEMATICS – I

**Cr. Hrs. 3(2+1+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

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

**CO1 :** Expand function in Taylor's and Maclaurin's series.

**CO2:** Trace the Cartesian and Polar curves.

**CO3:** Apply the partial differentiation to compute the minima and maxima of functions of two variables.

**CO4:** Compute areas and volumes by integration.

**CO5:** Solve linear differential equations of higher order and homogenous differential equations with constant coefficients.

### Unit-I

**Differential Calculus:** Taylor's and Maclaurin's expansions, Asymptotes and Curvature (Cartesian Coordinates only), Curve tracing (Cartesian and standard Polar Curves-Cardioids, Lemniscates of Bernoulli, Limacon, Equiangular Spiral).

### Unit-II

**Differential Calculus :** Partial Differentiation, Euler's Theorem on Homogeneous Functions, Maxima & Minima of Two Independent Variables, Lagrange's Method of Multipliers, Jacobians.

### Unit-III

**Integral Calculus :** Double Integral, Areas & Volumes by Double Integration, Change of Order of Integration, Triple integrals, Beta Function and Gamma Function (Simple Properties), Relation between Beta and Gamma functions.

### Unit-IV

**Differential Equations :** Linear Differential Equations of Higher Order with constant coefficients, Homogeneous Linear Differential Equations with constant coefficient.

**Text Books/ References**


1. Guar, Y.N. and Koul, *C.L, Engineering Mathematics*, Vols. I & II, Jaipur Publishing House, Jaipur (2013).
2. Babu Ram, *Engineering Mathematics-I*, Pearson Education, India (2011).
3. B.V. Ramana, *Higher Engineering Mathematics*, Tata McGraw Hill, India (2012).
4. J.L. Bansal and H.S. Dhami, *Differential Equations*, Vols. I & II, Jaipur Publishing House, Jaipur (2012).
5. M.Ray and Chaturvedi, *A Text Book of Differential Equations*, Student Friend & Co. Publisher, Agra.
6. Rao V. Dukkipati, *Engineering Mathematics*, New Age International (P) Ltd, New Delhi (2012).
7. Gupta C.B., Malik A.K., *Engineering Mathematics –I,* New Age international Publisher.


## ME 112 (ESC) MECHANICAL ENGINEERING

**Cr. Hrs. 3(3+0+0)**

| | L | T | P |
|---|---|---|---|
| Credit | 3 | 0 | 0 |
| Hours | 3 | 0 | 0 |

**Course Outcomes:** Upon completion of this course the students will be able to:

**CO1:** Apply the principles of conservation of mass, first and second laws of thermodynamics to analyse closed steady state systems and processes involving heat and work interactions.

**CO2:** Show understanding of concepts of reversibility, entropy and Carnot cycle.

**CO3** Demonstrate knowledge of properties of steam and ability to compute them from steam tables and Mollier chart.

**CO4:** Understand construction and working of steam boilers, steam engines and their specific applications.

**CO5:** Compute efficiency, power output, etc. of various vapour and gas cycles.

**CO6:** Demonstrate knowledge about construction and working of IC engines.

## Unit - I

**Thermodynamics:** Thermodynamic properties, closed and open systems, flow and non-flow processes, gas laws, laws of thermodynamics, internal energy. Application of First Law in heating and expansion of gases in non-flow processes only.

*Second law of thermodynamics:* Kelvin-Planck and Claussius statements. Reversible processes, Carnot cycle, Carnot theorem. Reversed Carnot cycle. Entropy, physical concept of entropy.

## Unit - II

**Properties of Steam:** Difference between gas and vapour, change of phase during constant pressure process. Generation of Steam, triple point and critical point. Internal energy and entropy of steam. Use of steam tables and Mollier chart, heating and expansion of vapour in non-flow processes.

## Unit - III

**Vapour Power Cycles:** Introduction to Carnot Cycle, Rankine cycle and modified Rankine cycle.

**Steam Generators:** Classification of steam boilers. Cochran, Lancashire, Locomotive and Babcock-Wilcox boilers, Boiler mountings and accessories.

**Steam Engines:** Introduction to simple and compound steam engines.

## Unit - IV

**Gas Power Cycles:** Introduction. Air Standard efficiency, other engine efficiencies and terms. Otto, diesel and dual cycles. Calculation of efficiency, mean effective pressure and their comparison.

**Internal Combustion Engines:** Introduction, Classification, terminology and description of IC Engines. Four stroke and two stroke petrol, gas and diesel engines. Comparison of petrol and diesel engines. Simple carburettor.

### Text Books/References


1. M. L. Mathur and F. S. Mehta: Thermal Engineering, (Vol. I, SI Edition), Jain Brothers, New Delhi.
2. R. K. Purohit: Foundation of Mechanical Engineering, Scientific Pub. (India), Jodhpur.
3. P.K. Nag: Engineering Thermodynamics, TMH.

## ME113 (ESC) WORKSHOP PRACTICE

**Cr. Hrs. 1.5(0 + 0 + 1.5)**

| | L | T | P |
|---|---|---|---|
| Credit | 0 | 0 | 1.5 |
| Hours | 0 | 0 | 3 |

**Course Outcomes:** Upon completion of this course the students will be able to:

**CO1:** Demonstrate knowledge of characteristics of various types of woods used in engineering applications.

**CO2:** Demonstrate knowledge of tools and operations in carpentry work, black smithy, fitting, sheet metal and plumbing works in engineering practice.

**CO3** Identify and use measuring instruments in workshop practice and pipe fittings.

**CO4:** Learn use of tools in the carpentry, fitting, smithy, sheet metal and plumbing shop to make simple jobs.

**Carpentry Shop:** Acquaintance with types of wood, tools and their uses. Simple exercises involving basic operations like sawing, planning, chiselling, etc. Preparation of simple joints, cross half lap joint, dovetail joint, bridle joint, tenon and mortise joint.

**Smithy Shop:** Acquaintance with types of tools and their uses. Simple exercises involving basic operations like bending, drawing, punching, shaping, upsetting, and riveting.

**Fitting Shop:** Acquaintance with tools, measuring and marking tools, precision measuring tools and their uses. Simple exercises involving basic operations like sawing, chipping, filling, drilling, reaming, threading with taps and dies.

**Sheet Metal and Plumbing Shop:** Demonstration of basic tools, pipe fittings and operations.

**Texts books/References:**

1. S.K. Hajra Choudhury and A.K. Hajra Choudhury: Elements of Workshop Technology (Vol. I), Media promoters & Publishers Pvt. Ltd., Bombay.

## CE 114 (ESC) ENGINEERING DRAWING

**Cr. Hrs. 1.5 (0+0+1.5)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **0** | **0** | **1.5** |
| **Hours** | **0** | **0** | **3** |

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

**CO1 :** Select, Construct and Interpret appropriate drawing scale as per the situation.

**CO2 :** Draw simple curves like ellipse, cycloid and spiral.

**CO3 :** Draw Orthographic projections of points, lines and planes.

**CO4 :** Draw orthographic projection of solids like cylinders, cones, prisms and pyramids including sections.

**CO5 :** Layout development of solids for practical situations.

**CO6 :** Draw isometric projections of simple objects.

Introduction and letter writing. Construction and use of plain, diagonal and vernier scale. Methods of drawing ellipse, parabola and hyperbola. Methods of drawing cycloids, spirals. Orthographic projection and projection of points.

Projection of lines, projection of planes, projection of solids. Introduction of prism, pyramid, cylinder and cone.

Section of solids, introduction of intersection of surfaces. Development of plane and curved surface. Isometric projection.

**Text Books / Reference**


1. N.D. Bhatt. Elementary Engg. Drawing, Rupalee publication, Anand.
2. Lakshmi Narayan and Vaishwanar. A Text Book of Practical Geometry, Jain Brother, New Delhi.
3. R.B. Gupta. A Text Book of Engineering Drawing, SatryPrakashan, New Delhi.
4. Fundamentals of Technical Drawing, Parkinson.

## BS 100P (BSC) ENGINEERING PHYSICS

**Cr. Hrs. 3(2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

**CO1:** Apply vector calculus approach to problems in electric field and magnetic field.

**CO2:** Apply laws of physics to simple LRC circuits.

**CO3:** Learn physics behind various types of lasers and their characteristics.

**CO4:** Understand the interference and diffraction from wave optics concepts and know its applications.

**CO5:** Understand polarization of light and its applications.

### Unit-I

**Electric Field:** Line integral of electric field, Potential difference, Field as gradient of potential, Divergence of a vector function, Differential form of Gauss's law, Laplacian, Laplace equations, Curl of a vector function. Gauss's divergence theorem.

**Magnetic Field:** Curl and Divergence of a magnetic field, Magnetic scalar and vector potential.

### Unit-II

**Varying Field:** Faraday's law-integral and differential form, Self and mutual inductance, Neumann's equation, Charge and discharge of a capacitor through register, Growth and decay of current in LR circuit, Energy stored in electric and magnetic field, Displacement current, Maxwell's equations.

### Unit-III

**Laser:** Coherence, Einstein's coefficient, Spontaneous and stimulated emission, Population inversion, Laser gain (pumping), Spectral narrowing in laser, Coherence length, Ruby and He-Ne laser.

**Interference:** Division of amplitude, colour of thin films, Newton's ring, Febry-Perot interferometer-principle, operation, determination of wave length and difference in wave length.

## Unit-IV

**Diffraction:** Double slit Fraunhoffer diffraction pattern, Fraunhoffer diffraction by a plane transmission grating, Formation of spectra.

**Polarization:** Analysis of linearly, circularly and elliptically polarized light (Half wave and quarter wave plates), Optical activity, specific rotations, Laurent's half shade polarimeter and its use for determination of specific rotation of sugar solution.

### Practical

1. To find refractive index and dispersive power of material of prism by spectrometer.
2. To find wave length of light by Newton's ring.
3. To find wave length of light by diffraction grating.
4. To find specific rotation of sugar solution by polarimeter.
5. To find wave length of light by Fresnel Biprism.
6. To find frequency of A.C. mains.
7. To determine dielectric constant of liquid using series resonance method.
8. To study charge and discharge of condenser through a resistor (C.R. Circuit).
9. To study LCR resonant circuit, resonance, quality factor and sharpness in (i) series circuit (ii) parallel circuit.

### Text Books/References


1. K.K. Tiwari. (1995). Electricity and Magnetism, S. Chand and Company, New Delhi.
2. N. Subrahmanyam and Brijlal. (1993). A Text Book of Optics,

S. Chand and Company, New Delhi.

3. Ahmed and Lal. (1966). Electricity, Magnetism and Electronics, Unitech House, Lucknow.
4. D.S. Mathur. (1993). Mechanics, S. Chand and Company, New Delhi.
5. Gupta and Kumar. (1995). Practical Physics, Pragati Prakashan, Meerut.

## CE 100 (ESC) ENGINEERING MECHANICS

**Cr. Hrs. 3(2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

**CO1:** Draw free body diagrams and determine the resultant of forces and/or moments.

**CO2:** Determine the centroid and second moment of area of sections.

**CO3:** Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.

**CO4:** Analyse statically determinate planar frames.

**CO5:** Analyse the motion and calculate trajectory characteristics.

**CO6:** Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

### *(A) STATICS*

**Unit-I**

**Introduction of condition of equilibrium:** Force, system of force, coplanar forces.

**Moment and couples:** Moment and parallel forces, Couples, General conditions of equilibrium

**Practical Applications:** Levers, Crank levers, Steel yards. Sagging chains and toggle joints.

**Centre of Gravity:** Centre of parallel forces, C.G. in some simple cases, C.G. of Solids.

**Moment of Inertia:** Moment of inertia, Radius of gyration and perpendicular axis. Determination of moment of inertia of simple sections. Mass of moment of inertia.

**Unit-II**

**Friction:** Introduction, Critical angle of friction, Friction on horizontal planes, Friction on inclined planes, Wedge and block, Screw Jack

**Machines:** Introduction, Effects of friction, Loss of work, Reversible and irreversible machine, Law of machine, Wheel and axle, Differential wheel and axle, Pulley block, Screw jack, Single and double winch crab, Worm and Worm wheel, System of pulleys.

**Frames:** Statically determinate plane frames, Method of joints, Method of sections.

***(B) DYNAMICS***

**Unit-III**

**Rectilinear Motion:** Motion under gravity, Projectiles equation of the path, Maximum height attained, Time of flight, Horizontal range. Angle of projection, Projectile from a given height, Projectile on an inclined plane, Problems.

**Work, Power and Energy:** Work, Power, Work done by torque, Energy, Law of conservation.

**Unit-IV**

**Centripetal and centrifugal forces, Laws of motion:** Newton's Law of motion and their explanation, Collision of elastic bodies; Impulse and impulsive force, Principle of conservation of momentum, Loss of kinetic energy during impact.

**Practical**

1. Verification of law of polygon of forces.
2. Verification of principle of moment in case of compound lever.
3. Verification of principle of moment in case of bell crank lever.
4. Determination of reaction in case simply supported beam with or without overhang.
5. To determine coefficient of friction between different surfaces on horizontal plane.
6. To determine coefficient of friction between different surfaces in inclined plane.
7. Study of differential wheel and Axle.
8. Study of single winch crab.
9. Study of worm and worm wheel.

10. Study of Weston's differential pulley block.
11. Determination of mechanical advantage, velocity ratio and efficiency of single winch crab.
12. Determination of mechanical advantage, velocity ratio and efficiency of double winch crab.
13. Determination of mechanical advantage, velocity ratio and efficiency of first system of pulley.
14. Determination of mechanical advantage, velocity ratio and efficiency of second system of pulleys.
15. Determination of mechanical advantage, velocity ratio and efficiency of third system of pulleys.

**Text Books / References**


1. I.B. Prasad. Engineering Mechanics, Khanna Publisher, New Delhi.
2. R.S. Khurmi. Applied Mechanics, S. Chand & Company Ltd., New Delhi
3. S.B. Junnarkar. Applied Mechanics, Charotar Publishing House, New Delhi.
4. Saluja. Applied Mechanics, SatyaPrakashan, New Delhi.


## EE 100 (ESC) ELECTRICAL ENGINEERING

| | | | |
|---|---|---|---|
| **Cr. Hrs.** | **4(3+0+1)** | | |
| | **L** | **T** | **P** |
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

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

**CO1 :** Proficiency in solving DC network.

**CO2 :** Know-how of single phase AC circuits

**CO3 :** Competency in solving three phase balanced AC circuits

**CO4 :** Dexterity in using basic electrical instruments

**CO5 :** Comprehension of transformer working principles.

**Unit-I**

Electro motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, hysteresis and eddy current losses.

Kirchoff's law, Delta-star and star-delta conversion, source conversion

Network theorems: Thevenin's, Norton's, superposition, and Maximum Power Transfer theorem.

**Unit-II**

Single Phase EMF generation, average and effective values of sinusoidal and linear periodic wave forms, instantaneous and average power, power factor, reactive & apparent power, solution of R-L-C, series, parallel, series-parallel circuits, complex representation of impedances, phasor diagram, series and parallel resonance.

**Unit-III**

Transformer*:* Faraday's laws of Electromagnetic induction, construction and principle operation of single phase transformer, EMF equation, voltage and current relationship and Phasor diagram for ideal transformer.

Fundamentals of DC machines: Working principle, operation and performance of DC machines (Motor and generator)

**Unit-IV**

Three phase A.C. circuits: Three phase EMF generation, delta and star connection, methods of three phase power measurement; power factor, reactive and apparent power, Series and parallel resonance.

Concept of Three phase induction motor: construction and operation. Basic introduction of single phase induction motor.

**Practical**

1. To Establish the Voltage-Current Relationship in an Electric Circuit and to Measure the Unknown Resistance by Ammeter-Voltmeter Method (Ohm's Law).
2. Experimentally Verify the Number of Resistance Connected in Series and parallel in an Electric Circuit can be replaced by in Equivalent Resistance without Disturbing the Circuit Condition.
3. Verify Kirchhoff's Current Law and voltage law for a DC Circuit.
4. Verify Superposition Theorem for a DC Circuit.

5. Verify Thevenin's Theorem for a DC Circuit.
6. To Measure Power and power factor in a Single Phase A.C. Series R-L Circuit.
7. Determination of Choke Coil Parameter Resistance (R) and Inductance (L).
8. To Study The Characteristics of an L-C-R Series Circuit.
9. Testing of Single Phase Energy Meter by Direct Loading Method.
10. Determination of Percentage Regulation of a Single Phase Transformer by Direct Loading Method.
11. Determination of Efficiency of a Single Phase Transformer By Direct Loading Method
12. To perform open circuit and short circuit test for single phase transformer
13. To obtain load characteristics of D.C. shunt/series/compound generator
14. To perform no-load & blocked –rotor tests on 3 ph. Induction motor to obtain equivalent circuit parameters
15. To perform no load & blocked –rotor test on 1 ph. induction motor & to determine the parameters of equivalent circuit.

**Text Books / References**


1. B.L. Therja. Electrical Technology, S. Chand.
2. M.E. Van Valkenberg. Network analysis, PH.I
3. Soni and Gupta. Introduction to Electrical Network Theory, Dhanpat Rai Publisher.
4. Dr. R.A. Gupta and Dr. Nikhal Gupta. (2002). Fundamentals of electrical & Electronics Engineering, JPH.
5. H.P. Tiwari. (2002). Electrical & Electronics Engineering, College Book Centre, Jaipur.
6. J. B. Gupta. (2002). Fundamentals of Electrical & Electronics. S.K. Kataria and Sons. Dehli.

## REE 100(HSM)
## ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

**Cr. Hrs. 2 (2+0+ 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **0** |
| **Hours** | **2** | **0** | **0** |

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

**CO1 :** Develop an understanding of different natural resources including renewable resources.

**CO2 :** Realize the importance of ecosystem and biodiversity for maintaining ecological balance.

**CO3 :** Develop an understanding of environmental pollutions and hazards due to engineering/technological activities and general measures to control them.

**CO4 :** Demonstrate an appreciation for need for sustainable development and role of science.

**CO5 :** Aware of important acts and laws in respect of environment.

### Unit-I

**Environmental Studies:** Definition, scope and importance. Natural Resources: Renewable and non-renewable resources and associated problems.

**Forest resources:** Use and over-exploitation. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects. Food resources: World food problems, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable and non-renewable energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Role of an individual in conservation of natural resources.

## Unit-II

**Ecosystems:** Concept, Structure and function. Energy flow in an ecosystem. Ecological succession, Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the various ecosystems.

**Biodiversity and its conservation:** Introduction, definition, genetic species & ecosystem diversity and biogeographical classification of India.

**Value of biodiversity:** Biodiversity at global, national and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation.

## Unit-III

**Environmental Pollution:** Definition, cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards.

**Solid Waste Management:** Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution.

**Social Issues and the Environment:** Urban problems related to energy; Water conservation, rain water harvesting, watershed management.

**Environmental ethics:** Issues and possible solutions; Wasteland reclamation, Consumerism and waste products. Environment Protection Act.

Issues involved in enforcement of environmental legislation. Public awareness, Human Population and the Environment: population growth, Family Welfare Programme.

**Environment and human health:** Human Rights, Value Education, HIV/AIDS, Women and Child Welfare.

Role of Information Technology in Environment and human health.

## Unit-IV

**Natural Disasters:** Meaning and nature, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Climatic change: global warming, Sea level rise, ozone depletion.

**Man Made Disasters:** Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, accidents.

**Disaster Management:** Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Armed forces in disaster response; Disaster response; Police and other organizations.

**Text Books / References**


1. Agarwal K.C., Environmental Biology, Nidi Publications, Bikaner, 2001.
2. Bharucha Erach. 2005. Text Book of Environmental Studies for Undergraduate Courses, University Grants Commission, University Press, Hyderabad.
3. Chary Manohar and Jaya Ram Reddy. 2004. Principles of Environmental Studies, BS Publishers, Hyderabad.
4. Chaudhary, B.L. and Jitendra Pandey: Environmental Studies, Apex Publishing House, Udaipur, 2005
5. Climate Change.1995: Adaptation and mitigation of climate change-Scientific Technical Analysis Cambridge University Press, Cambridge.
6. Gupta P.K. 2004, Methods in Environmental Analysis – Water. Soil and Air. Agro bios, Jodhpur.
7. Husain Majid. 2013, Environment and Ecology: Biodiversity, Climate Change and Disaster Management, online book.
8. Jhadav, H. & Bhosale, V.M.: Environmental Protection & Laws, Himalaya Pub. House, Delhi
9. Kaul S.N., Ashuthosh Gautam. 2002. Water and Waste Water Analysis, Days Publishing House, Delhi.
10. Rao, M.N. and A.K. Datta, Waste Water Treatment. Oxford & IBH Publ. Co. Pvt. Ltd.
11. Sharma J.P. 2003, Introduction to Environment Science, Lakshmi Publications.

12. Sharma, B.K., Environmental Chemistry, Goel Publishing House, Meerut

13. Sharma, R.K. & Sharma, G. 2005, Natural Disaster, APH Publishing Corporation, New Delhi.

14. Singh Pratap, N.S. Rathore and A.N. Mathur: Environmental Studies, Himanshu Publications, Udaipur, 2004.

15. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno Science Publications.

## BS 100C (BSC) ENGINEERING CHEMISTRY

**Cr.Hrs. 3(2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

**CO1 :** Demonstrate knowledge of science behind common impurities in water and methods to treat them.

**CO2 :** Describe the purpose and operational steps of key water treatment processes used to improve water quality including: Coagulation, Sedimentation, Filtration, Disinfection, Corrosion Control, Taste and Odour Control.

**CO3 :** Know the methods to determine the calorific value of fuels, perform flue gas analysis and combustion analysis.

**CO4 :** Apply the science for understanding corrosion and its prevention.

**CO5 :** Apply the knowledge of Kinetics of Reactions.

### Unit- I

**Sources of water:** Common impurities, requisites of drinking water in municipal water supply. Purification of water, sterilization, break point chlorination. Hardness, determination of hardness by Complexometric

(EDTA) method, degree of hardness, Boiler troubles, carry over corrosion, Sludge and scale formation. Caustic embrittlement, cause of boiler troubles and their prevention.

**Unit- II**

**Classification of fuels:** Solid fuels, Proximate and Ultimate analysis of coal, significance of constituents, theoretical method for calculation of Gross and net calorific values. Liquid fuels- Petroleum origin, Refining of Petroleum, knocking, octane number, anti knocking agents . Flue gas analysis by Orsat Apparatus, Calculations based on combustion.

**Unit- III**

**Corrosion and its control:** Definition and significance of corrosion, Mechanism of chemical (dry) and electrochemical (wet) corrosion, galvanic corrosion, concentration corrosion and pitting corrosion.

Protection from corrosion; protective coatings-galvanization and tinning, cathodic protection, sacrificial anode and modifications in design.

**Unit- IV**

**Chemical Kinetics:** Order and Molecularity of reaction, first and second order reaction, Derivation of equations for first and second order reaction, determination of order of reaction, Energy of activation and Arrhenius equations, Numerical of first and second order reactions.

**Practical**

1. Determination of viscosity of a liquid.
2. Estimation of free chlorine in a water sample.
3. Determination of temporary and permanent hardness by EDTA method.
4. Determination of Copper Sulphate iodometrically.
5. Estimation of Potassium dichromate iodometrically.
6. Determination of purity of Ferrous Ammonium Sulphate (Mohr's Salt) using Potassium Permanganate.
7. Estimation of available chlorine in Bleaching Powder sample.
8. Analysis of Brass.
9. Determination of Strength of Ferrous Ammonium Sulphate (FAS) using Potassium Ferricyanide as an external indicator.
10. Analysis of Common Salt.

**Text Books / References**


1. Jain and Jain. Engineering Chemistry, Dhanpat Rai Publishing Company(P) Ltd., New Delhi.
2. Jain and Gupta. A Text Book of Engineering Chemistry,Jaipur Publishing House,Jaipur
3. B.K. Sharma. Engg. Chemistry(General), Krishna Prakashan Media (P) Ltd., Merrut.
4. S.S. Dara. A Text Book of Engineering Chemistry, S.Chand & Co., New Delhi.
5. M.M. Uppal. A Text Book of Engineering Chemistry,Khanna Publishers, New Delhi.
6. S.S. Dara. A Text Book on Experiments and Calculations in Engg.Chem.

   S.Chand & Co., New Delhi.
7. Ameta and Yasmin. Practical Engineering Chemistry, Himanshu Publications, New Delhi


## EC100 (ESC) ELECTRONICS AND INSTRUMENTATION

**Cr.Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

### Unit-I

**Passive Components:** Construction and characteristics of various types of resistors, capacitors & inductors for electronic circuits, color coding of resistors. Semiconductor Devices: Basic theory of semiconductors, constructions and characteristics of PN diode, Zener diode, photodiode, LED, BJT & JFET.

### Unit-II

**Bipolar Junction Transistor:** Introduction to BJT biasing circuits, Basic concept of class-A, class-B, class-AB, class-C amplifiers.

**Power supply:** Rectifier circuits and filters. Concept of voltage regulators, Zener diode voltage regulators, Transistor series regulator.

## Unit-III

**Feedback & Oscilloscopes:** Concept of positive and negative feedback. Introduction to Oscilloscope.Barkhausen criteria. Working principle of RC- phase shift, Wien bridge, Hartley, Colpitts and Crystal Oscilloscopes.

## Unit-IV

**Transducers:** Active and Passive transducers. Working principle of Thermocouple, LVDT, Strain Gauge and Tacho Generator. Instrumentation: Introduction to data acquisition system. Working principle of Electronic Multimeter, Cathode Ray Oscilloscope, Digital Storage Oscilloscope and Spectrum Analyzer.

### Practical

1 . Identification and testing of different types of passive and active electronic components: Resistors, Capacitors, Inductors, Diodes, Transistors.

2 . Plot the V-I characteristics in forward and reverse bias mode for (a) PN junction diode (b) ZENER diode and find the cut- in and breakdown voltage respectively.

3 . Plot the V-I characteristics of LED diode in forward bias mode and find the glow voltage.

4 . Determine the R.M.S value of output voltage and check the waveform on CRO for:

(a) Half wave rectifier with and without filter.

(b) Full wave centre tapped rectifier with and without filter.

(c) Full wave bridge rectifier with and without filter.

5 . Plot the input and output characteristics for two configurations of transistors:

(a) NPN/PNP transistor in CE configuration.

(b) NPN/PNP transistor in CB configuration.

6 . Determine both theoretically and practically the frequency of oscillation for R-C Phase shift Oscilloscope.

7 . Determine the output voltage of an amplifier: (a) with feedback (b) without feedback.

8 . Study and perform basic measurement of Digital Multi Meter.

9 . Study and perform basic measurement of Cathode Ray Oscilloscope/ Digital Storage Oscilloscope.

10 . Study of Spectrum Analyzer and perform basic measurements.

***NOTE:*** *The actual number of experiments may be more than the above mentioned list.*

**Text Books / References**

1. Millman and Halkias. Integrated electronics: Mc Grew Hill

2. W.D Cooper. Electronics Instrumentation and Measurement : PHI

3. M.L.Gupta. Electrical Engineering Materials

4. Melvin,o Principles of Electronics

5. John D. Ryder. Electronics Fundamentals

## CS100 (ESC)
## COMPUTER PROGRAMMING FOR PROBLEM SOLVING

**Cr. Hrs. 3 (0+1+2)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **0** | **1** | **2** |
| **Hours** | **0** | **1** | **4** |

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

**CO1 :** Design, implement, test, debug, and document programs in C using conditional branching and iteration.

**CO2 :** To use arrays, understand how to write and use functions, how the stack is used to implement function calls, and parameter passing options

**CO3 :** Implement recursion functions & use of pointers and structures to formulate programs.

**CO4 :** To be able to create, read and write to/from files and to write simple searching and sorting algorithms

## Unit-I

Introduction to Programming, Algorithm, Flowchart, Arithmetic expressions and precedence: The Character set, constants, variables and keywords, data types, Type Conversion, Hierarchy of Operations, Conditional Branching: The if Statement, if-else Statement, Nested if-else, Ladder if-else, The Conditional Operators. Loops: While Loop, do-while loop, for Loop, Nesting of Loops, Multiple Initializations in for Loop, break Statement, continue Statement, Decisions using switch, Go to Keyword, finding roots of an equations.

## Unit-II

**Arrays:** Array Initialization, Bounds Checking, One and Two Dimensional Arrays, Memory Map of a 2-Dimensional Array, Strings: String Functions- strlen( ), strcpy( ), strcat( ), strcmp( ), Two-Dimensional Array of Characters. Function: Function Declaration and Prototypes, Parameter passing in functions: Call by Value and Call by Reference, Passing Array Elements to a Function, Passing an entire Array to a Function.

## Unit III

**Recursion:** Recursion such as Finding Factorial, Fibonacci series, Ackerman function etc. Structures: Declaring a Structure, Array of Structures. Pointers: Idea of pointers, Defining pointers, Use of Pointers in self-referential structures.

## Unit-IV

**File handling:** Create, open, insert, update, search and display operations. Basic Algorithms: Searching: linear & binary, Basic Sorting Algorithms (Bubble, Quick sort and Merge sort), Notion of linked list.

### Text books / References


1. "Let us C", Yashwant Kanetkar, Allied Publishers.
2. "The C programming language", Kernighan and Ritchie, Prentice Hall of India.
3. "Programming in ANSI C", E. Balaguruswamy, Tata McGraw Hill.

## BS100E (HSM)

## COMMUNICATION SKILLS AND PERSONALITY DEVELOPMENT

**Cr. Hrs. 3 (2 + 0 +1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome:** At the end of the course, students will be able to:

**CO1 :** Understand basic grammar principles, and apply them to synthesise and transform sentences and identify common errors in writing.

**CO2 :** Demonstrate enhanced communicative ability in English, and develop sensitivity to cultural differences in communication .

**CO3 :** Write structured paragraphs and essays, CVs, letters and professional emails .

**CO4 :** Understand their personality type, develop leadership qualities and time-management techniques.

**CO5 :** Understand the process and types of communication and the barriers to effective communication.

**CO6 :** Show improved vocabulary and pronunciation.

**CO7 :** Practice skills required for oral presentations, group discussions and interviews.

### Unit-I

Sentence and its types, Parts of Speech, Articles, Tenses, Concord, Modals, Narration and Voice

### Unit-II

**Nissim Ezekiel:** Goodbye Party for Miss Pushpa T.S. – Poem (Introduction to Indianisms and Difference between Indian English and Standard English)

**George Orwell:** Politics and the English Language – Essay (Writing process and what constitutes good or bad writing; rules of writing for effective communication)

**Unit-III**

C.V and Resume Writing, Letter Writing, E-mail Writing, Paragraph Writing (Topic sentence, inductive and deductive logic), Essay Writing (Narrative, Descriptive, Expository and Persuasive).

**Unit-IV**

Personality Traits (Big Five Model), *Skills of a Good Leader,* Effective Time Management Techniques, Communication: Process and Types (Verbal/Non-Verbal/Para-Verbal, Intrapersonal/Interpersonal, Upward/ Downward/Horizontal/Diagonal), Barriers to Effective Communication.

**Practical (Language Lab)**

Phonetics, Group Discussions, Mock Interviews, Presentations, Vocabulary Building (Synonyms, Antonyms, One-Word Substitutes, Idioms and Phrases), Listening Comprehension, Everyday Conversations.

**Text books / References**


1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan. 2007
3. High School English Grammar and Composition. Wren and Martin. S. Chand. 2018
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
6. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
7. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.
8. The Ultimate Book of Common Errors. Terry O'Brien. Rupa Publications. 2015.
9. Technical Writing for Engineers and Scientists. Barry J. Rosenberg. Addison-Wesley Professional. 2005.
10. Spoken English: A Manual of Speech and Phonetics. R.K. Bansal & J.B. Harrison. Orient Longman. 2013.

11. English Phonetics & Phonology: A Practical Course. P. Roach. Cambridge University Press, London. 2010.
12. Handbook of the International Phonetic Association: A Guide to the Use of the International Phonetic Alphabet. Cambridge University Press.
13. Communicating Your Way to Success: The Success Stories. Dale Carnegie. Manjul Publishing House. 2018.
14. Talk like TED: The Public-Speaking Secrets of the World's Top Minds. Carmine Gallo. St. Martin's Press. 2014.
15. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success. Gopalaswamy Ramesh and Mahadevan Ramesh. Pearson Education. 2013.

# FIRST YEAR B.TECH. (II SEMESTER)

## BS121 (BSC) MATHEMATICS – II

**Cr. Hrs. 3(2+1+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

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

**CO1 :** Show knowledge of vector calculus and its applications in engineering.

**CO2 :** Solve second order differential equations for application in their field of engineering.

**CO3 :** Solve partial differential equations of first order and higher orders (with constant coefficients).

**CO4 :** Solve simultaneous equations by matrix methods.

**CO5 :** Determine eigenvalues and eigenvectors.

**CO6 :** Diagonalise a matrix and invert a matrix.

### Unit-I

Vectors Calculus: Scalar and Vector field, Differentiation of vector functions, Gradient, Divergence, Curl and Differential Operator, Integration of vector functions, Line, Surface and volume Integrals, Green's Theorem in a Plane, Gauss's and Stoke's Theorem (without proof) and their Applications.

### Unit-II

Differential Equations: Second Order Ordinary Differential Equations with Variables Coefficients, Exact Forms, Part of Complimentary Function is known, Change of Dependent Variable, Change of Independent Variable, Normal Forms, Method of Variation of Parameter.

### Unit-III

Partial Differential Equations: Formation of partial differential equations, Partial Differential Equations of First Order, Lagrange's Form, Standard Forms Higher order linear partial differential equations with constant coefficients.

### Unit-IV

Matrices: Rank of a matrix, Inverse of a matrix by elementary transformations, Consistency and Solution of simultaneous linear equations, Eigen values and Eigen vectors, Cayley-Hamilton theorem (without proof), Diagonalization of matrix.

**Text Books / References**


1. Guar, Y.N. and Koul, C.L.(2013), *Engineering Mathematics,* Vols I and ll, Jaipur Publishing house.
2. Bansal, J.L. and Dhami, H.S.(2012), *Differential Equation* Vols I and ll, Jaipur Publishing house.
3. Babu Ram (2011), *Engineering Mathematics –I* , Pearson Education India.
4. B. V. Ramana (2012), *Heigher Engineering Mathematics*, Tata McGrew Hill, India.
5. M. Ray and Chaturvedi*, A text book of Differential Equation*, Student Friend & Co. Publisher, Agra.
6. Rao V. Dukkipati (2012), *Engineering Mathematics*, New Age International (p) Ltd., New Delhi.
7. Gupta C.B., Malik A.K., *Engineering Mathematics –II,* New Age international Publisher.


## CE 122 (ESC) CIVIL ENGINEERING

**Cr. Hrs. 2(1+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **1** | **0** | **1** |
| **Hours** | **1** | **0** | **2** |

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

**CO1:** Demonstrate knowledge of various surveying methods.

**CO2:** Conduct a compass survey.

**CO3:** Conduct levelling survey and be able to do RL calculations.

**CO4:** Demonstrate knowledge of properties of various building materials.

**CO5:** Plot work profile.

### *(A) SURVEYING AND LEVELING*

**Unit-I**

Principle and purpose of plane surveying.

*Introduction of Chain Surveying:* Instrument for chaining, Direct & indirect ranging. Introduction of laser based distance measurement

**Compass Surveying:** True & Magnetic meridian, whole circle bearing &quadrantal bearing system, construction & use of Prismatic & Surveyor Compass, Local attraction.

**Introduction of plane table Surveying:** Accessories and working operation.

**Unit-II**

**Level and leveling:** Definition of various terms used in leveling. Types of Bench mark and their uses. Construction and use of Dumpy level, Leveling staves. Temporary adjustment of Dumpy level. Simple, differential leveling, fly leveling, longitudinal and cross sectioning, plotting of profile leveling. Determination of level by line of collimation and rise and fall method, Arithmetical checks. Level book and record keeping, leveling difficulties and errors in leveling.

***(B) BUILDING MATERIAL***

**Unit-III**

**Stones:** Different types, properties of good building stones, common testing of stones, Dressing of stones and use of stones in construction.

**Bricks:** Types, raw materials, identification, composition. Properties and uses of ordinary bricks, fire resistant and chemical resistant bricks.

**Limes:** Definition, sources of lime, slaking of lime, ISI classification of lime.

**Unit-IV**

**Cement:** Chemical composition, types of cement, properties, uses and tests on cement.

**Mortars:** Proportioning, properties of ingredients and use of lime, cement and gauge mortars.

**Cement Concrete:** Ingredients, common proportions, properties of fresh hardened concrete, Water cement ratio, curing and compaction of concrete.

**Timber :** Properties of good quality timber. Decay and preservation of timber.

**Practical**

1. Study of accessories used in measurement of distances.
2. Ranging Direct and indirect and use of chain and tape.
3. Study of prismatic compass and taking bearings..
4. Study of Dumpy level, temporary adjustment and R.L. calculations.

5. Simply and differential leveling operation, record in level book, practice for staff reading line of collimation and Rise and fall method calculations.
6. Longitudinal sectioning.
7. Cross sectioning.
8. Fly leveling operation.
9. Plotting of working profile.
10. Introduction of laser based distance measurement.
11. Properties of good quality bricks.
12. Properties of good quality stone.
13. Properties of good quality timber.
14. Physical test of cement.

**Text Books / References**


1. S.C. Rangwala. Engineering Materials, Charotar Book Stall, Anand.
2. B.C. Punmiya. Surveying & Field Work (Vol. I), Laxmi Publications, New Delhi.
3. Kanetkar T. P., 'Surveying and leveling', Vol. I & II.
4. Duggal S. K., 'Text book-Surveying', Vol. I & II.


## ME123 (ESC) MECHANICAL DRAWING

| | | | | |
|---|---|---|---|---|
| **Cr. Hrs.** | | | | **1(0+0+1)** |
| | **W** | **L** | **T** | **P** |
| **Credit** | | **0** | **0** | **1** |
| **Hours** | | **0** | **0** | **2** |

**Course Outcomes:** Upon completion of this course the students will be able to:

**CO1:** Demonstrate knowledge of conventional representation employed in machine drawing.

**CO2:** Make detailed drawings of simple machine parts in first/third angle projection by proper choice of sectioned views as per need.

**CO3:** Read, interpret and visualize machine parts from a given drawing.

**CO4:** Demonstrate knowledge of riveted, welded, threaded and screwed joints and fastenings.

Introduction, conventional representation of different materials used in machine drawing, Introduction to BIS codes.

**Orthographic Projection:** First and third angle methods of projection. Preparation of working drawing from models and isometric views. Drawing of missing views.

**Dimensioning:** Different methods of dimensioning.

**Sectional Views:** Concept of sectioning. Revolved and oblique section. Sectional drawing of simple machine parts

**Riveted and Welded Joints:** Types of rivet heads and riveted joints. Processes for producing leak proof joints. Symbols for different types of welded joints.

**Screw Fastenings:** Nomenclature, thread profiles, multistart threads, left and right hand threads. Square headed and hexagonal nuts and bolts. Conventional representation of threads. Different types of lock nuts, studs, machine screws, cap screws and wood screws. Foundation bolts.

Different types of joints: Knuckle joint, cotter joint and universal joint.

**Text Books / References**


1. N. D. Bhatt. Machine Drawing, Charotar Book Stall, Anand.
2. V. Laxminarayan and ML Mathur. A Text Book of Machine Drawing, Jain Brothers, New Delhi.
3. P. S. Gill. Machine Drawing, S. K. Kataria & Sons, New Delhi.


## ME124 (ESC) WORKSHOP TECHNOLOGY

**Cr. Hrs. 3(2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcomes:** Upon completion of this course the students will be able to:

**CO1:** Understand welding principles, equipment and tools of arc-, gas and resistance welding, brazing and soldering.

**CO2:** Describe construction, operations and tools of lathe, shaper and drilling machines.

**CO3:** Understand basic hot and cold forming operations.

**CO4:** Demonstrate knowledge of types of patterns, cores, moulding sands and tools.

**CO5:** Understand sand, permanent mould and investments castings and casting defects.

## Unit-I

**Welding:** Introduction to types of welding. Principle of electric arc welding, welding tools and safety devices, welding positions, welding joints, types of welds, Resistance welding. Oxyacetylene gas welding, types of flames. Soldering and Brazing.

## Unit-II

**Lathes:** Constructional details of centre lathe. Main operations and tools used on centre lathes.

**Shaper:** Types of shapers. Constructional details of standard shaper, shaper tools and main operations.

## Unit-III

**Drilling Machines:** Types of drilling machines. Constructional details of pillar type and radial drilling machines. Main operations. Twist drills, drill angles and sizes.

**Forming:** Basic descriptions and applications of hot and cold working processes, forging, bending, shearing, drawing and forming operations.

**Measurement and Inspection:** Classification of measuring instruments, linear and angular measurement, comparators.

## Unit-IV

**Foundry & Casting Practices:** Introduction, types of patterns, Mouldings, moulding materials, cores, moulding tools and equipments. Moulding sands, properties of moulding sands. Casting defects. Casting methods: Permanent mould casting, investment casting.

## Practical

Practical exercises on welding, pattern making, foundry and machining operations.

## Text Books / References


1. Mathur Mehta and Tiwari: Elements of Mechanical Engineering, Jain Brothers, New Delhi.
2. S.K. Hajra Choudhury and A.K. Hajra Choudhury: Elements of Workshop Technology (Vol. I and II), Media promoters & Publishers Pvt. Ltd., Bombay.

# SECOND YEAR B. TECH. (III SEMESTER)

## BS231 (BSC) MATHEMATICS – III

**Cr. Hrs. 3 (2 + 1 + 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

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

**CO1:** Understand Finite differences, various difference operators and their relationships, factorial notation.

**CO2:** Use numerical methods in modern scientific computing.

**CO3:** Find the Inverse Laplace Transform by Partial Fractions.

**CO4:** Use the Laplace Transform to solve differential equation with constant coefficients.

**CO5:** Numerically integrate any function by Trapezoidal and Simpson's rule.

### Unit-I

**Interpolation:** Finite differences, various difference operators and their relationships, factorial notation, Interpolation with equal intervals, Newton's forward and backward interpolation formulae, Lagrange's interpolation formula for unequal intervals.

### Unit-II

Gauss forward and backward interpolation formulae, Stirling's and Bessel's central difference interpolation formulae.

**Numerical Differentiation:** Numerical differentiation based on Newton's forward and backward, Gauss forward and backward interpolation formulae.

### Unit-III

**Numerical Integration:** Numerical integration by Trapezoidal, Simpson's rule.

**Numerical Solutions of Ordinary Differential Equations:** Picard's method, Taylor's series method, Euler's method, modified Euler's method, Runge-Kutta methods.

### Unit-IV

**Laplace Transform:** Laplace transforms of elementary functions, Basic properties of Laplace transform, Initial value theorem, final value theorem and convolution property of Laplace transform, Inverse Laplace transforms, Applications of Laplace transform to solve ordinary differential equations.

**Text Book/ References**


1. H.C. Saxena, *Text Book of Finite Differences and Numerical Analysis*, S. Chand and Co.
2. M.K. Jain, S.R.K. Iyengar and R.K. Jain, *Numerical Methods for Scientific and Engineering computation*, New Age International (P) Ltd.
3. N.P. Bali and Manish Goyal, *A Text book of Engineering Mathematics*, Laxmi Publication Pvt. Ltd., New Delhi (VII Edition).
4. S.P. Goyal and A.K. Goyal, *Integral Transforms*, Jaipur Publishing House, Jaipur.
5. Bansal, Bhargava, *Numerical Analysis*, JPH, Jaipur.


## BS 232 (HSM) Human Values

**Cr. Hrs. 2 (2+0+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **0** |
| **Hours** | **2** | **0** | **0** |

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

**CO1:** Distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.

**CO2:** Engage in a process of self-reflection and know what they 'really want to be' in their life and profession

**CO3:** Understand the meaning of happiness and prosperity for a human being.

**CO4:** Understand harmony at all the levels of human living, and live accordingly.

**CO5:** Apply the understanding of harmony in existence in their profession, develop commitment and courage to act in order to lead an ethical life

### Unit-I

**Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

Understanding the need, basic guidelines, content and process for value education; Self Exploration - content and process; 'Natural

Acceptance' and Experiential Validation; Continuous Happiness and Prosperity with respect to Human Aspirations; Method to fulfil human aspirations: understanding and living in harmony at various levels.

**Unit-II**

**Understanding Harmony in the Human Beings and their Relationships - Harmony in Myself, Family and Society**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body'; Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha; Understanding the Body as an instrument of 'I' ,Understanding the characteristics and activities of 'I' and harmony in 'I'; Understanding the harmony of I with the Body: Sanyam and Swasthya;

Understanding harmony in the Family; Understanding values in human-human relationship; meaning of Nyaya and program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman);

Understanding harmony in the society , Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (AkhandSamaj), Universal Order (Sarvabhaum Vyawastha )- from family to world family.

**Unit-III**

**Understanding Harmony in 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 (Sah-astitva) of mutually interacting units in all pervasive Space; Holistic perception of harmony at all levels of existence.

**Unit-IV**

**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, and develop appropriate technologies and management models; Strategy for transition from the present state to Universal Human Order at the level of individual and society.

**Note:** In each unit, relevant practice exercises and case studies to be taken up. Mode of conduct should be through group discussions.

**Text Books/ References**

Textbook:

R R Gaur, R Sangal, G P Bagaria, A Foundation Course in Human Values and Professional Ethics, Excel Books, 2009. ISBN: 978-9-350-62091-5

**Other reference books:**

1. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Annie Leonard, 2010, The Story of Stuff, Free Press
4. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
5. R. Subramanian, Professional Ethics includes Human Values, Oxford Univ. Press.
6. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
7. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
8. A Nagraj, 1998, Jeevan Vidya: Ek Parichay, Divya Path Sansthan, Amarkantak.
9. A N Tripathy, 2003, Human Values, New Age International Publishers.
10. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co.
13. M Govindrajran, S Natrajan& V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.

## CE 233 (ESC)* STRENGTH OF MATERIAL

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

***Common to CE, AE, EE & MI***

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

**CO1:** Analyze behavior of materials under simple stress and strains

**CO2:** Analyze behavior of materials under compound stress and strains

**CO3:** Analysis of stress and strains by various methods, stresses in thin cylinder and special shells

**CO4:** Plot SFD and BMD of beams under various loading and determine shearing and bending stresses

**CO5:** Analyze various shafts under torque

**CO6:** Analyze and design columns using different formulae

### *Unit-I*

**Fundamentals:** Stress and strain, engineering properties, Saint-Venant's Principle. Stress strain diagrams, mechanical properties of materials, elasticity and plasticity. Shear stress and strain, pure shear, complementary shear. Poison's ratio, volumetric strain, bulk modulus of elasticity. Elastic constants and relation between elastic modulie.

Linear elasticity and Hooke's law. Temperature stresses and effects. Stress and strain in axially loaded members.

### *Unit-II*

**Analysis of Stress and Strain:** Stress at a point, stress components. Stresses on inclined planes. Plane stress and strain. Mohr's circle representation of plain stress and strain. Principle stresses and strains, maximum shear stresses. Hooke's law for plain stress.

Stresses in thin cylinder and special shells subjected to internal & external pressures.

### *Unit-III*

**Beam under Flexural Loads:** Bending moment and shear force, relation between load, Shear force and bending moment. Bending moment and shear force diagrams for simply supported, Cantilever and overhang beams under static loading of different types viz. point loads, Uniformly distributed loads, linearly varying loads, Pure bending. Theory

of simple bending of initially straight beams. Flexural stresses in beams. Built up and composite beams. Shear stresses in beams of Rectangular, Circular and I-section. Shear formula, effect of shear strain.

***Unit-IV***

**Torsion:** Torsion of solid and hollow circular shafts. Non-uniform torsion.

**Columns:** Buckling and stability, critical load. Euler's theory for initially straight column with different end conditions, equivalent length, Limitation of Eulor's formula. Rankine's formula. Column under eccentric loading. Secant, Perry's and Indian standard Formulae.

**Practical**

1. Study of Universal Testing Machine, its part and functions.
2. Operation of U.T.M, fixing of specimen for different testing.
3. Tensile test on mild steel specimen to failure and computing, Stresses, % elongation, Contraction etc.
4. Compression test on timber.
5. Compression test on mild steel.
6. Compression test on concrete cube.
7. Determination of toughness test of mild steel, Brass and Aluminum by Charpy test.
8. Determination of toughness by Izod test for wood, Aluminum & Brass.
9. Study of torsion testing machine.
10. Performance of torsion test on circular shaft specimen.
11. Bending test on wooden beam and determination of modulus of rupture.
12. Deflection test on wooden beam.

**Text Books/References**


1. Junarkar S.B. and Shah H.J., 'Mechanics of Structures' Vol.-I Charoter Publishing, Anand.
2. PunmiaB.C., 'Strength of Materials and Mechanics of Structures', Vol-I, Standard Publisher distributors, New Delhi.
3. Fedinard L., 'Strength of Materials', Singer& Andrew Pytel'.
4. Fenner, 'Mechanics of Solids'.
5. Davis H. E, Trophell, G.E. &Hanck, G.F.W., 'The Testing of Engineering Materials', McGraw Hill.
6. Timoshenko, S.P. & Young, D.H., 'Strength of Materials', East West Press Limited.

# EC 234 (ESC) BASIC ELECTRONICS

**Cr. Hrs. 3 (2 +0+1)**
**L T P**
**Credit 2 0 1**
**Hours 2 0 2**

**Course Outcome:**

**CO1:** Competency in theory of operation of solid-state devices.

**CO2:** Proficiency in technicalities various solid-state devices & their biasing techniques.

**CO3:** Ability to hands-on laboratory experience of solid state devices.

**CO4:** Capability to design & analyse small signal Amplifiers.

## Unit-I

**Diode circuits:** P-N junction diode, I-V characteristics of a diode; review of halfwave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

**BJT circuits:** Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.

## Unit-II

**MOSFET circuits:** MOSFET structure and I-V characteristics. MOSFET as a switch.

MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

## Unit-III

**Differential, multi-stage and operational amplifiers:** Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal opamp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product).

## Unit-IV

**Linear applications of op-amp:** Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier,integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion.

**Nonlinear applications of op-amp:** Hysteretic Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators.

**Text Books/References**


1. J. Millman & C.C. Halkias. Integrated Electronics: analog & Digital ciruits system, TMH.
2. Jacob Millman and Arvin Grabel. Microelectronics, McGraw Hill.
3. Robert L.Boyle sted & Louis Nashelshky. Devices and Circuit Theory, PHI.


## EE 235(PCC) CIRCUIT THEORY – I

**Cr. Hrs. 4 (3+0+ 1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course Outcome :**

**CO1:** Proficiency in fundamental laws and elements of electrical networks.

**CO2:** Competence in waveforms, signals, transients and steady state response of various RLC circuits.

**CO3:** Ability to solve any DC or AC electrical circuit using various network theorems.

**CO4:** Capability to harness mathematical tools like Laplace and Fourier transforms to solve electrical circuits.

### Unit-I

**Basic circuit element and paramter:** circuit component, ideal and practical voltage and current sources and their inter conversion, independent and dependent sources, unilateral and bilateral, active and passive, linear and non linear, distributed and lumped parameters.

**Network theorem for AC network:** Mesh and Nodal analysis, Thevenin, Norton, Superposition, Maximum Power Transfer, Milliman, Telegen, compensation, reciprocity theorem.

**Unit-II**

Resonance in series and parallel circuit, Transient and steady state response AC and DC network, analysis of magnetically coupled circuit under sinusoidal excitation, coefficient of coupling,

**Unit-III**

Analysis of 3-phase balanced and unbalanced circuit, measurement of 3 phase active and reactive power. Power and Power factor in ac circuits.

**Unit –IV**

**Two port Network:** open circuit, Short circuit, transmission, Hybrid parameters, their inter- relationship and interconnection, Two port symmetry, Input Impedance, output impedance, Image Impedance, Brune's test.

**Text Books/References**

1. Soni & Gupta. Electrical Circuit Analysis, Dhanpat Rai Publisher.
2. Sudhakar. Circuit Analysis & Synthesis, TMH.

## EE 236(PCC)
## ELECTRICAL MEASUREMENTS & INSTRUMENTS

**Cr. Hrs. 3 (3+0 + 1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course outcome :**

**CO1:** Proficiency in measurement of circuit quantities.

**CO2:** Competence in Minimization of errors in measurement.

**CO3:** Capability of harnessing Instrument transformer in measurements.

**CO4 :** Know-how of Magnetic Measurements.

**Unit-I**

**Measuring Instruments:** Principle of operation, construction detail, torque equation, uses and error in Moving coil, moving iron, electrodynamics and induction instruments. Applications of instruments for measurement of current, voltage, single-phase power and single-phase energy. Errors in

wattmeter and energy meter and their compensation and adjustment. Testing and calibration of single-phase energy meter by phantom loading. Introduction and types of galvanometer.

**Unit-II**

**Potentiometers:** Theory of operation and construction of D.C. and A.C. potentiometers (polar and coordinate type), standardization and applications.

**Measurements of Resistance:** Classification of resistance. Measurement of medium resistances – ammeter and voltmeter method, substitution method, Wheatstone bridge method. Measurement of low resistances – Potentiometer method and Kelvin's double bridge method. Measurement of high resistance: Price's Guard wire method. Measurement of earth resistance.

**Unit-III**

**A.C. Bridges:** Generalized treatment of four-arm AC bridges. Sources and detectors. Maxwell's bridge, Hay's bridge and Anderson bridge for self inductance measurement. Heaviside's bridge for mutual inductance measurement. De Sauty Bridge for capacitance measurement. Wien's bridge for capacitance and frequency measurements. Sources of error in bridge measurements and precautions. Screening of bridge components. Wagner earth device.

**Instrument Transformers:** Theory and construction of current and potential transformers, Ratio and phase angle errors and their minimization, effects of variation of power factor, secondary burden and frequency on errors, Testing of CTs and PTs.

**Unit-IV**

**Magnetic Measurements:** Determination of B-H curve and hysteresis loop of ring specimens, Measurement and separation of iron losses.

Digital voltmeters and multimeters, Measurement of time, phase and frequency, Principle and working of cathode ray oscilloscope.

**Text Books/References**

1. A.K. Sawhney. Electrical & Electronics Measurements & Instrumentation. Dhanpat Rai & Co.
2. H.S. Kalsi. Electronic Instrumentation 3. E.W.Goldin. Electrical Measurements.

## EE 237(PEC), ELECTRICAL ESTIMATION & COSTING

**Cr. Hrs. 1 (0+0+1)**
**L T P**
**Credit 0 0 1**
**Hours 0 0 2**

**Course outcome :**

**CO1:** Proficiency in working of electrical appliances used in daily life.

**CO2:** Competency in electrical appliances problem solving.

**CO3:** Ability to devise optimum earthing practices.

**CO4:** Capability in various basic House Wiring techniques.

### Unit-I

**Estimating & Costing:** Introduction, Estimating, Various Steps to Form an Estimate, Purpose of Estimating & Costing, Quantities of a Good Estimator, Essential Elements of Estimating & Costing, Price List, Net Price, Purchase Organisation. Common Hand Tools their uses, Care and Maintenance, General Electrical Accessories and Insulating Materials, Measurement of Earth Resistance and Testing of Installations.

### Unit-II

Estimating and Conductor Size Calculations for Internal Wiring H.T. & L.T. Overhead Lines and Under Ground Cables. Installation and Estimates for Service Lines.

### Unit-III

Estimating and Costing of Material in Electrical Installation for Residential Buildings, Workshops and Halls

Estimation of the quantity of materials and their cost required for the P.V.C. casing-capping wiring system used in a house the plan of which is as shown below. Assume that the height of roof is 3.75m and one plug point is to be provided in each room.

### Unit-IV

Estimates for L.T. Distributor and Street Light Feeders: A pole and stay assembly as shown in Fig. 17.1 are to be erected. Determine the volume of excavation required to be done and also draw a list of material which will be used to provide such an arrangement.

Estimates for 11 K.V. Feeders and Substations: Determine the quantity of material required and cost for erecting 300 KVA 0.4/11kv substations. Assuming that 400 volts generator panel is at a distance of 50 m in an adjoining power house.

**Text Books/References**

1. Electrical design Estimation & Costing by K. B Raina.
2. Electrical installation Estimation & Costing by J. B Gupta.

# SECOND YEAR (SEMESTER-IV)

## BS241 (BSC) MATHEMATICS-IV

**Cr. Hrs. 3 (2 + 1 + 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

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

**CO1:** Demonstrate proficiency in solving Fourier Series.

**CO2:** Solve Algebraic and Transcendental Equation.

**CO3:** Solve Wave equation and Laplace's equations.

**CO4:** Show competence in Statistics, Correlation and regression.

### Unit-I

**Fourier Series:** Fourier series, even and odd functions; Half range series; Change of interval; Exponential form of Fourier series; Harmonic analysis.

### Unit-II

**Roots of Nonlinear (Algebraic and Transcendental) Equations:** Bisection method, False position method, Newton Raphson method; Convergence of False position and Newton Raphson method. Complex roots of polynomials by Bairstow's method.

### Unit-III

**Partial Differential Equations:** Classifications of partial differential equations; Method of separation of variables to solve Heat equation, Wave equation and Laplace's equations.

### Unit-IV

**Statistics:** Correlation and regression; Principle of least square method and curve fitting.

**Probability Distribution Functions:** Random variable; Mathematical expectations; Moment generating functions; Discrete and continuous distribution functions; Binomial, Poisson and Normal distributions.

**Text Book/ Reference**


1. J.L. Bansal and H.S. Dhami, *Differential Equations (Vols.-II)*, Jaipur Publishing House, Jaipur (2005).
2. N.P. Bali and Manish Goyal, A Text book of Engineering Mathematics (VII Edition), Laxmi Publication Pvt. Ltd., New Delhi.
3. S.C. Gupta and V.K. Kapoor, Mathematical Statistics, Sultan Chand & Sons, New Delhi.


## EC 242(ESC) Fundamental of Digital Electronics

**Cr. Hrs. 3 (2+0+ 1)**
**L T P**
**Credit 2 0 1**
**Hours 2 0 2**

**Course outcome:**

**CO1:** Proficiency in applications of digital circuits in present scenario.

**CO2:** Competency in Boolean algebra and correlation between Boolean expressions.

**CO3:** Ability in analysing and designing of combinational and sequential circuits.

**CO4:** Capability to harness various memory devices & their applications.

### Unit-I

**Fundamentals of Digital Systems and logic families:** Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital lCs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

## Unit-II

**Combinational Digital Circuits:** Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

## Unit-III

**Sequential circuits and systems:** A 1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J- K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

## Unit-IV

**A/D and D/A Converters:** Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter lCs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

### Text Books/References


1. A.P. Malvino & D.P. Leach. Digital Principles & Applications, Tata Mc-graw Hill, Delhi.
2. Morris Mano. Digital Circuit & Logic Design; Prentice Hll of India.
3. Tocci. Digital Systems, Pearson Education
4. Gree. Digital electronics, Pearson Education
5. Msno. Digital Desigh, Pearson Education

## ME243 (ESC) Mechanical Engineering-II

**Cr. Hrs. 3 (2+0+ 1)**
**L T P**
**Credit 2 0 1**
**Hours 2 0 2**

**Course Outcomes:** Upon completion of this course the students will be able to:

**CO1:** Demonstrate knowledge of characteristics of power transmission drives with flexible connectors and gears and application forelementary calculations.

**CO2:** Solve simple balancing problems of rotating and reciprocating masses.

**CO3:** Describe brakes, dynamometers, bearings, couplings and lubrication methods.

**CO4:** Explain the sources and types of vibrations encountered in machines.

**CO5:** Describe the construction and operation of high pressure steam boilers, turbines and condensers.

**CO6:** Explain various cycles of refrigeration and basic concepts of air-conditioning.

**CO7:** Demonstrate knowledge of performance characteristics of water turbines and centrifugal pumps required for selection of proper machine.

### Unit-I

**Transmission of Power:** Belts, ropes and chains, length of belt, tension in belt, centrifugal tension and maximum power transmitted by belts, Spur gear nomenclature, involute and cycloidal profiles, helical, bevel and worm gears. Gear trains.

**Brakes and Dynamometers :** Band brake, block, band and block brake. Single and multiple disc clutches. transmission and absorption type dynamometers.

### Unit-II

**Balancing :** Balancing of rotating mass in single multiple and planes. partial primary and secondary balancing of reciprocating masses.

**Vibrations :** Free, longitudinal, transverse and torsional, Critical speed.

**Bearing and Couplings :** Main types of bearing and coupling. Antifriction bearings; Lubrication: Laws of friction for dry and lubricated surfaces, Methods of lubrication of bearings.

**Unit-III**

**Steam Boilers :** High pressure boilers of natural and forced circulation type, La Mont, Benson, Loeffiler, Velox Boilers;

**Steam Turbine :** Expansion of steam through nozzles with and without friction. Throat pressure for maximum discharge. Working of impulse and reaction turbine. Compounding. Velocity diagrams. Governing of turbines. Emergency governing;

**Condensers :** Types, classifications and details. Vacuum efficiency. Cooling towers and spray ponds.

**Unit-IV**

**Gas Turbines :** basic principles, simple gas turbine cycle, application of gas turbines.

**Refrigeration and Air Conditioning :** Bell-Colleman refrigerator, vapour compression and absorption refrigerators. Psychrometric chart. Introduction to comfort air-conditioning.

**Water Turbine:** classification & characteristics of various water turbines, governing of turbine, problems of cavitations, selection of turbine for hydropower schemes.

**Centrifugal Pumps:** Classification, characteristics & selection of various centrifugal pumps.

**Practicals**

Study of gears, brakes and dynamometers. Study of various types of clutches and antifriction bearings. Study of critical speed of shaft. Study of air compressors. Study of high pressure boilers and condensors. Study of steam and gas turbines. Study and experiments on refrigeration systems. Study of air conditioner.

**Text Books/References**


1. M.L. Mathur and F.S. Mehta. Thermal Engineering, (Vol.I& II, SI Edition), Jain Brothers. New Delhi.
2. R.K.Purohit. Thermal Engineering.
3. R.S.Khurmi and J.K.Gupta. Theory of Machines, Eurasia publishing House (Pvt.) Ltd. New Delhi.
4. P.L.Ballaney. Theory of Machines, Khanna Publishers, Delhi.

## EE 244 (PCC) CIRCUIT THEORY – II

**Cr. Hrs. 4 (3+0+1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course Outcome :**

**CO1:** Competency in advanced methods for network analysis.

**CO2:** Proficiency in time domain & frequency domain analysis.

**CO3:** Capability to design filters and their applicability.

**CO4:** Ability to concepts of network synthesis and its application.

### Unit-I

Laplace transform and its application to network analysis, transform networks and sources, initial and final value, and inverse transform, Unit impulse response, unit step response, the time shift theorem, convolution.

### Unit-II

**Network functions and complex frequency plane:** Transfer functions, concepts of complex frequency, poles and zero and restrictions on their location in s-plane, Time domain behaviour from pole-zero configuration ,frequency response , magnitude and phase of network functions ,a relation between time domain and frequency domain analysis .

### Unit-III

**Filters:** Two port reactance networks, image impedance, attenuation, phase shift and insertion loss, characteristics and design of constant –k and m-derived filters

### Unit-IV

**Fourier series:** Periodic function, Trigonometric Fourier series, Evaluation of Fourier coefficient, waveform symmetry Analysis of simple circuit with non sinusoidal excitation. Fourier transform and its application to circuit analysis,

**Text Books/References**

1. Soni & Gupta. Electrical Circuit Analysis, Dhanpat Rai Publisher.

2. Sudhakar. Circuit Analysis & Synthesis, TMH. 2016/CTAE/09.

## EE 245(PCC) POWER SYSTEM – I

**Cr. Hrs. 4 (3+0+1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course outcome :**

**CO1:** Proficiency in insulator's voltage distribution over an insulator string.

**CO2:** Competency in designing parameters of transmission lines and their performance.

**CO3:** Capability to harness distribution system configurations, equipment and loads.

**CO4:** Know-how of travelling waves and their significance.

### Unit-I

**Basics of power system: AC and DC transmission concept. Insulators:** Type of insulators, bushings, voltage distribution over an insulator string, grading and methods of improving string efficiency, pollution flashover; Corona: Electric stress between parallel conductor's, Disruptive critical voltage and visual critical voltage, calculation for three phase overhead lines for corona power loss, factors effecting corona, effect of corona.

### Unit-II

**Parameters of transmission lines:** Resistance, inductance and capacitance of overhead lines, effect of earth on capacitance, line transposition, geometric mean radius and distance, calculation of inductance and capacitance of single phase transmission line, Skin and Proximity effect.

### Unit-III

**Performance of transmission lines:** Steady state analysis of short, medium and long transmission lines, Generalized ABCD line constants, receiving end and sending end power circle diagrams, Ferranti effect, interference with communication circuits.

### UNIT-IV

**Underground cables:** Type of cables, insulation resistance and capacitance calculation, reduction of maximum stresses, causes of breakdown, idea about oil and gas filled cables, thermal rating of cables.

**Travelling waves:** Travelling waves on transmission lines, wave equation, specification of travelling waves, reflection and refraction of travelling waves, typical cases of line terminations.

**Text Books/References**

1. B.R Gupta. Power System Analysis & Design.

2. Soni Gupta and Bhatnagar. A course in Electrical power.

3. C.L Wadhwa. Electrical Power Systems.

4. Naghrath & Kothari. Modern Power System Analysis.

5. J.J Grainger & W.D stevenson. Power System Analysis.

## EE 246(PCC) ELECTRICAL MACHINES – I

**Cr. Hrs. 4 (3+0+1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course Outcome :**

**CO1:** Proficiency in electrical machines and their applications.

**CO2:** Competency in testing & operational issues of Transformers.

**CO3:** Dexterity in operational aspects, starters and speed control Of DC Machines.

**CO4:** Know-how of cross fields machinery and their applications.

### Unit-I

**Transformers:** Constructional features, emf equation, phasor diagram, equivalent circuits, open circuit and short circuit test, polarity test, Sumpner's test, losses and efficiency, voltage regulation, parallel operation, all-day efficiency.

**Auto transformers:** construction, principle, applications and comparison with two winding.

Transformer

## Unit-II

**Polyphase Transformers:** Standard connections and parallel operation for three-phase transformers, Phase conversion - Scott connection, three-phase to six-phase conversion

**Electromechanical Energy Conversion:** Basic principles of electromechanical energy conversion, energy balance, energy stored in the magnetic circuit; force as a partial derivative of stored energy with respect to position of a moving element; torque as a partial derivative of stored energy with respect to angular position of a rotating element, basic principles of operation of electric generators and motors.

## Unit-III

Fundamentals of DC machine, construction, armature windings, simple lap and wave windings. Construction of commutator, linear commutation DC Generators: EMF equation, Types of DC generators, no load and load characteristics, voltage build-up in a shunt generator, critical field resistance and critical speed. Armature Reaction: Distribution of armature and field mmfs, cross magnetizing and demagnetizing mmfs and their approximate estimation.

## Unit-IV

**DC Motors:** Principle of operation, production of torque, back emf, torque-current and torque-speed characteristics of separately excited, series and shunt motor, starting of motors, speed control by variation of armature voltage, field current and Ward Leonard method, electric braking, losses and efficiency, direct and indirect tests, Swinburne's test, Hopkinson's test, field test and retardation test.

**Practicals:** Lab experiments based on theory

**Text Books/References**

1. B.R. Gupta & Vandana Singhal. Fundamentals of Electric Machines.

2. I.J. Nagrath & D.P. Kothari. Electric Machines (Second Edition).

3. P.K.Mukherjee & S.Chakravorti. Electrical Machines.

## EE 247(PEC), MICROPROCESSOR

**Cr. Hrs. 4 (3+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome:**

**CO1:** Know-how of modern microprocessor functions.

**CO2:** Capability in harnessing microprocessor peripheral devices for system development.

**CO3:** Competency in the assembly language programming.

**CO4:** Know-how of PLC and Industrial control for engineering problems.

### Unit-I

**Microprocessor Architecture:** Introduction to 8085 Microprocessor Architecture, CPU, address bus, data bus and control bus. Input/Output devices, buffers, encoders, latches and memories. Internal Data Operations and Registers, Pins and Signals, Peripheral Devices and Memory Organization, Interrupts, status flag.

### Unit-II

**Programming the 8085:** Microprocessor Instructions, classification, Format and Timing. Instruction Set: 8 Bit and 16 Bit Instructions, Programming and Debugging, Subroutines. Modular & structured programming, Macro, Micro programming.

### Unit-III

**8085 Microprocessor Interfacing:** 8259, 8257, 8255, 8253, 8155 chips and their applications. A/D conversion, memory, keyboard and display interface (8279).

Micro controllers and -Introduction & applications Programmable Logic Controller: Principles of operation, architecture of Programmable controller, applications.

### Unit-IV

**Basic Computer Architecture:** Central Processing Unit, memory and input/output interfacing. Memory Classification Volatile and non-volatile memory, Primary and secondary memory, Static and Dynamic memory, Logical, Virtual and Physical memory. Types Of Memory: Magnetic core memory, binary cell, Rom architecture and different

types of ROM, RAM architecture, PROM, PAL, PLA, Flash and Cache memory, SDRAM, RDRAM and DDRAM. Memory latency, memory bandwidth, memory seek time.

**Practicals:** Lab experiments based on theory.

**Text Books/References**


1. S. Gaonkar Ramesh. Microprocessor Architecture, Programming, and Applications with the 8085; 4th ED; Prentice Hall
2. D.V. Hall. (1986). Microprocessor and Interfacing Programming and Hardware, McGraw Hill Co., New York.
3. G.A. Gibson, Y.C. Liu. (1986). Microcomputer System the 8086/8088 Family, Prentice Hall India Pvt. Ltd., New Delhi (second edition).


## EE 248 (PEC), ELECTRICAL ENGINEERING MATERIALS

**Cr. Hrs. 2 (2+0+0)**
**L T P**
**Credit 2 0 0**
**Hours 2 0 0**

**Course Outcome :**

**CO1:** Know-how of specific conductor materials.

**CO2:** Proficiency in magnetic material & typical applications.

**CO3:** Competency in semi-conductors technicalities and their utility.

**CO4:** Awareness of advancement in super conducting materials & its technicalities.

### Unit-I

**Conductor Materials:** Electrical, thermal and mechanical properties of conductive and resistive materials. Important characteristics and applications of specific conductor materials like copper, aluminium, AAC, ACSR, silver, gold, platinum and tungsten, study of important resistance materials, carbon and nicrome, standard resistance materials. Soldering alloys. Basic of solid state physics. crystral structures and defects, ceramics materials, insulating.

## Unit-II

**Super-conducting Materials:** Introduction, critical field and critical current density, type I and type II superconductors, intermediate state, penetration depth and thin films, Superconductivity at high frequencies, application of superconductivity. Advancements in super conducting materials. Dielectric materials: Dielectric behaviour of materials under static and dynamic field, Polarisation, induced and permanent dipole moments, Surface resistivity. Breakdown processes. Thermal properties Electrical properties of important dielectric materials including plastics and ceramics, ferroelectric and piezo-electric materials.

## Unit-III

**Magnetic Materials:** Characteristics of diamagnetic, paramagnetic, ferromagnetic, ferrities, ferromagnetic and anti-ferromagnetic materials, Properties and applications of common no retentive and retentive magnetic materials including various alloys, ferrites and powder cores. Eddy current and hysteresis losses, Curie point.

## Unit-IV

**Semiconductor materials:** Electric properties of semiconducting elements and compounds and their application. Zone refining and crystal growth. Miscellaneous materials: important electronic properties of electron emitting materials, photosensitive materials and luminescent materials. photoconductivity .Introduction to nanotechnology & basics of nano materials.

### Text Books/References


1. C. S. Indulkar & S. Thriuvengadam. An introduction to Electrical Engineering Materials, S.Chand.
2. S. P. Seth & P.V.Gupta. A course in Electrical Engineering Materials, Dhanpat Rai & Sons.
3. B. D. Indu. Electrical Engineering Materials, Jain Brothers.
4. A. J. Dekkar. Electrical Engineering Materials.
5. R. M. Rose et al. Structure and properties of Materials, Wiley Eastern Ltd.

# THIRD YEAR (SEMESTER-V)

## BS 351 (BSC) MATHEMATICS –V (EE)

**Cr. Hrs. 3 (2+1+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

**Course Outcome :**

**CO1:** Proficiency in solving Differences equations.

**CO2:** Competence in general Z-transformation and their applications.

**CO3:** Capability in numerical methods for solution of simultaneous linear equations.

**CO4 :** Ability to solve engineering specific partial differential equation problems.

### Unit-I

**Difference Equations:** Homogeneous linear difference equations with constant coefficients; Non-homogeneous linear difference equations with constant coefficients, method of undetermined coefficients, method of operators; Homogeneous\ Non-homogeneous linear difference equations of first order with variable coefficients.

### Unit-II

**Z-Transforms:** Basic properties of Z-transforms; Initial value theorem, final value theorem and convolution theorem of Z-transforms; Inverse Z transforms; Applications of Z-transforms to solve difference equations.

### Unit-III

**Solutions of Simultaneous Linear Equations:** Gaussian elimination method, pivoting; Gauss-Jordan method; Gauss-Seidal method; Cholesky's method. Eigen values and Eigen vectors: Power and inverse power method.

### Unit-IV

**Fourier Transforms:** Complex Fourier transforms, Fourier sine and cosine transforms; Inverse Fourier transforms; Simple properties of Fourier transforms; Applications of Fourier transforms to solve partial differential equations.

**Text Books/References**


1. N.P. Bali and Manish Goyal. A Text book of Engineering Mathematics (VII Edition), Laxmi Publication Pvt. Ltd., New Delhi.
2. R.K. Jain and S.R.K. Iyengar. Advanced Engineering Mathematics (II Edition), Narosa Publishing House, New Delhi.
3. S.P. Goyal and A.K. Goyal. Integral Transforms, Jaipur Publishing House, Jaipur.


## EE352 (PCC), POWER SYSTEM – II

**Cr. Hrs. 4 (3+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome :**

**CO1:** Proficiency in protective schemes and various faults in the Power System.

**CO2:** Capability in harnessing switchgear equipment for reliability.

**CO3:** Competency in protection of power system.

**CO4:** Know-how of Symmetrical Component & per unit system

### Unit-I

**Per Unit System:** Percent and per unit quantities, single line diagram & impedance diagram for a balance system; Symmetrical Fault Analysis: Transient in R-L Circuit, symmetrical and asymmetrical short-circuit current in synchronous generation, equivalent circuit of synchronous machine in different conditions, analysis of three phase fault.

### Unit-II

**Symmetrical Component:** Fortesque theorem and symmetrical component transformation, phase shift in star delta transformer, sequence impedance and sequence circuit for synchronous machine, transformer and transmission line, sequence network of a power system. Symmetrical and Unsymmetrical fault analysis: Single line to ground fault, Line to line fault, Double line to ground fault.

**Unit-III**

**Switchgear & Protection:** Fuses, Selectivity, Discrimination, Sensitivity, Reliability, Fastness, Time grading & current grading, Primary & back up protection.

**Construction & operation of relays:** Electromagnetic over current relays, Reverse Power Directional relay, Instantaneous Earth Fault Relay, Buchholtz Relay. Distance protection of transmission lines, C. T. & P. T. connection for distance relays.

**Unit-IV**

**Unit Protection:** Protection of Transformer, stator winding of alternator, Protection against Excitation failure, Prime mover failure, Frame Leakage, principle of overcurrent protection, Differential protection of: Generator-Transformer unit, 3-phase transformer, Buchholz protection. *Circuit Breakers:* Theorem of current interruption, Recovery theory, Construction and operation of Bulk oil, Air blast, MOCB, SF6, Vacuum circuit breaker, Advantages & disadvantages of static relay.

**Text Books/References**


1. I.J. Grainger. Power system analysis. W.D. Stevenson.
2. Nagrath, Kothari. Power system engineering.
3. B.R. Gupta. Power system Distribution.
4. H.C. Rai.. Numerical Problem and Objective. Evaluation in Power system. 5. C.L. Wadhwa. Electrical Power system


## EE 353(PCC), POWER ELECTRONICS – I

**Cr. Hrs. 4 (3+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome :**

**CO1:** Proficiency in Power Electronics systems as an enabling technology.

**CO2:** Know-how of basic power electrical devices.

**CO3:** Competency in analyzing basic converter topologies.

**CO4:** Ability in designing single-phase and three-phase thyristor converters.

**Unit-I**

**Semiconductor Power Devices:** Characteristics of power Diodes, power Transistors like BJT, MOSFET& IGBT, Diac, SCR and UJT.

**Unit-II**

**Thyristor:** Principle of operation, Construction and characteristics, specification and ratings, pulse transformer, optical isolators, methods of turn on, Protection of SCR protection against over voltage, over current, dv/dt, di/dt, switching surges, overheating. Gate protection,

SCR mounting, Heat transfer process in SCR, *Thyristor firing circuit***-** Principle features of a typical gate triggering circuit R & R-C, UJT relaxation oscillator.

**Unit-III**

**Converters:** Half wave converters for single, two, three, six phase; Single phase and three-phase full wave convertor with R, R-L and RLE loads; Performance factors for line commutated converters; Inversion operation semi converters, dual converter; Effect of source impedance; Microprocessor based firing scheme for three phase fully controlled bridge converter.

**Unit-IV**

**Power supplies:** Basic series and shunt voltage regulators, Integrated circuit regulators. Switch mode d.c. Power supplies, Fly back converter, forward converter, push-pull converter, half and full bridge converters, A.C. power supplies; UPS configurations, On-line and Off-line UPS.

**Text Books/References**

1. Berdi. Power Electronics

2. Bhimbra. Power Electronics

## EE 354(PCC), ELECTRICAL MACHINES – II

**Cr. Hrs. 4 (3+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome :**

**CO1:** Capability in harnessing electromechanical energy conversion.

**CO2:** Proficiency in operational technicalities of induction motors.

**C03:** Competency in operational technicalities of synchronous motor.

**C04:** know-how of Fractional Horse Power Motors.

## Unit-I

**Induction Motors:** Rotating magnetic fields, construction, basic principal of induction motor, induction motor as a generalized transformer, phasor diagram, equivalent circuits, no-load and blocked rotor tests, circle diagram, calculation of performance, effect of rotor resistance, operating characteristics of induction motor, method of speed control, starting and braking, cogging, crawling. Elementary idea of induction generator and induction regulators.

## Unit-II

**Synchronous Generators:** Constructional features, general equation of induced emf, effect of distribution, chording, armature reaction, theory of cylindrical rotor machine, saturation effects, phasor diagram, open circuit, short circuit and zero power factor characteristic, Poitier triangle, regulation by synchronous impedance, M.M.F. & A.S.A. methods and their relative comparison. Theory of Salient pole machines Blondel's two reaction theory, phasor diagram, direct and quadrature-axis reactance their determination; parallel operation of alternators, synchronizing operation of infinite bus, synchronizing power, power-angle characteristics, stability. Types of loses and efficiency calculation.

## Unit-III

**Synchronous Motor:** Construction, principle of operation, salient and cylindrical pole machine, equivalent circuit, phasor diagram, power flow equation, V curves, starting, hunting & damping.

**Single Phase Induction Motor:** Basic Principle, revolving field theory, methods of starting, equivalent circuit.

## Unit-IV

**Fractional Horse Power Motors:** Construction, principle of operation, Torque-speed characteristics and applications of universal motors, repulsion motors, hysteresis motor, brush less motors, linear induction and stepper motors.

### Text Books/References

1. H. Cotton. Advanced Electrical Technology.

2. I.J. Nagrath & D.P.Kothari. Electric Machines (Second Edition).

3. P.K. Mucherjee & Scharkravorti. Electrical Machines.

4. P.S. Bhimbhra. Electrical Machinery.

5. M.G. Say. Performance and design of AC machines

6. B.R. Gupta & Vandana Singhal. Fundamentals of Electric Machines.

## EE 355(PCC), CONTROL SYSTEM – I

**Cr. Hrs. 5 (3+1+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **1** | **1** |
| **Hours** | **3** | **1** | **2** |

**Course Outcome :**

**CO1:** Capability in transfer function modelling.

**CO2:** Proficiency in performance predictions including relative stability.

**CO3:** Competency in analysing stability & behaviour of linear dynamic systems.

**CO4:** Ability to devise a dynamic system from its time or frequency response.

### Unit-I

Mathematical modelling and Representation of loop system, electrical analogy, Laplace transforms, Mathematical modelling, transfer functions and feedback system, block diagram reduction techniques, signal flow graphs, mason's gain formula, control system components – error detectors, potentiometers, synchros, d.c. and a.c techogenerator , d.c .and a.c. servo motors.

### Unit-II

**Time Response analysis and Design specifications:** Transient and steady state response, standard test signals, Time response of a first order and second order system to standard signals, steady state error, error coefficients, generalized error series sensitivity, control actions (proportional, derivative and integral controls)

### Unit-III

Concept of stability, Absolute stability, relative stability, Routh Hurwitz criteria, Characteristic equation, Root Locus Technique

### Unit-IV

**Frequency Response Analysis:** Frequency Domain Specification, correlation between time and Frequency Response, Polar plot, Bode Plot, Gain Margin, Phase Margin Nquist stability criteria, Lag, Lead and Lag-Lead compensation Network.

**Text Books/References**


1. C. Kuo Benjamim. Automatic Control System.
2. Ogata Katsuhika. Advance Control System.
3. I.J. Nagrath & M. Gopal. Control System Engineering. Wiley Eastern Ltd., New Delhi.
4. B. S. Manke. Linear Control System.

# THIRD YEAR (SEMESTER-VI)

## BS361 (BSC), Mathematics-VI, EE

| | | | |
|---|---|---|---|
| **Cr. Hrs.** | **3(2+1+0)** | | |
| | **L** | **T** | **P** |
| **Credit** | **2** | **1** | **0** |
| **Hours** | **2** | **1** | **0** |

**Course Outcome :**

**CO1:** Understand analytic functions, bilinear mapping.

**CO2:** Construct analytic functions using Milne-Thomson method.

**CO3:** Perform Complex integration and apply them to their field.

**CO4:** Expand any function by Taylor's and Laurent's series expansions.

**CO5:** Classify the singularities and then apply to evaluate the real integrals.

### Unit-I

**Complex variables:** Analytic functions; Cauchy-Riemann equations; Polar form; Construction of analytic functions, Milne-Thomson construction method. Conformal mapping: Elementary transformations; bilinear mapping.

### Unit-II

**Complex integration:** Properties of Complex integrals; Cauchy's integral theorem; Cauchy's integral formula and derivatives of an analytic function; Morera's theorem; Cauchy's inequality; Liouville theorem; Poisson's integral formula.

### Unit-III

**Power series:** Circle of convergence and radius of convergence for power series; Theorems on power series. Taylor's and Laurent's series expansions.

### Unit-IV

**Classifications of singularities:** Residue of functions, Cauchy's residue theorem; Evaluation of real integrals by means of calculus of residue.

**Text Books/References**


1. G.N. Purohit and S.P. Goyal. Complex Analysis, Jaipur Publishing House, Jaipur.
2. B.S. Tyagi. Functions of Complex Variables, Kedarnath Ramnath, Meerut.

3. N.P. Bali and Manish Goyal. A Text book of Engineering Mathematics (VII Edition), Laxmi Publication Pvt. Ltd., New Delhi.

4. R.K. Jain and S.R.K. Iyengar. Advanced Engineering Mathematics (II Edition), Narosa Publishing House, New Delhi.

## EE 362(PEC), ELECTROMAGNETIC & FIELD THEORY

**Cr. Hrs. 3 (3+0+0)**
**L T P**
**Credit 3 0 0**
**Hours 3 0 0**

**Course Outcome :**

**CO1:** Proficiency in Vector relation of various co-ordinate systems.

**CO2:** Capability in analysing Electric field due to charge configuration.

**CO3:** Competency in Magnetostatics & Field mapping.

**CO4:** Ability to analyse Time-Varying Fields.

### Unit-I

Vector relation in rectangular, cylindrical, spherical and general curvilinear coordinate system, line, surface & volume integral; Concept and physical interpretation of: Gradient, Divergence, Curl, Stokes Theorem, Helmholtz Theorem**.**

### Unit-II

**Electrostatics:** Introduction to Electric field vectors, Electric field intensity , Electric flux density, Electric field due to charge configuration, Potential function and displacement ratio; Electric field due to point, line, plane and spherical charge distribution, Gauss law, Couloumb's law, Poison's and Laplace's equation's, Uniqueness theorem, continuity equation, Capacitance of simple configuration & electrostatic energy, Field determination by method of image, Boundary condition, Field mapping and concept of field cell.

### Unit-III

**Magneto statics:** Introduction to magnetic field vectors and magnetic circuits, Bio-Savant and Ampere's law, Lorentz force, Magnetic scalar and vector potential Self and mutual inductance energy stored in magnetic field, Boundary condition, Analogy between electric and magnetic field, Field mapping and concept of field cell. Magneto motive force, Reluctance .

**Unit-IV**

**Time-Varying Fields:** Faraday's law, Displacement current & equation of continuity, Maxwell's equation, UPW: Free space, dielectrics and conductors, Skin effect and sinusoidal time variation, Reflection, refraction and polarization of UPW, standing wave ratio, Pointing vector and power consideration.

**Text Books/References**

1. Hayt Jr, William. Engineering Electromagnetics 5/e TMH.

2. Kraus, Fleish. Electromagnetics with application, 5/e, Mcgraw Hill.

3. Griffith David J.. Introduction to Electromagnetics 3/e, PHI.

## EE363 (PCC), POWER ELECTRONICS – II

**Cr. Hrs. 4 (3+0+1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course Outcome :**

**CO1:** Proficiency in converter system technicalities.

**CO2:** Capability in Cyclo-converters design & operation.

**CO3:** Competency in choppers design, control & operational issues.

**CO4:** Ability to design different Inverter system.

**Unit-I**

**Converters:** Performance measures of single and three-phase converters, discontinuous conduction in two quadrant converters, power factor improvements: Extinction angle control, symmetrical angle control, pulse width modulation control, and sinusoidal pulse width modulation control; Thyristor commutation scheme- Line commutation, load commutation, forced and external pulse commutation, issues of line current harmonics and distortion factor.

**Unit-II**

**Cycloconverter:** Basic principle of operation, single phase to single phase, three phase to three phase and three phase to single phase cycloconverters, Output equation.

**Unit-III**

**Choppers:** Principle of chopper operation, control strategies, step-up chopper, reversible chopper, Steady state time domain analysis of type-A chopper, Chopper configuration, and chopper commutation. AC Chopper, Multiphase chopper.

### Unit-IV

**Inverters:** Inverter classification, Voltage source thyristor inverters, single phase half and full bridge inverters with auxiliary communication and with complementary communication, Three phase bridge inverters with 180 mode & 120 mode, Pulse width modulation inverters, Current source inverters, single phase capacitor-commutated CSI with restive load, single phase auto-sequential commutated inverter, three phase auto-sequential commutated inverter, single phase series inverters & parallel or push pull inverters, Voltage control of inverters.

**Practicals:** Lab experiments based on theory

**Text Books/References**

1. P.S. Bimbhra. Power Electronics.

2. Berde. Power Electronics.

3. P.C. Sen. Power Electronics.

## EE 364(PCC), INSTRUMENTATION

**Cr. Hrs. 4 (3+0+1)**
**L T P**
**Credit 3 0 1**
**Hours 3 0 2**

**Course Outcome :**

**CO1 :** Know-how of instrumentation errors & error computation.

**CO2:** Proficiency in Signal conditioning.

**CO3:** Competency in transducer technology.

**CO4:** Ability in Signal recovery techniques.

### Unit-I

**Theory of errors:** Accuracy and precision, Gross, systematic and random errors, limits of errors, probable errors and standard deviation, Gaussian error curves, Combinational errors.

### Unit-II

**Transducers:** Classification of transducer: primary and secondary, passive and active, analogue and digital, selection. criteria of transducers, working principle and operation of potentiometer, strain gauge, resistance thermometers, thermistors, thermocouple, linear variable differential transformer, rotary variable differential transformer, capacitive transducer, piezo-electric transducer, Hall-effect transducer, electromagnetic flow meter.

### Unit-III

**Signal conditioning:** D.C or AC signal conditioning system, instrumentation amplifier, charge amplifier, null and deflection type Wheatstone bridge, AC bridges using push-pull transducer. A/D & D/A converters. Phase sensitive detectors, shielding and grounding.

### Unit-IV

**Signal transmission and telemetry:** Types of telemetry system, Modulation methods, pulse modulation, transmission channels and media, time and frequency division multiplexing.

**Display devices and recorders:** Digital versus analog display, digital display units, storage oscilloscopes, recorders: x-y recorder, magnetic tape recorder.

**Practicals:** Lab experiments based on theory

**Text Books/References**

1. A.K. Shawney. Electrical Measurement & Instrumentation.

2. Kalsi. Electronic Instrumentation.

3. Albert Cooper. Electronic Instrumentation.

## EE 365(PCC), CONTROL SYSTEM – II

**Cr. Hrs. 5 (3+1+1)**
**L T P**
**Credit 3 1 1**
**Hours 3 1 2**

**Course Outcome :**

**CO1:** Know-how of State Space Analysis.

**CO2 :** Capability in devising developing Sampled Data System .

**CO3:** Competency in Non linear systems & stability criterion.

**CO4:** Dexterity in analyzing controllability and observability of systems.

### Unit-I

**State Space Analysis:** Concept of state, state space representation of systems, phase variable form, canonical variable form, physical variable form, Diagonalization, relationship between state equation and transfer

function, solution of state equation, concept of controllability and observability, eigen values and eigen vector. State transition matrix

**Unit-II**

**Sampled Data System:** Importance of sampling, mathematical analysis of sampling, spectrum analysis of sampling process, Shannon's Theorem, signal reconstruction, hold circuit, Z transform, inverse Z transform, difference equation, pulse transfer function, state variable representation of sampled data system, solution of discrete state equation.

**Unit-III**

**Non linear system:** Characteristic of non linear system, type of Non linearity, jump resonance, limit cycle, describing function method of analysis.

**Unit-IV**

Digital PID controllers, tuning rules for digital controller, Tunable PID controller, Digital temperature control system and digital position control system and Root Loci of feedback controller design.

**Practicals:** Lab experiments based on theory

**Text Books/References**


1. Nagrath & M.Gopal. Control System Engineering .
2. B. S. Manke. Control System Design.
3. Ogata. Modern Control Engineering.
4. D. Roy Choudhary. Modern Control Engineering.
5. M. Gopal, Digital control and State variable methods. Mc Graw Hills.


## EE 366(PEC) GENERATION OF ELECTRICAL POWER

**Cr. Hrs. 3 (3+0+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcome :**

**CO1:** Know-how of Bulk Energy Generation.

**CO2:** Ability in devising Tariffs strategies.

**CO3:** Competency in Selection and location of various power plants.

**CO4:** Capability in Computation of most economical power factor in varying condition.

## Unit-I

**Method of Bulk Energy Generation:** Introduction to thermal, hydel, nuclear and gas power plants with their layouts, Concept of co-generation, Impact of thermal, hydro and nuclear stations on environment.

**New Energy Sources:** Elementary ideas of electric energy generation by wind, solar, tidal and geothermal energy and fuel cell, Open and close cycle MHD power generation.

## Unit-II

**Load And Load Curve:** Types of load, chronological load curves, load duration curve, energy load curve, mass curve, maximum demand, demand factor, load factor, capacity factor, utilization factor, diversity factor.

**Power Plant Economics:** Capital cost of plants, annual fixed and operating costs of plants, generation cost and depreciation. Effect of load factor on unit energy cost, Role of load diversity in power system economics, off peak energy utilization. Energy cost reduction.

## Unit-III

**Tariffs:** Objectives of tariffs. General tariff form, flat demand rate, straight meter rate, block meter rate, two part tariffs, power factor dependent tariffs, three part tariff, spot (time differentiated) pricing.

**Power Factor Improvement:** Causes and effects of low power factor, advantages of power factor improvement, power factor improvement using shunt capacitors and synchronous condensers. Calculation of most economical power factor when kW demand is constant and kVA demand is constant.

## Unit-IV

**Selection of Power Plant:** Comparative study of thermal, hydel, nuclear and gas power plants. Base load and peak load plants, Size of generating units, types of reserve and size of plant, Selection and location of power plants.

### Text Books/References

1. B.R. Gupta. Generation of Electrical Energy (4/e).
2. S.L. Uppal. Electrical Power (13/e).
3. V.K. Mehta. Principles of Power system (3/e).
4. Soni, Gupta and Bhatnagar. Generation of Electrical Power.
5. L. Elgerd Olle. Electric Energy Systems Theory, PHI.
6. C.A. Gross. Power System Analysis, TMH.

## EE 367(PEC) ELECTRIC ENERGY SYSTEMS THEORY

**Cr. Hrs. 3 (3+0+ 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcome :**

**CO1:** Proficiency in electric supply systems.

**CO2:** Competency in Load flow analysis.

**CO3:** Ability in steady state and dynamic performance evaluation of AVR.

**CO4:** Capability to ANFC control of multi area system.

### Unit-I

Fundamental concept of electric energy system theory; electric supply systems; economics of power transmission, Economic load dispatch, System constraints-equality & inequality constraints,Econominc dispatch neglecting losses, optimum load dispatch including transmission losses. automatic load dispatching.

### Unit-II

**Load flow analysis:** Static load flow equation, system variable and its solution, Bus admittance matrix, Bus classification, Solution of load flow problem by gauss siedal, Newton Rephson and fast decoupled method, forward/backward sweep distribution load flow, Comparison of above method.

### Unit-III

The energy system in steady state-Basic generator control loops, Mathematical modelling and description of various components of automatic voltage regulator, steady state and dynamic performance of AVR.

### Unit-IV

Automatic load-frequency control of single area system, Mathematical modelling and description of various components of ALFC, steady state and dynamic performance of ALFC, steady state, dynamic and transient stabilities, Equal Area criterion, step by step method of solving swing equation. System Stability concepts.

**Text Books/References**


1. Olle L. Elgerd. Electric Energy Systems Theory, PHI
2. C.A. Ggross. Power System Analysis, TMH
3. C.L. Wadhwa. Eletrical Power Systems, New Age International Publishers.

## EE 368(PEC) SYSTEM DESIGN & SIMULATION LAB

**Cr. Hrs. 2 (0+1+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **0** | **1** | **1** |
| **Hours** | **0** | **1** | **2** |

**Course Outcome :**

**CO1:** Capability to simulate electrical system using MATLAB.

**CO2:** Proficiency in MATLAB programming of control & power Electronics system.

**CO3:** Competency in harmonic analysis.

**CO4:** Dexterity in drive control systems simulation using MATLAB.

Design & Simulation of rudimentary electrical system using MATLAB, Study of emerging trends in design and control of different electrical system: HVDC & HVAC systems design, harmonic analysis, Interfacing problems & design of solar and wind based system; Design & Simulation of recent trends in drive control technology: Vector and DTC controlled system, design and simulation of ALFC and AVR, Simulation of power flow and stabilities problems.

**Text Books/References**

1. Rudra Pratap. Getting Saterted with MATLAB.

2. Hadi Saadat. Power System Analysis, McGraw-Hill.

3. B. K. Bose. Modern Power Electronics and AC Drives, Prentice Hall.

# FINAL YEAR (SEMESTER-VII)

## EE 471(PCC), ELECTRICAL MACHINE DESIGN

**Cr. Hrs. 3 (3+0+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcome :**

**CO1:** Know-how of machine design and designing limitations.

**CO 2:** Proficiency in designing heating and cooling system of electrical machines.

**CO3:** Competency in design of transformers & its technicalities.

**CO4:** Dexterity in DC and AC machines design.

### Unit-I

**Principle of electrical machine design:** Design factors, limitations in design, magnetic circuit calculations, magnetic leakage calculations, magnetising current calculations, unbalanced magnetic pull. Heat dissipation, Heating, cooling curve, Estimation of minimum temperature rise, cooling media, quantity of cooling media, design of fan, Ratings.

### Unit-II

General features of armature winding, single layer, double layer & commutator winding, integral & fractional slot winding, winding factors, harmonics, Eddy current losses in conductors. Design of D.C. Machines, output equation, main dimensions, staggering of buses, selection of no. of poles, airgap, specific magnetic & electric loading.

### Unit-III

Design of transformers, General consideration, output equation, EMF per turn, main dimension conductor size, window yoke & over all dimensions, tank design, choice of electric & magnetic loading.

### Unit-IV

Design of Induction motors, output equation, selection of frame size, selection of no. of stator slots, calculation of air gap length & conductor size. Design of squirrel cage motor, Rotor bar, elimination of harmonic torque. Design of synchronous machine, output equation, selection of

no. of slots, Runaway speed, main dimension, Effect of SCR on machine performance, air gap.

**Text Books/References**

1. M.G. Say. A.C. Machine Design

2. A.K.Shawney. Machine Design

## EE 472(PCC), ELECTRIC DRIVES AND CONTROL

**Cr. Hrs. 4 (3+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome :**

**CO1:** Proficiency in design of Switching Mode Regulators.

**CO2:** Know-how of Dynamics of Electric Drives.

**CO3:** Ability in designing closed loop control of D.C. drive.

**CO4:** Competency in A.C. drives technology.

### Unit-1

**Switching Mode Regulators:** Buck, boost, buck-boost and Cuk regulators; Ac Voltage Controllers: Single-phase AC controllers with R and RL load, sequence control of AC controllers, three phase AC controllers.

### Unit-II

**Dynamics Of Electric Drives:** Fundamental Torque Equations, Speed-Torque conventions And Multi-quadrant Operation, Equivalent Values Of Drive Parameters, Components Of Load Torques, Nature And Classification of Load Torques, Calculation Of Time and Energy Loss In Transient Operation, Steady State Stability, Load Equalization.

### Unit-III

**D.C. Drives:** Characteristics of separately exited D.C. Motor and its operating modes for motoring regenerating braking & dynamic braking. Types of Electrical braking, Phase control drives, chopper control drives. Block diagram and explanation for close loop control of d.c.

drive. Soft start, acceleration control and current limiting, various industrial applications of drive

**Unit-IV**

**A.C. drive:** Speed control of Induction motor, stator voltage control & soft start, variable frequency control from current sources, rotor resistance control, slip power recovery. Block diagrams & their explanation for closed loop control, stator voltage control, volts hertz control with current limiting, volts hertz control with slip regulation, static Cramer drive. Synchronous motor drive-volts hertz control. Sensor less control Electric drives.

**Practicals:** Lab experiments based on theory

**Text Books/References**

1. P.S.Bimbhra. Power Electronics.

2. Berde. Power Electronics.

3. Rasid. Power Electronics.

## EE 473(PEC), ADVANCED POWER SYSTEMS

**Cr. Hrs. 3 (3 + 0+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcome :**

**CO1:** Know-how of high voltage AC system.

**CO2:** Proficiency in HVDC transmission.

**CO3:** Know-how of FACTS and their applications.

**CO4:** Capability to harness multi-terminal DC systems.

**Unit-I**

**EHV AC Transmission:** Need of EHV transmission lines, power handling capacity and surge impedance loading. Problems of EHV transmission, bundled conductors geometric mean radius of bundle, properties of bundle conductors. Electrostatic fields of EHV lines and their effects, corona effects: Corona loss, audio and radio noise.

## Unit-II

**HVDC Transmission:** Types of D.C. links, advantages and disadvantages of HVDC transmission, Basic scheme and equipment of converter station. Analysis of HVDC Converters, twelve-pulse converter. Ground return. Basic principles of DC link control and basic converter control characteristics, system control hierarchy, various controls of HVDC like VDCOL, firing angle control, current and extinction angle control, power controller.

## Unit-III

Introduction to multi-terminal DC systems, application of MTDC Systems, types of MTDC systems, Control and protection of MTDC systems. Description of various converters and inverters circuits, HVDC circuit breakers, Harmonics and filters, Measurement of HVDC quantities, Reactive power requirements and sources of reactive power. Converter Faults and protection against over currents, over voltages.

## Unit-IV

**FACTS:** Problems of AC transmission lines. Phenomena of voltage collapse, basic theory of line compensation. Series and shunt compensation. Basic features of FACTS controllers, Basic schemes and operations of thyristor controlled series compensator phase angle regulator and dynamic brake, Introduction to static synchronous compensator (STATCOM) and unified power flow controller (UPFC).

### Text Books/References


1. J J Grainger and W D Stevenson. Power system analysis, McGraw Hill Pub.
2. Wooden Woollen Berg. Power system analysis, John wiley and sons.
3. R Bergen. Power system analysis.
4. A S Pabla. Electric power Distribution, 4th Ed. TMH Pub.
5. K. R. Padiyar. Flexible AC transmission systems-A status review summer school on "Recent Advances in power Electronics".
6. A Adris. FACTS Technology Development. An Update, IEEE Power Engineering Review, March 2000, pp 4-9.

## EE 474(PEC)
## NEURAL AND FUZZY BASED CONTROL SYSTEM

**Cr. Hrs. 4 (3+0+ 1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **1** |
| **Hours** | **3** | **0** | **2** |

**Course Outcome :**

**CO1:** Know-how of Artificial neural networks.

**CO2:** Proficiency in learning techniques of artificial neural networks.

**CO3:** Know-how of fuzzy control techniques.

**CO4:** Capability to Adaptive Fuzzy control design.

### Unit-I

**Artificial Neural Networks:** Neural Networks- an overview, Introduction to Artificial Neural Networks (ANN), Historical Development of Neural Networks, Biological Neural Networks, Comparison Between the Brain and Computer, Comparison Between Artificial and Biological Neural Network. Basic Building Blocks of ANN: Network Architecture, Setting of Weights, Activation Function, ANN Terminologies

### Unit-II

**Fundamental Models of Artificial Neural Networks:** Introduction, McCulloch-Pitts Neuron Model. Learning Rules: Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule (Widrow-Hoff Rule or Least Mean Square (LMS) Rule), Back Propagation Rule

### Unit-III

**Fuzzy Logic:** Fuzzy logic concepts and application areas, classical and fuzzy Sets, fuzzy relation and membership functions, fuzzification and defuzzification methods, fuzzy rule base system.

### Unit-IV

Neural Network and Fuzzy Logic application in load forecasting, fault detection, economic load dispatch, voltage and reactive power control, load flow and electric drive control.

Practical Lab experiments based on theory.

**Text Books/References**


1. S N Sivanandanm, S Sumathi and S N Deepa. Introduction to Neural Networks Using MATLAB- Tata McGraw- Hill Publishing Company Limited.
2. J.M. Zurada. Introduction of artificial neural systems - Jaico Publication House.
3. D. Driankov, H. Hellendoorn and M Rein frank. An introduction to fuzzy control - Narosa Publication House, 2nd reprint.


## EE 475 (PEC), UTILIZATION OF ELECTRICAL POWER

**Cr. Hrs. 2 (2+0+0)**
**L T P**
**Credit 2 0 0**
**Hours 2 0 0**

**Course Outcome :**

**CO1:** Proficiency in drive system design.

**CO2:** Know-how of Different methods of electric heating.

**CO3:** Competency in the interior & flood lighting design.

**CO4:** Capability in designing Systems of electric traction.

### Unit-I

**Electric drives:** Characteristics of load, characteristic of different drives, size and rating of electric drives, load equalization and flywheel, Selection of electric drives for specific application, Electric braking, Behavior of motor during starting, acceleration braking & reversing operation.

### Unit-II

**Different methods of electric heating:** Principle of high frequency induction and dielectric heating, Arc furnace & induction furnace.

### Unit-III

**Principles of illumination:** Electric light sources, Designing scheme for commercial, Industrial street & flood lighting.

### Unit-IV

**Systems of electric traction:** Track electrification, Means of supplying power & train lighting, substation equipment & layout, over head equipment, D.C. & A.C. traction motor, speed control, various method of starting, Metadyne control series-parallel starting methods of electric braking of traction motor speed-time curve, Tractive efforts specific energy conversion, Mechanics of train movement.

**Text Books/References**


1. H. Pratap. Utilisation of Electrical Power. Khanna Publisher.
2. Soni, Gupta, Bhatnagar. Electrical power systems, Dhanpath Rai and Company.


## CE 478a (OE) URBAN WASTE MANAGEMENT

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

**CO1:** Demonstrate knowledge of Problems & National & global scenario of solid waste management.

**CO2:** Demonstrate knowledge of solid waste seperation, collections, transfer and transport.

**CO3:** Analysis of solid waste & chemical characteristic of refuse.

**CO4:** Understand composting and incineration.

**CO5:** Understand sanitary land filling.

**CO6:** Monitor effects of solid waste on environment.

### Unit -I

**General:** Problems associated with Solid Waste Disposal. National & global scenario of solid waste management.

**Generation of Solid Waste:** Objectives of solid waste management, Classification of solid waste. Activities associated with generation of solid waste, quantity of waste generation, factors affecting solid waste generation.

**Unit -II**

**Types of Solid Waste:** Sources of solid waste. Food & biodegradable waste, recyclable waste. hazardous waste.

**Waste Collections, Transfer and Transport:** Storage of waste at source & source separation of waste. Primary collection of waste, secondary storage of waste. Waste storage depot. Transportation of waste.

**Unit-III**

**Analysis of Solid Waste:** Need for physio-chemical analysis of municipal solid waste. Physical characteristic of refuse: specific weight & category analysis.

**Chemical Characteristic of Refuse:** Determination of moisture content, volatile solid, pH, carbon, nitrogen, phosphorus, potassium & calorific value.

Composting & incineration, their advantages & disadvantages.

**Unit-IV**

**Sanitary Land Filling:** Introduction, approach to design of sanitary land filling. Typical component of land-fill cover. Various guide lines for design of land-fill. Trench of municipal solid waste disposal. Environmental quality monitoring at land-fill site. Recommendation for problems of municipal solid waste.

**Practical:** As per theory syllabus.

**Suggested Books & References**


1. G. Techobanogious, H. Theisen & R. Blassen, 'Solid Waste Engineering, Principles and Management Issues', McGraw Hills, Book Co. New York.
2. C.L. Mentell, 'Solid Waste Management, 'John Whely, New York.
3. Bhide & Sundrashen, 'Solid Waste Management in Developing Countries'.

## CE 478b (OE) GROUND IMPROVEMENT TECHNIQUES

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

**CO1:** Ground Improvement Techniques & Methods of soil stabilization.

**CO2:** Understand soil cements stabilization.

**CO3:** Stabilize dune sand by lime fly ash

**CO4:** Demonstrate knowledge of Soil Bituminous stabilization and Thermal stabilization.

**CO5:** Understand Granular column and soil reinforcement.

**CO6:** Demonstrate knowledge of Dynamic compaction.

### Unit -I

**Ground Improvement Techniques:** Shallow and deep techniques. Soil stabilization; Purpose, mechanical mixing of different types of soils, grading land plasticity charcteristics,.

**Soil Lime Stabilisation:** Base exchange, Pozzolinic reaction, curing, Types of soils, stabilised, density, effect on consistency properties. Effect of lime on liquid limit, plastic limit, plasticity index and shrinkage limit. Relationship of strength with curing period & density.

### Unit -II

**Soil Cement Stabilisation:** Soil cement stabilisation, Mechanism of soil cement stabilisation. Various theories; Modified soil cement & plastic soil cement. Effect of density, curing period and surface area on strength.

**Soil Fly-Ash Stabilisation:** Soil-lime fly ash stabilisation, principles of pozzolanic reaction. Proportions used in practice. Stabilisation of dune sand by lime fly ash.

### Unit-III

**Soil Bituminous Stabilisation:** Soil bituminous stabilization Intimate mix theory & plug theory. Effect of mixing, moisture, aerating, density & compaction.

**Thermal Stabilisation:** Theory of thermal stabilisation, Electroosmotic drainage. Double layers, 'Ke' electro osmotic coefficient of permeating, Full scale field test, Electro osmotic chemical hardening Field construction methods and equipment.

Dynamic compaction of soil Equipments used, tests performed in field, Pre compression and Vertical Drains.

**Unit -IV**

**Granular Columns:** Methods of construction, bearing capacity of composite soil. Empirical methods/charts, Theory of determination of settlement of composite soil. Vibro-flotation &vibro-compaction.

**Soil Reinforcement:** Geosynthetics, Geomembrane,

**Practicals :**As per theory syllabus.

**Suggested Books & References**


1. Purushotham, P. Raj, 'Ground improvement Techniques'.
2. Venkaramiah, C., 'Ground Improvement'.
3. Madhav, M.R., 'Development in Reinforcement of Ground and Slopes'.


## CS 478 (OE) CSE INTRODUCTION TO CYBER SECURITY

**Cr. Hrs. 3 (3 + 0+0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

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

**CO1:** Describe and analyze the term ethics related to cyber security.

**CO2:** Evaluate designs related to ethical hacking, penetration testing, privacy and security of system.

**CO3:** Analyse and compare symmetric-key encryption public-key encryption schemes based on different security models

**CO4:** Identify issues to protect digital assets in compliance with cyberwarfare.

**Prerequisite:** Prior knowledge of using open source operating system, shell programming, open source security tools and ability to design a cryptosystem is desirable.

**Unit – I**

**Introduction to Ethics:** the field of ethics, how it differs from either law or religion, why it is still necessary when we have both law and religion; The Ethical Frameworks: introduction to three stances applied to thinking about ethics: virtue ethics, utilitarianism, and deontological ethics.

**Unit – II**

**The Ethical Hacker:** Introduction to the notion of ethical hacking, the hacker code and the particular problem of penetration testing; The Problem of Privacy: What is privacy?, how is it different from security?, ethical issues related to privacy.

**Unit – III**

**Cryptography Techniques:** Plain Text and Cipher text, Substitution techniques, Transposition techniques, Encryption & decryption, Computer-based Symmetric key Cryptography Algorithms: Algorithms types and modes, overview of symmetric key cryptography, data encryption standards (DES), Advance encryption standards (AES), Shannon's theory of confusion and diffusion. Computer- based Asymmetric key Cryptographic Algorithms: RSA algorithms, MD5 Digital Signature.

**Unit – IV**

**The Problem of Surveillance:** Introduction to surveillance, types of surveillance, surveillance practices; The Problem of Piracy: the problem of piracy and intellectual property theft.

**Problem of Cyberwarfare:** What is cyberwarfare?, the players involved, ethics of cyberwarfare; The Way Forward: some thoughts about what a Code of Ethics contains and what it means to practice professionalism in one's craft, future of cyber security, introduction to some ethical issues.

**Text Books/References**

1. "Cybersecurity Ethics: An Introduction", Mary Manjikian, Taylor & Francis Group.

2. “Cybersecurity and Cyberwar: What everyone needs to know”, P. W. Singer and Allan Friedman, Oxford University Press.
3. “Cryptography and Network Security”, Atul Kahate, Tata McGraw-Hill Publishing Company Ltd.
4. “Cryptography and Network Security”, William Stallings, Pearson Asia.

## MI 478 (a) (OE) ENGINEERING GEOLOGY

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome**: At the end of course, the students will be will able to:

Identify the structure of earth; Distinguish between different rocks and their properties; Select sites for different structures in different zones and Explore subsurface using different techniques

### Unit-I

**General Geology:** Subdivision of Geology. Importance of Geology in Civil Engineering. Internal Structure of the Earth, physical properties of minerals, weathering and erosion. Geological work of wind, river and ocean. Stratigraphic aspects of rocks for civil engineers. Geological Time Scale, rock provinces.

### Unit-II

**Petrology:** Origin & classification of rocks. Texture & Structures of Igneous, Sedimentary and Metamorphic Rocks. Engineering Properties of rocks. Rocks and dimensional stones as a construction material. Suitability of rocks for different Civil Engineering purposes. Structural Geology: Causes & Classification of fold, fault, joints & unconformities. Outcrop pattern. Recognition of structure from rock outcrops.

### Unit- III

**Natural Disasters and Geological Investigations (in reference to Civil Engineering):** Earthquake, its causes, intensity scale and seismic zone of India. Site selection for dam, tunnels, multistoried buildings,

reservoirs and bridge structures Improvement Techniques: Sites improvement techniques practiced in different civil engineering projects. Introduction to drilling methods.

**Unit-IV**

**Geophysical Methods for Subsurface Exploration:** Electrical resistivity, Seismic refraction & Ground Penetrating Radar method of civil engineering importance. Remote Sensing: Introduction and applications in Civil Engineering. Image acquisition, image interpretation (visual and digital, digital terrain model, airborne lithological identification). Remote sensing software used in civil engineering interpretation.

**Practical:** As per theory part

**Text Books/References**


1. Goodman, R. E., 'Engineering Geology - Rock in Engineering Construction', John Wiley and Sons.
2. Parbin Singh, 'Text Book Engineering Geology'.
3. Blyth, F.G. and De Freitas, M.H., 'A Geology for Engineers', (7th Edition), Edward Arnold.
4. N.Chenna Kesavulu, 'Text Book of Engineering Geology'.
5. Leggot R.F., 'Geology for Engineers'.
6. Kryinine & Judd, 'Engineering Geology and Geo-techniques'.
7. John Pitts, 'Manual of Geology for Civil Engineers'.
8. Tony Waltham, 'Foundations of Engineering Geology


## MI 478 (b) (OE) EARTH MOVING MACHINERY

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome:** At the end of course, the students will be will able to:

Understand construction and working of various heavy earth moving machinery, pumping system used in mines, maintenance aspects.

## Unit-I

Construction and operation of blast hole drills, rippers, shovels, hydraulic excavators, scraper, dragline, dumpers, wheel loaders, dozers, graders, surface miners, BWE, spreader, stacker & reclaimer.

**High capacity belt conveyors:** constructional detail and selection procedures; High angle conveyor, Cable belt conveyor.

## Unit-II

**Aerial rope ways :** Classification, layout and constructional features.

Classification, application and constructional features of crushers, breakers and feeders; In pit crushers

**Compressors:** Basic theory, classification and application of compressors used in mines; Construction and operation of centrifugal and axial flow compressors; Performance characteristics of compressors; Selection of compressors for mining application.

## Unit-III

**Centrifugal Pumps:** Principle of operation; theoretical and actual head, construction of impeller, multistage centrifugal pumps, axial thrust balancing, performance characteristics, parallel and series operations of pumps, capacity, selection of mine pumps; Pumping system layout for mines.

Construction and operation of slurry, submersible, air lift and mono pumps; installation and maintenance of pumps

## Unit-IV

Recent trends and development of surface mining equipment: Automation and control in HEMM. Selection criteria of open cast mining equipment. Safety aspects related to open cast mining equipment: Fire protection system used in HEMM.

Faults and their rectification in HEMM and their maintenance.

**Practical:** As per theory syllabus

### Text Books/References


1. Surface Mining Technology– S. K. Das;Geeta Book Stores.
2. Elements of Mining Technology– D.J. Deshmukh; Vidyasewa Prakashan.
3. Mine, Pumps, Haulage & Winding– S. Ghatak; Coalfield Publishers, Asansol.
4. Conveying machines; Part I & II – A. Spivakovsky, V. Dyachkov; Mir Publishers, Moscow.

5. Recent Development of Heavy earth Moving machineries – A. De, Lovely Prakashan.
6. Moving the Earth – Nicholes.
7. On and with the Earth – J. Singh.
8. Drilling Technology Handbook– C. P. Chugh.

## MI 478 (c) (OE) TUNNELING ENGINEERING

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

Understand various methods of tunneling, use of latest numerical techniques for tunnel design, stability analysis and ground control measures with various steel support and rock reinforcement, maintenance of tunnels, provision of facilities such as ventilation, illumination etc in tunnels.

### Unit-I

Introduction to tunneling; geological concept of tunneling. Influence of geological aspects on design & construction of tunnels.

### Unit-II

**Tunnelling Methods:** Conventional and special Drill & blast roadway drivage machines, tunnel boring machines (TBM).

### Unit-III

Stresses and displacements associated with excavating tunnels, Ground control or treatment in tunneling and drivages. Design of Supports of Tunnels; Steel supports, rock enforcements, new Australian tunneling methods (NATM).

### Unit-IV

**Design of Tunnels:** Rock conditions, RMR, Q-system, RSR, rock mass behavior, stress strain behavior and stress analysis of tunnels.

Maintenance: Dewatering, ventilation and illumination drivages tunnels. Numerical techniques: Introductory use of FLAC, PLAXIS etc.

**Practical:** As per theory

**Text Books/References**


1. Richards E. Bullock – Tunnelling and Underground Construction Techniques.
2. Stack Barbara – Hand Book of Mining and Tunnelling Machinery, John Wiley & Sons.
3. R.V. Proctor – Rock Tunneling with Steel Supports.
4. J. Johnsen – Modern Trends in Tunneling and Blast Design.


## ME478(a) (OE)
## ENTREPRENEURSHIP AND INDUSTRIAL MANAGEMENT

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcomes:** Upon completion of this course the students will be familiar with:

**CO1:** Selection and development of a small or medium business idea

**CO2:** Make and Implement project proposals and reports to hunt for venture capital etc.

**CO3:** Market competition and innovation in products and processes.

**CO4:** Develop managerial skills to achieve goals, & Plan and implement projects applying management techniques.

**CO5:** Understand social responsibility as a modern management concept.

### Unit-I

**Entrepreneurship:** Definition and Meaning; Characteristics of Entrepreneurship/Traits of an Entrepreneur; Functions of Entrepreneurship - Job Creation, Innovation, Inspiration, Economic Development; Types of Entrepreneurship, Entrepreneurship and Intrapreneurship, Entrepreneurship Strategy.

**The Business Plan: Creating and Starting the Venture:** The Marketing Plan, The Financial Plan, Sources of Capital; Legal Issues for the Entrepreneur: Patents, Trademarks, Copyrights, Trade Secrets, Licensing, Product Safety and Liability, Insurance; Contracts, Advertising, Supply Chain Management, Retail & FDI

**Proposals & risks:** Project Report Preparation (Feasibility, Cost Estimation, CVP Analysis, Detailed Project Report, Concept of Risk and decision making, Risk Management-SWOT etc

**Unit-II**

**Entrepreneurship and Innovation:** The Innovation Concept, Importance of Innovation for Entrepreneurship, Source of Innovation for Opportunities, The Innovation Process, Product life cycle, new product development process, mortality curve, Creativity and innovation in product modification/ development

**Entrepreneurship and Economic Development:** Role of Entrepreneurship in Modern Economy, Managers Vs Entrepreneurship**:** Characteristic of Managers, Characteristic of Entrepreneurs, Similarities and differences between Managers and Entrepreneurs

**Unit-III**

**Industry, Commerce and Business:** Types of ownership in the organization- Definition, characteristics, Merits & Demerits; Single ownership, Partnership, Cooperative Organizations, Joint Stock Companies, Government owned, Differences between Management and Administration, Leadership Models.

**Industry Size & Current schemes:** Micro, Small, Medium- Industry; Registration Process, Current Promotional Schemes for new Enterprise

**Unit-IV**

**Function of Management:** Planning- Types of Planning - Strategic Plan, Tactical Plan and Operation Plan; Organizing- Definition and Meaning, Types of Organizing; Staffing- Definition and Meaning, Types of Staffing – Internal & External, The Basic Steps in the Staffing Process; Directing (Leading)- Definition and Meaning; Controlling**-** Definition and Meaning, Relationship between Planning and Controlling.

**Social Responsibility:** Social Obligation, Social Responsiveness and Social Responsibility, Managerial Ethics

**Practical:** As per theory

**Text Books/References**


1. Entrepreneurship Development and Management, A. K. Singh, Jain Book Agency (JBA) publishes, New Delhi
2. Small Scale Industries and Entrepreneurship, Vasant Desai, Himalaya 2008
3. Industrial Engineering and Management, O.P.Khanna, Dhanpat Rai and Sons, Delhi
4. Industrial Management and Entrepreneurship, V. K. Sharma, Scientific Publishers, New Delhi.
5. Entrepreneurship, Roy Rajeev, Oxford Latest Edition.


## ME478(b) (OE) BIO-ENERGY SYSTEMS DESIGN

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcomes:** Upon completion of this course the students will be familiar with:

**CO1:** Classifybioenergy fuels and their conversion technologies.

**CO2:** Describe the knowledge for operation of biomass gasifier, biomass pyrolysis and biogas plant.

**CO3:** Design system for biomass gasification, pyrolysis and biogas production.

**CO4:** Demonstrateproduction of biodiesel and bioethanol, and their application power generation and transportation.

**CO5:** Demonstrate socio-economic aspects and cost-economics analysis of biomass conversion technologies.

### Unit–I

**Introduction:** Introduction to bio-energy from, classification of biomass as fuel – Agro based, Forest, residue. Bio-energy systems/Conversion devices – Incinerators, gasifiers, digestors.Design objectives for sustainable bio-energy systems.Bio-mass bricketing machine.

**Biomass conversion processes:** Thermo chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction, biochemical conversion, anaerobic digestion.

**Unit–II**

**Bio-mass Combustion:** Basics of combustion, Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**Unit–III**

**Bio-mass Gasification:** Working principle, Gasifiers – Fixed bed system – Downdraft and updraft gasifiers,Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

**Bio-mass Pyrolysis:** Pyrolysis – types, slow, fast; Manufacture of charcoal: methods -yields and application; Manufacture of pyrolytic oils and gases, yields and applications.

**Unit–IV**

**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status, Design and constructional features; Biomass resources and their classification for biogas.

**Review of mechanical Design:** Materials of Construction, corrosion damage, testing and inspection.

**System modelling:** Basics and its mathematical model, Use of Software in system design. Economicsanalysis of bio-energy systems.

**Practical:** As per theory

**Text books/ References**


1. Prabir Basu, Biomass Gasification, Pyrolysis and Torrefaction: Practical Design and Theory, Academic Press, Elsevier, 2018.
2. John Rezaiyan, Nicholas P. Cheremisinoff, Gasification Technologies, Taylor & Francis, 2005.
3. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.

4. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

5. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

6. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

## ME478(c) (OE) ENERGY CONSERVATION AND MANAGEMENT

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcomes:** Upon completion of this course the students will be familiar with:

**CO1:** To understand the basic knowledge ofdifferent terms & principles of energyconservation,audit and management

**CO2:** To understand efficient heat utilization, saving andrecovery in different thermal system

**CO3:** To prepare energy audit report fordifferent energy conservation instances

**CO4:** To Evaluate the energy saving &conservation in different mechanical utilities

### Unit-I

**Energy Scenario:** Commercial and Non-Commercial Energy, Primary Energy Resources, Commercial Energy Production, Final Energy Consumption, Energy Needs of Growing Economy, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy and **Environment:** Air Pollution, Climate Change, Energy Security, Energy Conservation and its Importance, Energy Strategy for the Future, Energy Conservation Act-2001 and its Features.

## Unit-II

**Energy Management & Audit:** Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.

**Financial Management:** Investment-need, Appraisal and criteria, Financial analysis techniques- Simple pay back period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.

## Unit-III

**Energy Monitoring and Targeting:** Defining monitoring & targeting, Elements of monitoring & targeting, Data and information-analysis, Techniques -energy consumption, Production, Cumulative sum of differences (CUSUM).

**Global Environmental Concerns:** United Nations Framework Convention on Climate Change (UNFCC), Kyoto Protocol, Conference of Parties (COP), Clean Development Mechanism (CDM), Prototype Carbon Fund (PCF), Sustainable Development.

## Unit-IV

**Energy Efficiency in Thermal Utilities and systems:** Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas, Boilers: Types, combustion in boilers, performances evaluation, analysis of losses, Condensate and flash steam recovery system, identifying opportunities for energy savings, Cupola, non-ferrous melting, Induction furnace, performance evaluation of a furnace, hot air generators, Feed water treatment, blow down, energy conservation opportunities, Furnaces: Classification, general fuel economy measures in furnaces, excess air, heat distribution, Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation, Steam System: Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, Steam utilization, Performance assessment more details, installation, Temperature control, draft control, waste heat recovery. Forging furnace heat balance, Thermic fluid heaters, super critical boilers, Thermo-compressor, steam pipe insulation, condensate pumping, steam dryers.

**Cogeneration:** Definition, need, application, advantages, classification, saving potentials. Heat balance, steam turbine efficiency, tri-generation, micro turbine. Heat Exchangers: Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc. Waste Heat Recovery: Classification, advantages and applications, commercially viable waste heat recovery devices, saving potential. Insulation and Refractories: Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss. Cold insulation. Heating, ventilation, air conditioning (HVAC) and Refrigeration System: Factors affecting Refrigeration and Air conditioning system performance and savings Opportunities. Vapor absorption refrigeration system: Working principle, types and comparison with vapor compression system and saving potential, heat pumps and their applications, section on ventilation system, ice bank system, and performance assessment of window and split room air conditioners, Star labeled pumps, cold storage refrigeration, and humidification system.

**Practical:** As per theory

**Text Books/References**


1. Energy Conservation Guidebook, Dale R Patrick, Stephen W Fardo, 2nd Edition, CRC Press.
2. Handbook of Energy Audits, Albert Thumann, 6th Edition, The Fairmont Press.
3. Bureau of Energy Efficiency Reference book: No.1, 2, 3 4.
4. Energy Management Handbook, W.C. Turner, John Wiley and Sons, A Wiley Interscience publication.
5. Carbon Capture and Sequestration: Integrating Technology, Monitoring, and Regulation dited byE J Wilson and D Gerard, Blackwell Publishing.
6. Heating and Cooling of Buildings - Design for Efficiency, J. Krieder and A. Rabl, McGraw Hill Publication, 1994.

## EC 478(a) (OE) INTELLECTUAL PROPERTY RIGHTS

**Cr. Hrs. 3(3+0+ 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcomes:** The student will be able to

**CO1:** Understand the concept of Intellectual Property Rights and Patents.

**CO2:** Understand the concept of Trademark and its related Statutory authorities.

**CO3:** Apprehend the idea of Copyright and registerability of a design.

**CO4:** Understand International IPR, Case laws and World intellectual property organization.

### Unit-I

**Introduction:** Concept of IPR, Historical development , kinds of IPR, brief description of patent, trademark, copyright ,industrial design, importance of IPR, IPR authorities.

**Patents:** Introduction, Indian Patent Act 1970 &2002, Protectable subject matter--patentable invention, Procedure for obtaining patent, Provisional and complete specification Rights conferred on a patentee, transfer of patent, Revocation and surrender of patents, Infringement of patents, Action for infringement, Patent agents, Patent in computer programs.

### Unit-II

**Trademark:** Introduction, Statutory authorities, principles of registration of trademarks, rights conferred by registration of trademarks, Infringement of trademarks and action against infringement, procedure of registration and duration, licensing in trademark.

### Unit-III

**Copyright:** Introduction, Author and ownership of copyright, rights conferred by copyright ,term of copyright, assignment/licence of copyright, Infringement of copyright ,remedies against infringement of copyright, registration of copyright, copyright enforcement and societies

**Industrial design:** The design act-2000, registerability of a design, procedure of registration of a design, piracy of a registered design, Case law on designs.

### Unit-IV

**International IPR & case laws:** World intellectual property organization, WCT, WPPT, TRIPS, Copyright societies, international IPR dispute resolution mechanism. Case laws.

**Text Books/References**


1 Law Relating to Intellectual property, fourth edition by B.L.Wadehra . Universal law publishing co. pvt. Ltd, 2007.

2 Intellectual property: Patents, copyright, trademarks and allied rights. Fifth edition by W.R. Cornish. Sweet & Maxwell publisher, 2003.

3 Law and practice of intellectual property in India by Vikas Vashishth, 2006.

4 Patents, copyrights, trademarks and design by B L Wadhera, 2014.

5 Dr. B. L. Wadhera, "Intellectual Property Law Handbook". Universal Law Publishing 2002.


## EC 478 (b) (OE) E-COMMERCE

**Cr. Hrs. 3(3+0+ 0)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **3** | **0** | **0** |
| **Hours** | **3** | **0** | **0** |

**Course Outcomes:** The student will be able to

**CO1:** Understand the concept of Electronic Commerce and its need.

**CO2:** Understand the idea of Network Infrastructure for E- Commerce.

**CO3:** Apprehend the notion of security issues on web and importance of Firewall.

**CO4:** Understand Electronic Payments, SET protocol and E- Commerce Law.

### Unit-I

**Introduction:** Definition of Electronic Commerce, E-Commerce: technology and prospects, incentives for engaging in electronic

commerce, needs of E-Commerce, advantages and disadvantages, framework, Impact of E-commerce on business, E-Commerce Models

**Unit-II**

**Network Infrastructure for E- Commerce:** Internet and Intranet based E-commerce- Issues, problems and prospects, Network Infrastructure, Network Access Equipments, Broadband telecommunication (ATM, ISDN, and FRAME RELAY). Mobile Commerce: Introduction, Wireless Application Protocol, WAP technology, Mobile Information device.

**Unit-III**

**Web Security:** Security Issues on web, Importance of Firewall, components of Firewall, Transaction security, Emerging client server, Security Threats, Network Security, Factors to consider in Firewall design, Limitation of Firewalls.

**Unit-IV**

**Electronic Payments:** Overview, The SET protocol, Payment Gateway, certificate, digital Tokens, Smart card, credit card, magnetic strip card, E-Checks, Credit/Debit card based EPS, online Banking. EDI Application in business, E- Commerce Law, Forms of Agreement, Govt. policies and Agenda.

**Text Books/References**


1 Goel, Ritendra "E-commerce", New Age International,2007.

2 Ravi Kalakota, Andrew Winston, "Frontiers of Electronic Commerce", Addison- Wesley. 1996.

3 Vinod Kumar Garg and Venkita krishnan N K, "Enterprise Resource Planning – Concepts and Practice", PHI 2004.


## REE 478(OE); RENEWABLE ENERGY TECHNOLOGIES

**Cr. Hrs. 3 (2+0+1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome:**

This course is undertaken to introduce basic aspects of renewable energy supply presenting fundamental characteristics of the resource base (solar, wind energy, bio energy, etc.) and principles of related technical systems (photovoltaic, wind, biomass power generation, etc.).

In a further step an economic analysis of supply technologies will be undertaken. Students will learn to acquire a basic understanding of issues related to renewable energy supply systems.

### Unit I

**Conventional and Alternative Energy Sources:** Effect on environment of fossilfuels, nuclear energy and hydroelectric power. Energy consumption pattern & energy resources in India. Renewable energy options, potential and utilization.

### Unit II

**Solar Energy:** Solar thermal and Photovoltaic System for power generation. Flat platecollectors & Focusingcollectors. Solar water and air heaters, solar distillation, solar cooker, drying of materials, application in industries.

### Unit III

**Wind Energy:** Nature and potential, wind mill types, their merits and demerit. Wind farms. Brief description of geothermal energy, ocean thermal energy, tidal and wave energy.

### Unit IV

**Biomass:** Nature and potential, different bio conversion techniques, biogas, biodiesel. Power generation from biomass (gasification &dendro thermal) and fuel cell technology.

### Practical

1. To study solar drying system.
2. To study solar water heating system.
3. To study box type solar cooker.
4. To study solar distillation system.
5. To study different biogas plants.
6. To study wind energy conversion systems.
7. To study downdraft biomass gasifier for thermal application.

### Suggested Readings

1. G.D. Rai. Non Conventional Energy Sources, 2013, Khanna Publishers.

2. Twidell, J., & Weir, T. (2015). *Renewable energy resources*. Routledge.
3. Basu, Prabir. *Biomass gasification and pyrolysis: practical design and theory*. Academic press, 2010.
4. Rathore N. S., Kurchania A. K., Panwar N. L.;Non Conventional Energy Sources, Himanshu Publications, 2000.

## SWE478(OE) AERIAL PHOTOGRAPHY, RS and GIS

**Cr. Hrs. 3 (2 +0+ 1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

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

Familiarize with aerial photographs and its interpretation. Developing skill of use of various hardware and software in use of satellite data, GPS technology. Development of resource mapping and planning studies using RS and GIS.

### Unit I

**Aerial photography:** Aerial photograph, their classification, map v/s aerial photograph, photogrammetry and its application. Elements of aerial photo interpretation, aerial photo interpretation and its use.

### Unit II

**Remote sensing:** Definition, electromagnetic radiations,Interactions with the Atmosphere,Passive v/s Active Sensing, Characteristics of Images, Satellite and Sensors-Satellite Characteristics, Resolution, Multi-spectral Scanning, Thermal Imaging, Satellite missions, microwave sensing, Image Analysis- Visual interpretation, Digital image processing, image, Enhancement and Classification.

### Unit III

**GIS:** Definition, basic components, data types- spatial, non- spatial, GIS data modeling, vector and raster representation, GIS data base management, GIS data file management.

### Unit IV

**GIS data input and editing:** Data input methods, scanning, digitization, GPS data, data editing, errors and data reduction, Data analysis- format conversion, spatial measurement, overlay analysis and data output.

**Practical**

1. Study of aerial photographs under mirror stereoscope.
2. Preparation of stereo model of aerial photograph.
3. Land use/cover studies through aerial photograph.
4. Use of optical scanners and digitizers. U
5. Use of GPS in mapping and GIS data input, satellite data product.
6. Familiarization with image processing and GIS software's and their applications.

**Suggested Readings**


1. K.K. Rampal. (1999) Hand Book of Aerial Photography and Interpretation, Concept Publishing Company, New Delhi.
2. M. A. Reddy (2002) Remote Sensing and Geographical Information Systems, B.S. Publications, Hyderabad.
3. Lillisand and Kiefer (1987) Remote sensing and Image Interpretation, John Weiley and sons.


## FMP 478(OE) : MACHINERY FOR LAND DEVELOPMENT

**Cr. Hrs. 3 (2 +0 + 1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome:** At the end of the course, the student will have the knowledge of different earth moving machineries used for land development operation.

### Unit-I

**Land leveling:** Criteria for land leveling, plane profile and inspection, engineering fundamentals related to earth-moving machinery.

## Unit-II

Earth moving and excavation machines classification and application of bulldozers, advantage and disadvantage, straight and angle bulldozers, moving earth with bulldozers and estimation of output of a bulldozer numerical problems.

**Land clearing equipments, Power shovel:** Construction and operation of power shovel size selection of power shovel factors affecting the output of a power shovel.

## Unit-III

**Scraper:** Types, construction and operation of scrapers, size of the scraper, cycle time production rates of scrapers, numerical problems, load-growth curve and estimation of output of a scraper.

**Dragline:** Types of dragline, size basic parts and operation of a dragline, output of a dragline, estimation of output, effect of different factors on output, numerical problems.

**Clam shell:** Basic parts and operation of a clam shell, application, size and output of a clam shell.

**Motor grader:** Construction and operation of motor grader, application, basic adjustment parameters of major grader, output of motor grader,

## Unit-IV

**Trenching machines:** types, construction and operation of wheel and ladder type trenching machines, selection of suitable equipment for excavating trenches and production rates of trenching machines.

### Practical

1. Study of various components of bulldozers
2. Study of various components of Scraper:
3. Study of various components of Dragline
4. Study of various components of Clam shell
5. Study of various components of Scraper: Motor grader
6. Study of various components of Scraper: Trenching machines

### Suggested Readings

1. R.L. Peurifoy. Construction, Planning, Equipment and Methods.

2. Mahesh Verma. Construction equipment and its planning and application.
3. Jagman Singh. Heavy construction, planning, equipment and methods.
4. A.M. Michael. Irrigation theory and practices.

## PFE 478(OE) : PACKAGING MATERIALS AND METHODS

**Cr. Hrs. 3 (2 +0+ 1)**

| | L | T | P |
|---|---|---|---|
| **Credit** | **2** | **0** | **1** |
| **Hours** | **2** | **0** | **2** |

**Course Outcome:**

At the end of the course, the student will be able to acquaint with various packaging materials, various aspects of packaging methods and technology.

### Unit-I

Factors affecting package material, Packaging, requirement, importance and scope, frame work of packaging strategy, environmental considerations, Packaging systems, types: flexible and rigid; retail and bulk; levels of packaging.

### Unit-II

Different types of packaging materials, their key properties and applications, metal cans, plastic packaging, different types of polymers used in packaging and their barrier properties. Manufacture of plastic packaging materials; glass containers, types of glass used in food packaging, manufacture of glass and glass containers, closures for glass containers. Paper and paper board packaging, modification of barrier properties and characteristics of paper/ boards.

### Unit-III

Labeling on packages, shrink and cling packaging, vacuum and gas packaging; active packaging, factors affecting the choice of packaging materials, disposal and recycle of packaging waste, printing and labeling; lamination.

## Unit-IV

Package testing, testing methods for flexible materials, rigid materials and semi rigid materials; Tests for paper, glass containers, metal containers.

### Practical

1. Identification of different types of packaging materials.
2. Determination of tensile / compressive strength of given material/package.
3. Vacuum packaging of agricultural produces.
4. Determination of tearing strength of paper board.
5. Measurement of thickness of packaging materials.
6. To perform grease-resistance test in plastic pouches.
7. Determination of bursting strength of packaging material.
8. Determination of water-vapour transmission rate.
9. Shrink wrapping of various horticultural produce.
10. Testing of chemical resistance of packaging materials.
11. Determination of drop test of food package and visit to relevant industries.

### Suggested Readings


1. Coles R., McDowell D. and Kirwan, M.J. 2003. Food Packaging Technology, Blackwell Publishing Co.
2. Gosby, N.T. 2001. Food Packaging Materials, Applied Science Publication.
3. John, P.J. 2008. A Handbook on Food Packaging, Narendra Publishing House,
4. Mahadevia, M., Gowramma, R.V. 2007. Food Packaging Materials, Tata McGraw Hill.
5. Robertson, G. L. 2001. Food Packaging and Shelf life: A Practical Guide,Narendra Publishing House.
6. Robertson, G. L. 2005. Food Packaging: Principles and Practice, Second Edition, Taylor and Francis Pub.

# Notes