# VISVESVARAYA TECHNOLOGICAL UNIVERSITY
## BELAGAVI


Scheme of Teaching and Examination and Syllabus

# B.E. MEDICAL ELECTRONICS

## III-VIII SEMESTER

(Effective from Academic year 2018-19)

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**III SEMESTER**

| Sl. No | Course and Course Code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | BSC | 18MAT31 | Transform Calculus, Fourier Series and Numerical Techniques | Mathematics | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 2 | PCC | 18ML32 | Electronic Instrumentation and Measurements | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 3 | PCC | 18ML33 | Analog Electronic Circuits | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 4 | PCC | 18ML34 | Digital Design and HDL | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 5 | PCC | 18ML35 | Human Anatomy and Physiology | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 6 | PCC | 18ML36 | Network Analysis | ML | 3 | 2 | -- | 03 | 40 | 60 | 100 | 4 |
| 7 | PCC | 18MLL37 | Analog Electronic Circuits Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 8 | PCC | 18MLL38 | Digital Design and HDL Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 9 | HSMC | 18KVK39/49 | Vyavaharika Kannada (Kannada for communication) | HSMC | -- | 2 | -- | -- | 100 | -- | 100 | 1 |
| | | 18KAK39/49 | Aadalitha Kannada (Kannada for Administration) | | | | | | | | | |
| | | **OR** | | | | | | | | | | |
| | | 18CPC39/49 | Constitution of India, Professional Ethics and Cyber Law | | 1 | -- | -- | 02 | 40 | 60 | | |
| | | | | | Examination is by objective type questions | | | | | | | |
| | | | | **TOTAL** | **13 OR 14** | **16 OR 18** | **04** | **24 OR 26** | **420 OR 360** | **480 OR 540** | **900** | **24** |

**Note:** BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

**Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | NCMC | 18MATDIP31 | Additional Mathematics - I | Mathematics | 02 | 01 | -- | 03 | 40 | 60 | 100 | 0 |

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for SEE.
(b)These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

**Courses prescribed to lateral entry B. Sc degree holders admitted to III semester of Engineering programs**

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

**AICTE Activity Points to be earned by students admitted to BE/B.Tech/B.Plan day college programme (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines):**

Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.

The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**IV SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | BSC | 18MAT41 | Complex Analysis, Probability and Statistical Methods | Mathematics | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 2 | PCC | 18ML42 | Signal Conditioning and Data Acquisition Circuits | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 3 | PCC | 18ML43 | Embedded Controllers | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 4 | PCC | 18ML44 | Signal and Systems | ML | 3 | 2 | -- | 03 | 40 | 60 | 100 | 4 |
| 5 | PCC | 18ML45 | Biomedical Transducers and Instrumentation | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 6 | PCC | 18ML46 | Scientific and Analytical Instrumentation | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 7 | PCC | 18MLL47 | Embedded Controllers Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 8 | PCC | 18MLL48 | Physiological Measurements & Biomedical Instrumentation Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 9 | HSMC | 18KVK39/49 | Vyavaharika Kannada (Kannada for communication)/ | HSMC | -- | 2 | -- | -- | 100 | -- | 100 | 1 |
| | | 18KAK39/49 | Aadalitha Kannada (Kannada for Administration) | | | | | | | | | |
| | | **OR** | | | | | | | | | | |
| | | 18CPC39/49 | Constitution of India, Professional Ethics and Cyber Law | | 1 | -- | -- | 02 | 40 | 60 | | |
| | | | | | Examination is by objective type questions | | | | | | | |
| | | | | **TOTAL** | **13** | **16** | | **24** | **420** | **480** | | |
| | | | | | **OR** | **OR** | **04** | **OR** | **OR** | **OR** | **900** | **24** |
| | | | | | **14** | **18** | | **26** | **360** | **540** | | |

**Note:** BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39/49Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39/49 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

**Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | NCMC | 18MATDIP41 | Additional Mathematics - II | Mathematics | 02 | 01 | -- | 03 | 40 | 60 | 100 | 0 |

((a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for SEE.

(b)These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

**Courses prescribed to lateral entry B.Sc. degree holders admitted to III semester of Engineering programs**

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

**AICTE activity Points:** In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**V SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | PCC | 18ES51 | Technological Innovation Management & Entrepreneurship | HSMC / ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 2 | PCC | 18ML52 | Control Systems | ML | 3 | 2 | -- | 03 | 40 | 60 | 100 | 4 |
| 3 | PCC | 18ML53 | Digital Signal Processing | ML | 3 | 2 | -- | 03 | 40 | 60 | 100 | 4 |
| 4 | PCC | 18ML54 | Diagnostic and Therapeutic Equipment's | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 5 | PCC | 18ML55 | Rehabilitation Engineering | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 6 | PCC | 18ML56 | VLSI Design | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 7 | PCC | 18MLL57 | Signal Conditioning Circuits and Data Acquisition Lab. | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 8 | PCC | 18MLL58 | Diagnostic and Therapeutic Equipment's Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 9 | HSMC | 18CIV59 | Environmental Studies | Civil/ Environmental [Paper setting: Civil Engg. Board] | 1 | -- | -- | 02 | 40 | 60 | 100 | 1 |
| | | | | **TOTAL** | **15** | **16** | **4** | **26** | **360** | **540** | **900** | **25** |

**Note:** PCC: Professional Core, HSMC: Humanity and Social Science.

**AICTE activity Points:** In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**VI SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | PCC | 18ML61 | Analog and Digital Communication Systems | ML | 4 | -- | -- | 03 | 40 | 60 | 100 | 4 |
| 2 | PCC | 18ML62 | Medical Image Processing | ML | 4 | -- | -- | 03 | 40 | 60 | 100 | 4 |
| 3 | PCC | 18ML63 | Java Programming | ML | 4 | -- | -- | 03 | 40 | 60 | 100 | 4 |
| 4 | PEC | 18ML64X | Professional Elective -1 | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 5 | OEC | 18ML65X | Open Elective -A | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 6 | PCC | 18MLL66 | Medical Image Processing Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 7 | PCC | 18MLL67 | Java Programming Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 8 | MP | 18MLMP68 | Mini-project | ML | -- | -- | 2 | 03 | 40 | 60 | 100 | 2 |
| 9 | Internship | -- | Internship | To be carried out during the vacation/s of VI and VII semesters and /or VII and VIII semesters. | | | | | | | | |
| | | | | **TOTAL** | **16** | **08** | **06** | **24** | **320** | **480** | **800** | **24** |

**Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective, MP: Mini-project.**

**Professional Elective -1**

| Course code under18ML64X | Course Title |
|---|---|
| 18ML641 | Medical Physics |
| 18ML642 | Hospital Design, Planning and Management |
| 18ML643 | Medical Electronics Design |
| 18ML644 | Virtual Bio-Instrumentation |

**Open Elective -A**

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 18XX65X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

**Mini-project work:**
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.
**CIE procedure for Mini-project:**
**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.
**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.
The CIE marks awarded for the Mini-project shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.
**SEE for Mini-project:**
**(i) Single discipline:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.
**(ii) Interdisciplinary:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.
**Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

**AICTE activity Points:** In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education(OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**VII SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | PCC | 18ML71 | Biomedical Digital Signal Processing | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 2 | PCC | 18ML72 | ARM Processor | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 3 | PEC | 18ML73X | Professional Elective - 2 | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 4 | PEC | 18ML74X | Professional Elective - 3 | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 5 | OEC | 18ML75X | Open Elective -B | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 6 | PCC | 18MLL76 | Biomedical DSP Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 7 | PCC | 18MLL77 | ARM Processor Lab | ML | -- | 2 | 2 | 03 | 40 | 60 | 100 | 2 |
| 8 | Project | 18MLP78 | Project Work Phase - 1 | ML | -- | -- | 2 | -- | 100 | -- | 100 | 1 |
| 9 | Internship | -- | Internship | (If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters ) | | | | | | | | |
| | | | | **TOTAL** | **10** | **14** | **06** | **21** | **380** | **420** | **800** | **20** |

**Note:** PCC: Professional core, PEC: Professional Elective., OEC: Open Elective

**Professional Elective - 2**

| Course code under 18ML73X | Course Title |
|---|---|
| 18ML731 | Database Management System in Healthcare |
| 18ML732 | Ergonomics |
| 18ML733 | Biomechanics and Biodynamics |
| 18ML734 | Biometric Systems |

**Professional Electives - 3**

| Course code under 18ML74X | Course Title |
|---|---|
| 18ML741 | Biostatistics |
| 18ML742 | Lasers and Optical Fibers in Medicine |
| 18ML743 | Medical Informatics and Expert Systems |
| 18ML744 | Internet of Things |

**Open Elective -B**

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 18XX75X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

**Project work:**
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinaryproject can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

**CIE procedure for Project Work Phase - 1:**
**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report(covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

**Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-

| |
|---|
| up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. |
| **AICTE activity Points:** In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card. |
| |

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI**
**Scheme of Teaching and Examination 2018 – 19**
**Outcome Based Education(OBE) and Choice Based Credit System (CBCS)**
**(Effective from the academic year 2018 – 19)**

**Programme: MEDICAL ELECTRONICS**

**VIII SEMESTER**

| Sl. No | Course and Course code | | Course Title | Teaching Department | Teaching Hours /Week | | | Examination | | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Theory Lecture | Tutorial | Practical/ Drawing | Duration in hours | CIE Marks | SEE Marks | Total Marks | |
| | | | | | L | T | P | | | | | |
| 1 | PCC | 18ML81 | Medical Imaging Systems | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 2 | PEC | 18ML82X | Professional Elective - 4 | ML | 2 | 2 | -- | 03 | 40 | 60 | 100 | 3 |
| 3 | Project | 18MLP83 | Project Work Phase - 2 | ML | -- | -- | 2 | 03 | 40 | 60 | 100 | 8 |
| 4 | Seminar | 18MLS84 | Technical Seminar | ML | -- | -- | 2 | 03 | 100 | -- | 100 | 1 |
| 5 | Internship | 18MLI85 | Internship | Completed during the vacation/s of VI and VII semesters and /or VII and VIII semesters.) | | | | 03 | 40 | 60 | 100 | 3 |
| | | | | **TOTAL** | **04** | **04** | **4** | **15** | **260** | **240** | **500** | **18** |

**Note:** PCC: Professional Core, PEC: Professional Elective.

**Professional Electives - 4**

| Course code under 18ML82X | Course Title |
|---|---|
| 18ML821 | Bio-MEMS |
| 18ML822 | Computer Communication Networks in Healthcare |
| 18ML823 | Biomaterials and Artificial Organs |
| 18ML824 | Artificial Intelligence and Machine Learning |

**Project Work**

**CIE procedure for Project Work Phase - 2:**

**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

**SEE for Project Work Phase - 2:**

**(i) Single discipline:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

**(ii) Interdisciplinary:** Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

**Internship:** Those, who have not pursued /completed the internship, shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

**AICTE activity Points:** In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

| Semester - VI | | | |
|---|---|---|---|
| **OPEN ELECTIVE - A** | | | |
| Course Code | **18ML65X** | CIE Marks | 40 |
| TeachingHours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

Students can select any one of the open electivesoffered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

| **Sl.No.** | **Board and the Department offering the Electives** | | **Course** | | **Course Title** |
|---|---|---|---|---|---|
| | | | **Sl. No.** | **code under 18BM65X** | |
| 01 | **EI/ BM/ ML** | Medical Electronics | 1 | 18ML651 | Biomedical Transducers and Medical Instrumentation |
| | | | 2 | 18ML652 | Fundamentals of Medical Imaging Techniques |
| | | | 3 | 18ML653 | Rehabilitation Engineering and Assistive Technology |

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**OPEN ELECTIVE - B**

| | | | |
|---|---|---|---|
| Course Code | **18ML75X** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

| **Sl. NO.** | **Board and the Department offering the Electives** | | **Course** | | **Course Title** |
|---|---|---|---|---|---|
| | | | **Sl. No.** | **code under 18BM75X** | |
| | **EI/ BM/ ML** | Medical Electronics | 1 | 18ML751 | Biomedical Signal Processing |
| | | | 2 | 18ML752 | Biomedical Image Processing |
| | | | 3 | 18ML753 | Medical Informatics |

## III SEMESTER

**B. E. Common to all Programmes**
**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**
**SEMESTER - III**

**TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES**

| | | | |
|---|---|---|---|
| Course Code | **18MAT31** | CIE Marks | 40 |
| Teaching Hours/Week (L: T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives:**

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

**Module-1**

**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions (statement only) and unit-step function – problems.
**Inverse Laplace Transform**: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Solution of linear differential equations using Laplace transforms.

**Module-2**

**Fourier Series**: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period $2\pi$ and arbitrary period. Half range Fourier series. Practical harmonic analysis.

**Module-3**

**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.
**Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.

**Module-4**

**Numerical Solutions of Ordinary Differential Equations(ODE's)**:
Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.

**Module-5**

**Numerical Solution of Second Order ODE's:** Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).
**Calculus of Variations:** Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

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

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module.

| Sl No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Advanced Engineering Mathematics | E. Kreyszig | John Wiley & Sons | 10th Edition, 2016 |
| 2 | Higher Engineering Mathematics | B. S. Grewal | Khanna Publishers | 44th Edition, 2017 |
| 3 | Engineering Mathematics | Srimanta Pal et al | Oxford University Press | 3rd Edition, 2016 |
| **Reference Books** | | | | |
| 1 | Advanced Engineering Mathematics | C. Ray Wylie, Louis C. Barrett | McGraw-Hill Book Co | 6th Edition, 1995 |
| 2 | Introductory Methods of Numerical Analysis | S.S.Sastry | Prentice Hall of India | 4th Edition 2010 |
| 3 | Higher Engineering Mathematics | B.V. Ramana | McGraw-Hill | 11th Edition,2010 |
| 4 | A Textbook of Engineering Mathematics | N. P. Bali and Manish Goyal | Laxmi Publications | 6th Edition, 2014 |
| 5 | Advanced Engineering Mathematics | Chandrika Prasad and Reena Garg | Khanna Publishing, | 2018 |

**Web links and Video Lectures:**

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - III**

**Electronic Instrumentation and Measurements**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18EI/BM/ML32** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits - 3**

**Course Objectives:** This course will enable the students to

- Impart with the knowledge of generalized measurement systems.
- Learn the characteristics of various types of measurement systems and errors in measuring instruments.
- Analyze the circuits for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- Impart with the basic concepts of CRO and its usage for the measurement of various parameters.
- Understand the concepts of Ammeters, Voltmeter and Multimeters
- Understand the importance of Display Devices and Recorders in practical fields

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Measurements:** Introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.(Verify)<br>**Measurement Errors:** Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems) | 8 Hours | L1,L2 |
| | | |
| **Module -2**<br>**Ammeters, Voltmeter and Multimeters:**<br>Introduction, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, Extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems)<br>**Digital Voltmeters:**<br>Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems).<br>**Digital Instruments**: Introduction, Block diagram of a Basic Digital Multi-meter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement. | 8 Hours | L1,L2,L3, L5 |
| | | |
| **Module -3**<br>**Oscilloscopes:** Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch.<br>**Analog storage oscilloscopes**: Need for trace storage, bistable storage CRT, | 8 Hours | L1,L2,L3, L4 |

| | | |
|---|---|---|
| Variable persistence storage CRT.<br>**Digital storage oscilloscopes**: Basic DSO operation only. | | |
| | | |
| **Module -4**<br>**Signal Generators :**<br>Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator.<br>**Bridge Circuits for Measurement of R, L & C:**<br>**DC bridges**: Introduction, Wheatstone bridge, Kelvin Bridge<br>**AC bridges**: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell's bridge, Schering Bridge. (relevant problems) | 8 Hours | L1,L2,L3,L5,L6 |
| | | |
| **Module -5**<br>**Display Devices and Recorders:**<br>Introduction, electrical indicating instruments, digital instruments, digital display methods, digital display unit. Segmental Displays: Seven segmental display, dot matrices, LED, LCD, decade counting assemblies, display systems. Recorders: Recording requirements, analog recorders- Graphic recorders, strip chart recorders & its types, X-Y recorder, Magnetic & Digital tape recorders. | 8 Hours | L1,L2,L3,L5 |
| | | |

**Course Outcomes:** After studying this course, students will able to:

- Analyze instrument characteristics, errors and generalized measurement system.
- Analyze and use the circuit for the measurement of R, L, C, F, I, V etc
- Use of Ammeters, Voltmeter and Multimeters and CRO for measurement
- Analyze and interpret different signal generator circuits for the generation of various waveforms
- Understand and use different display devices and recorders

**Graduate Attributes (as per NBA)**

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Modern tool usage

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. "Electronic Instrumentation", H. S. Kalsi, TMH, 2004 (Module- 2,3 & 4)
2. "Electronic Instrumentation and Measurements", David A Bell, PHI / Pearson Education2006/ Oxford Higher Education, 2013. (Module 1 & 3)
3. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.(Module- 1 & 5)


**Reference Books:**


1. "Principles of Measurement Systems", John P. Beately, 3rd Edition, Pearson Education, 2000
2. "Modern Electronic Instrumentation and Measuring Techniques", Cooper D & A D Helfrick, PHI, 1998.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - III**

**Analog Electronic Circuits**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18EI/BM/ML33** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits - 3**

**Course Objectives:** This course will enable the students to

- Describe the types of BJT/ FET biasing, and Demonstrate use of BJT/FET amplifiers
- Understand the modeling of BJT/FET for analysis and to Design of BJT/FET Amplifier,
- Understand and Demonstrate Generalize Frequency response of BJT and FET amplifiers.
- Design and analyze Power amplifier circuits.
- Understand the concept of Feedback and its effect on amplifier circuits and Oscillator circuits.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**DC Biasing – BJT's**<br>Introduction, operating point, Fixed-Bias configuration, Emitter-bias configuration, Voltage-Divider Biasing, Emitter Follower Configuration. Relevant problems.<br>**DC Biasing – FET's**<br>Introduction, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider biasing, Numerical. | 8 Hours | **L1 L2** |
| | | |
| **Module -2 BJT AC Analysis**<br>BJT modeling, re transistor model: Common Emitter fixed Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration (Excluding P-spice Analysis), Emitter Follower Configuration, Cascaded Systems. The Hybrid Equivalent model, Approximate Hybrid Equivalent Circuit, Fixed bias configuration, Voltage-Divider configuration. Hybrid $\pi$ Model. | 8 Hours | **L1 L2** |
| | | |
| **Module -3**<br>**FET Amplifiers**<br>Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed-Bias Configuration, Self-Bias Configuration (with bypassed Rs only), Voltage-Divider Configuration, Source Follower Configuration.<br>**BJT and JFET Frequency Response:**<br>Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, Multistage frequency effects. | 8 Hours | **L1, L2, L3** |
| | | |
| **Module -4** | 8 Hours | **L1,L2, L3,L4** |

| | | |
|---|---|---|
| **Power Amplifiers:-**<br>Introduction: Definitions and Amplifier Types, Series Fed Class A Amplifier, Transformer Coupled Class A Amplifier, Class B Amplifier operation.<br>Class B amplifier circuits:-Transformer-Coupled Push-Pull Circuits, Complementary–Symmetry Circuits only, Amplifier Distortion, Class C and Class D Amplifier. | | |
| | | |
| **Module -5**<br>**Feedback and Oscillator Circuits:-**<br>Feedback concepts, Feedback connection types, effects of negative feedback, practical feedback circuits: - FET based voltage series Feedback, BJT based current series, and FET based voltage shunt feedback.<br>**Oscillator operation: -**Barkhaunsen's criteria,Tunedoscillator Circuits: BJT based Colpitts, Hartley and Crystal oscillator. Unijunction transistor oscillator | 8 Hours | **L2, L3** |
| Note:- **Relevant problems on all topics** | | |

**Course Outcomes:** After studying this course, students will able to:

- Explain the biasing of BJT and FET
- Model BJT/FET for ac/dc analysis
- Design Single stage, Multistage amplifier, with and without feedback
- Analyze Frequency responseof BJT and FET.
- Acquire the knowledge of classifications of Power amplifier, operation, and able to design power amplifier.
- Apply the knowledge gained in designing ofBJT/FET/UJT based Oscillators.

**Graduate Attributes (as per NBA)**

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)
- Interpretation of data

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Book:**

Robert L. Boylestad and Louis Nashelsky, "Electronics devices and Circuit theory", Pearson, 10th Edition, 2009, ISBN:9788131727003

**Reference Book:**

David A. Bell, "Electronic Devices and Circuits", Oxford University Press

| Choice Based Credit System (CBCS)<br>Semester - III | | | | |
|---|---|---|---|---|
| **Digital Design and HDL<br>(Common to EI, BM &ML)** | | | | |
| Course Code | : **18EI/BM/ML34** | | IA Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | Exam Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |
| **Credits – 3 (Each module – 8 Hours)** | | | | |

**Course Objectives:** This course will enable the students to

- To impart the concepts of simplifying Boolean expression using K-map techniques and Quin-Mc Cluskey minimization techniques.
- To impart the concepts of designing and analyzing combinational logic circuits.
- To impart design methods and analysis of sequential logic circuits.
- To impart the concepts of HDL-Verilog data flow and behavioral models for thedesign of digital systems.

| Modules | Revised Bloom's Taxonomy (RBT)Level |
|---|---|
| **Module -1**<br>**Principles of Combinational Logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique.Quine-McCluskey using Don't Care Terms. (Text 1, Chapter 3). | L2<br>L3<br>L4 |
| **Module -2**<br>**Logic Design with MSI Components and Programmable Logic Devices:**<br>Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Read only Memories (PROMS). (Text 2, Chapter 5) | L1<br>L2<br>L3 |
| **Module -3**<br>**Flip-Flops:**<br>Basic Bistable Elements, Latches, Timing Considerations, TheMaster-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip-flops, Edge Triggered Flip-flops, Characteristic equations. (Text 2, Chapter 6) | L1<br>L2<br>L3 |
| **Module -4**<br>**SimpleFlip-Flops Applications:** Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T , JK , D and SR flip-flops. (Text 2, Chapter 6) | L2<br>L3<br>L4 |
| **Module -5**<br>**Introduction to Verilog:**<br>Structure of Verilog module, Operators, Data Types, Styles of Description- Data flow description, Behavioral description.<br>Implementation of half adder and full adder using Verilog data flow description.<br>**Verilog Behavioral description:** Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1,4:1,8:1).<br>(Text 3, Chapters:1, 2, 3) | L3<br>L4<br>L5 |

**Course Outcomes:** After studying this course, students will able to:

- Simplify Boolean functions using K-map and Quine-McCluskey minimization technique
- Analyze and design for combinational logic circuits.
- Analyze the concepts of Latches and Flip Flops. (SR, D, T and JK).
- Analyze and design the synchronous sequential circuits.
- Implement Combinational circuits (adders, subtractors, multiplexers) using Verilog descriptions.

**Graduate Attributes (as per NBA)**

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Modern tool usage

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Book:**

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001
2. Digital Principles and Design by Donald D. Givone, McGraw Hill, 2002.
3. HDL Programming VHDL and Verilog by Nazeih M. Botros, 2009 reprint, Dreamtech press.

**Reference Books:**

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Digital Principles and Design – Donald D Givone,12th reprint, TMH,2008
3. Logic Design, Sudhakar Samuel, Pearson/ Saguine, 2007
4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010

| Choice Based Credit System (CBCS)<br>Semester - III | | | | |
|---|---|---|---|---|
| **Human Anatomy and Physiology<br>(Common to BM and ML)** | | | | |
| Course Code | : **18BM/ML35** | | CIE Marks | : 40 |
| Number of Lecture Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |
| **Credits - 3** | | | | |

**Course Objectives:**

- To understand the internal environment of human body and homeostasis mechanism
- To provide the basic knowledge of different types of tissues.
- To provide the knowledge of structure and functioning of nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system
- To provide the knowledge of physiological parameters of normal health and factors affecting various physiological processes in the body.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Introduction: Homeostasis, Tissue, Cartilage:** The internal environment and homeostasis, survival needs of the body, movement of substances within the body, body fluids, action potential, propagation of action potential, cell-structure and functions. Epithelial tissue- simple epithelium, stratified epithelium, connective tissue- cells of connective tissue, loose connective tissue, Adipose tissue, Dense connective tissue, Lymphoid tissue, Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage. | 08 Hours | L1, L2 |
| | | |
| **Module -2**<br>**Nervous System:** Functional Components of nervous system**,** Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: Meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum, Brainstem, Cerebellum, Spinal cord- grey matter, white matter, spinal reflex, Spinal nerves (in brief list & functions), Cranial nerves (in brief list & functions), Autonomic nervous system (in brief)- functions and effects. Pituitary gland and hypothalamus. | 08Hours | L1, L2, L3, L4 |
| | | |
| **Module -3**<br>**Cardiovascular System:** Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, capillaries, control of blood vessel diameter, blood supply- internal respiration, cell nutrition. Heart- position, structure- pericardium, myocardium, endocardium, interior of the heart, flow of blood through the heart, blood supply to heart, Conducting system of the heart, factors affecting heart rate, the Cardiac cycle, cardiac output, blood | 08Hours | L1, L2, L3, L4 |

| | | |
|---|---|---|
| pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation- aorta (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, explanation with flow diagram only) | | |
| | | |
| **Module -4**<br>**Respiratory System:** Organs of respiration, Nose and Nasal cavity- position, structure and functions, pharynx - position, structure, functions. Larynx - position, structure and functions. Trachea, bronchi, bronchioles and alveoli, lungs- position, associated structure, pleura and pleural cavity. Respiration - muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity<br>**Digestive System:** Organs of the digestive system – mouth, tongue, teeth, salivary glands, pharynx, oesophagus, stomach, gastric juice and functions of stomach, small intestine-structure, chemical digestion in small intestine, large intestine - structure, functions of the large intestine. Pancreas and Liver (only physiology) | 08Hours | L1, L2, L3, L4 |
| | | |
| **Module -5**<br>**Skeletal System:** Bone, Types of bone, structure, bone cells, functions of bone. Axial skeleton- skull, sinuses, Fontanelles, vertebral column characteristics of typical vertebra, different parts of vertebral column (parts only), features of vertebral column, movements and functions of vertebral column, sternum, ribs, shoulder girdle and upper limb, pelvic girdle and lower limb.<br>**Muscles and Joints (Study of muscles along with joints):** Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue, muscle tone and fatigue. Types of joint- Fibrous, Cartilaginous, Synovial, characteristics of synovial joints, shoulder joint, elbow joint, radioulnar joint, wrist joint, Hip joint, Knee joint, ankle joint. | 08Hours | L1, L2 |
| | | |
| **Course Outcomes:** After studying this course, students will able to:<br>• Describe internal environment of human body and explain the fundamental concept of homeostasis.<br>• Explain the structure and functioning of various types of tissues.<br>• Describe the structure and explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.<br>• Demonstrate and analyze various physiological parameters in normal and abnormal conditions. | | |
| **Graduate Attributes (as per NBA)**<br>• Engineering knowledge<br>• Problem analysis<br>• Investigation of Complex Problem<br>• Lifelong learning | | |
| **Question Paper Pattern:**<br>• The question paper will have TEN questions.<br>• Each full question carry 20 marks<br>• There will be TWO full questions (with maximum of THREE sub questions) from each module.<br>• Each full question will have sub questions covering all the topics under a module.<br>• The students will have to answer FIVE full questions, selecting ONE full question from each module. | | |

**Text Books:**

1. Ross & Wilson's Anatomy and Physiology in Health and Illness – by Anne Waugh and Allison Grant, 9th Edition, Churchill Livingstone Publications

**Reference Books:**

1. Concise Medical Physiology- by Sujit K. Chaudhuri, 5th Edition, New Central Book Agency Pvt. Ltd.
2. Essentials of Medical Physiology - by K. Sembulingam and PremaSembulingam, 3rd Edition, Jaypee Publications
3. Human Physiology: From Cells to Systems – by Lauralee Sherwood, 6th Edition, Thomson India Edition, 2007.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - III**

**Network Analysis**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18EI/BM/ML36** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 03+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits – 4 (Each Module 10 Hrs)**

**Course Objectives:** This course will enable the students to

- To introduce the Basic circuit laws, Network theorems and analyze the networks.
- To analyze the networks by using optimized methods
- To analyze the network behavior during switching states.
- To realize the network parameters.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT) Level |
|---|---|---|
| **Module -1**<br>**Basic concepts**: Sources of electrical energy, Source transformation, Loop and node analysis with dependent & independent sources for DC networks, concept of super node and super mesh analysis for only independent sources for DC networks.<br>Numerical on all Topics | 10 Hours | L1, L2, L3, L4 |
| **Module -2**<br>**Network theorems**:<br>Super position, reciprocity, Millman's theorem Thevinin's& Norton's theorem (for DC networks only),<br>Maximum power transfer theorem (for AC & DC networks)<br>Numerical on all Topics | 10 Hours | L1, L2, L3, L4 |
| **Module -3**<br>**Transient behavior and initial conditions**: Behavior of circuit elements under switching condition and their representation, evaluation of initial & final conditions in RL, RC &RLC circuits for DC excitations.<br>**Two port network parameters**: Definitions and modeling of Z, Y, H & transmission parameters<br>Numerical on all Topics | 10 Hours | L1, L2, L3, L4 |
| **Module -4**<br>**Resonant Circuits**:<br>Series resonance: Variation of current and voltage with frequency, Selectivity & Bandwidth, Q-factor Parallel resonance: General case-resistance present in both branches, Selectivity & Bandwidth.<br>Numerical on all Topics | 10 Hours | L1, L2, L3, L4 |
| **Module -5**<br>**Network topology**: Graph of a network, concepts of: tree & co-tree, | 10 Hours | L1, L2, L3, L4 |

| | | |
|---|---|---|
| incidence matrix, tie-set & cut-set schedules, Principle of duality.<br>Numerical on all Topics | | |

**Course Outcomes:** After studying this course, students will able to:

- Apply the basic concepts (Laws, theorems) of networks to obtain solution.
- Choose the appropriate/specific technique to analyze the networks.
- Realize and Analyze the network behavior

**Graduate Attributes (as per NBA)**

- Applying the Engineering concepts to analyze the networks
- Realizing and solving the complex circuits

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- In each full question, preferably 40% should be related to theoretical concepts/derivations and 60% should be related problems/solutions.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition.
2. Networks and Systems, D Roy Choudhury, New Age International Publishers, 3rd Edition.
3. Network Analysis, M.E. Van Valkenburg, Prentice-Hall, 3rd Edition.

**Reference Books:**

1. Introduction to Electric circuits, Richard C Dorf& James A Svoboda, Wiley, 9th Edition.
2. Electric Circuits, MahmoodNahvi, McGraw Hill, 9th Edition

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - III**

**Analog Electronic Circuits Lab**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18 EI/BM/ML L37** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Practical Hours | : 42 | | Exam Hours | : 03 |

**Credits - 2**

**Course Objectives:**

This laboratory course enables students to get practical knowledge & experience in design, assembly and evaluation/testing of

- Rectifier circuits without and with filter
- BJT as Amplifier without and with feedback
- JFET Characteristics and as Amplifier.
- MOSFET Characteristics
- BJT as Power Amplifiers
- Oscillators using BJT and FET for frequency generation
- UJT characteristics
- Verification of Theorems and applications in practical fields

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| **Laboratory Experiments**<br>NOTE: The experiments are to be carried using discrete components only | **Revised Bloom's Taxonomy (RBT)Level** |
|---|---|
| 1. To design and test Full Wave Rectifier (with center tap transformer) with and without filters. | L3, l4, L5, L6 |
| 2. To design and test Full Wave Bridge Rectifier with and without filters. | L3, l4, L5, L6 |
| 3. To plot characteristics of UJT and to determine its intrinsic stand-off ratio. | L1, L2, L3, L4 |
| 4. To design and test the common emitter amplifier (voltage divider bias) without feedback and determine input, output impedance, gain and bandwidth. | L3, l4, L5, L6 |
| 5. To design and test the Emitter follower amplifier (BJT) using voltage divider bias and determine input, output impedance, gain and bandwidth. | L3, l4, L5, L6 |
| 6. To plot the Drain and Transfer characteristic for the given FET and to find the Drain Resistance and Trans-conductance. | L1, L2, L3, L4 |
| 7. To plot the input and output characteristics of n-channel MOSFET and calculatedrain resistance, mutual conductance and amplification factor. | L3, l4, L5, L6 |
| 8. To design, test and plot the frequency response of Common Source JFET/MOSFET amplifier, and to determine its bandwidth. | L1, L2, L3, L4 |

| | |
|---|---|
| 9. Wiring and testing of Complimentary symmetry class B push pull power amplifier and calculation of efficiency. | L1, L2, L3, L4 |
| 10. To design and test the RC-Phase shift Oscillator using BJT for the given frequency. | L3, L4, L5, L6 |
| 11. To design and test the following tuned oscillator circuits for the given frequency. (a) Hartley Oscillator using BJT (b) Colpitts Oscillator using FET. | L3, L4, L5, L6 |
| 12. Testing of crystal oscillator and to determine its frequency of oscillation. | L1, L2, L3, L4 |

**Course Outcomes:** After studying this course, students will able to:

- Able to design Single stage, Multistage amplifier, with and without feedback
- Able to analyze Frequency response of BJT and FET.
- Acquire the knowledge of Power amplifiers, operation, and able to design power amplifier.
- Apply the knowledge gained in the design of BJT/FET circuits in Oscillators
- Knowledge of UJT characteristics and its application.
- Applications of theorems in various practical fields.

**Graduate Attributes (as per NBA)**

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly)

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Reference Books:**


1. Electronics Lab Manual by K. A. Navas, Volume I, PHI, 5th Edition, 2017, ISBN:9788120351424.
2. Electronics Laboratory Primer - A Design Approach by S.Poorna Chandra, B.Sasikala, S Chand Pub.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - III**

**Digital Design and HDL Lab**
**(Common to EI, BM & ML)**

| | | | |
|---|---|---|---|
| Course Code | : **18 EI/BM/ML L38** | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Practical Hours | : 42 | Exam Hours | : 03 |

**Credits - 2**

**Course Objectives:** This course will enable the students to

- The operation of various logic gates and digital circuits and write the Verilog code.
- Design of logic circuits for combinational and sequential circuits and write Verilog code.
- Synthesis of digital circuits, FFs, shift registers and counters using ICs.
- To use FPGA/CPLD kits for downloading the Verilog code and test the output.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| **Laboratory Experiments:**<br>**Note:** **(1)** Use discrete components to test and verify the logic gates.<br>(2) Use FPGA/CPLD kits for down loading the Verilog code and test the output. | **Revised Bloom's Taxonomy (RBT) Level** |
|---|---|
| 1. Simplification, realization of Boolean expressions using logic gates/Universal gates | L1,L2,L3 |
| 2. To design and implement<br>a) Adder/Subtractor – Full/half using logic gates.<br>b) 4-bit Parallel Adder/ subtractor using IC 7483. | L3, L4, L5,L6 |
| 3. To realize<br>a) BCD to Excess-3 code conversion and vice versa<br>b) Binary to Gray code conversion and vice versa | L2,L3, L4 |
| 4. To realize<br>a) 4:1 Multiplexer using gates<br>b) 1:8 Demux<br>c) Priority encoder and 3:8 Decoder using IC74138<br>d) One / Two bit comparator | L2, L3, L4 |
| 5. To realize the following flip-flops using NAND Gates<br>(a) T type (b) JK Master slave (c) D type | L2, L3, L4 |
| 6. To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193) | L2, L3, L4 |
| 7. Adder/Subtractor – Full/half using Verilog data flow description | L2, L3, L4 |
| 8. Code converters using Verilog Behavioral description<br>a) Gray to binary and vice versa<br>b) Binary to excess3 and vice versa | L2, L3, L4 |
| 9. Multiplexers/decoders/encoder using Verilog Behavioral description<br>- 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder<br>- 1:8 Demux and verify using test bench<br>- 2-bit Comparator using behavioral description | L2, L3, L4 |
| 10. Flip-flops using Verilog Behavioral description<br>a) JK type b) SR type c) T type and d) D type | L2, L3, L4 |
| 11. Counter up/down (BCD and binary), sequential counters using Verilog | L2,L3, L4 |

| | |
|---|---|
| Behavioral description. | |
| 12. Interface experiments: (a) Stepper motor (b) Relay (c) Waveform generation using DAC. | L2,L3, L4 |

**Course Outcomes:** After studying this course, students will able to:

- Realize Boolean expression using Universal gates / basic gates using ICs and Verilog
- Demonstrate the function of adder/subtractor circuits using gates/ICs & Verilog.
- Design and analyze the Comparator, Multiplexers Decoders, Encoders circuits using ICs and Verilog.
- Design and analysis of different Flip-flops and counters using gates and FFs
- Able to use FPGA/CPLD kits for down loading Verilog codes for shift registers and counters and check output.

**Graduate Attributes (as per NBA)**

- Engineering Knowledge.
- Problem Analysis.
- Design/Development of solutions

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero

**Reference Books:**


1. Digital Principles and Design – Donald D Givone,12th reprint, TMH,2008
2. HDL Programming VHDL and Verilog By Nazeih M. Botros, 2009 reprint, Dreamtech press.
3. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001
4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010.

**B. E. Common to all Programmes**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**SEMESTER –II / III / IV**

**Aadalitha Kannada**

| | | | |
|---|---|---|---|
| Course Code | **18KAK28/39/49** | CIE Marks | 100 |
| Teaching Hours/Week (L:T:P) | (0:2:0) | | |
| Credits | 01 | | |

**DqÀ½vÀ PÀ£ÀßqÀ PÀ°PÉAiÀÄ GzÉÝÃ±ÀUÀ¼ÀÄ:**

- ¥ÀzÀ« «zÁåyð¼ÁVgÀÄªÀÅzÀjAzÀ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀjZÀAiÀÄ ªÀiÁrPÉÆqÀÄªÀÅzÀÄ.
- «zÁåyðUÀ¼À°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ ªÁåPÀgÀtzÀ §UÉÎ CjªÀÅ ªÀÄÄÆr¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ gÀZÀ£ÉAiÀÄ°è£À ¤AiÀÄªÀÄUÀ¼À£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ §gÀºÀzÀ°è PÀAqÀÄ§gÀÄªÀ zÉÆÃµÀUÀ¼ÀÄ ºÁUÀÆ CªÀÅUÀ¼À ¤ªÁgÀuÉ. ªÀÄvÀÄÛ ¯ÉÃR£À aºÉßUÀ¼À£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀÅzÀÄ.
- ¸ÁªÀiÁ£Åå CfðUÀ¼ÀÄ, ¸ÀPÁðj ªÀÄvÀÄÛ CgÉ ¸ÀPÁðj ¥ÀvÀæªÀåªÀºÁgÀzÀ §UÉÎ CjªÀÅ ªÀÄÄÆr¸ÀÄªÀÅzÀÄ.
- ¨sÁµÁAvÀgÀ ªÀÄvÀÄÛ ¥Àæ§AzsÀ gÀZÀ£É §UÉÎ C¸ÀQÛ ªÀÄÄÆr¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ¨sÁå¸À ªÀÄvÀÄÛ ¸ÁªÀiÁ£Åå PÀ£ÀßqÀ ºÁUÀÆ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀzÀUÀ¼À ¥ÀjZÀAiÀÄ ªÀiÁrPÉÆqÀÄªÀÅzÀÄ.

**¥Àj«r (¥ÀoÀå¥ÀÄ¸ÀÛPÀzÀ°ègÀÄªÀ «µÀAiÀÄUÀ¼À ¥ÀnÖ)**

CzsÁåAiÀÄ – 1 PÀ£ÀßqÀ¨sÁµÉ – ¸ÀAQë¥ÀÛ «ªÀgÀuÉ.
CzsÁåAiÀÄ – 2 ¨sÁµÁ ¥ÀæAiÉÆÃUÀzÀ¯ ÁèUÀÄªÀ ¯ÉÆÃ¥ÀzÉÆÃµÀUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À ¤ªÁgÀuÉ.
CzsÁåAiÀÄ – 3 ¯ÉÃR£À aºÉßUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À G¥ÀAiÉÆÃUÀ.
CzsÁåAiÀÄ – 4 ¥ÀvÀæ ªÀåªÀºÁgÀ.
CzsÁåAiÀÄ – 5 DqÀ½vÀ ¥ÀvÀæUÀ¼ÀÄ.
CzsÁåAiÀÄ – 6 ¸ÀPÁðgÀzÀ DzÉÃ±À ¥ÀvÀæUÀ¼ÀÄ.
CzsÁåAiÀÄ – 7 ¸ÀAQë¥ÀÛ ¥Àæ§AzsÀ gÀZÀ£É (¦æ¸ÉÊ¸ï gÉÊnAUï), ¥Àæ§AzsÀ ªÀÄvÀÄÛ ¨sÁµÁAvÀgÀ.
CzsÁåAiÀÄ – 8 PÀ£ÀßqÀ ±À§Ý¸ÀAUÀæºÀ.
CzsÁåAiÀÄ – 9 PÀA¥ÀÆålgï ºÁUÀÆ ªÀiÁ»w vÀAvÀæeÁÕ£À.
CzsÁåAiÀÄ – 10 ¥Áj¨sÁ¶PÀ DqÀ½vÀ PÀ£ÀßqÀ ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛ vÁAwæPÀ/ PÀA¥ÀÆålgï ¥Áj¨sÁ¶PÀ ¥ÀzÀUÀ¼ÀÄ.

**DqÀ½vÀ PÀ£ÀßqÀ PÀ°PÉAiÀÄ ¥sÀ°vÁA±ÀÀUÀ¼ÀÄ:**

- DqÀ½vÀ ¨sÁµÉ PÀ£ÀßqÀzÀ ¥ÀjZÀAiÀÄªÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ ªÁåPÀgÀtzÀ §UÉÎ CjªÀÅ ªÀÄÄÆqÀÄvÀÛzÉ.
- PÀ£ÀßqÀ ¨sÁµÁ gÀZÀ£ÉAiÀÄ°è£À ¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¯ÉÃR£À aºÉßUÀ¼ÀÄ ¥ÀjZÀ¬Ä¸À®àqÀÄvÀÛªÉ.
- ¸ÁªÀiÁ£Åå CfðUÀ¼ÀÄ, ¸ÀPÁðj ªÀÄvÀÄÛ CgÉ ¸ÀPÁðj ¥ÀvÀæªÀåªÀºÁgÀzÀ §UÉÎ CjªÀÅ ªÀÄÄÆqÀÄvÀÛzÉ.
- ¨sÁµÁAvÀgÀ ªÀÄvÀÄÛ ¥Àæ§AzsÀ gÀZÀ£É §UÉÎ C¸ÀQÛ ªÀÄÄÆqÀÄvÀÛzÉ.
- PÀ£ÀßqÀ ¨sÁµÁ¨sÁå¸À ªÀÄvÀÄÛ ¸ÁªÀiÁ£Åå PÀ£ÀßqÀ ºÁUÀÆ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀzÀUÀ¼ÀÄ ¥ÀjZÀ¬Ä¸À®àqÀÄvÀÛªÉ.

**¥ÀjÃPÉëAiÀÄ «zsÁ£À : ¤gÀAvÀgÀ DAvÀjPÀ ªÀiË®åªÀiÁ¥À£À -** CIE **(Continuous Internal Evaluation):**

PÁ¯ÉÃdÄ ªÀÄlÖzÀ°èAiÉÄ DAvÀjPÀ ¥ÀjÃPÉëAiÀÄ£ÀÄß 100 CAPÀUÀ½UÉ «±Àé«zÁå®AiÀÄzÀ
¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¤zÉðÃ±À£ÀzÀAvÉ £ÀqÉ¸ÀvÀPÀÌzÀÄÝ.

**¥ÀoÀå¥ÀÄ¸ÀÛPÀ : DqÀ½vÀ PÀ£ÀßqÀ ¥ÀoÀå ¥ÀÄ¸ÀÛPÀ (Kannada for Administration)**
**¸ÀÀA¥ÁzÀPÀgÀÄ**
**qÁ. J¯ï. wªÉÄäÃ±À**
**¥ÉÆæ. «. PÉÃ±ÀªÀªÀÄÆwð**

| B. E. Common to all Programmes<br>Outcome Based Education (OBE) and Choice Based Credit System (CBCS)<br>SEMESTER –II & III/IV | | | |
|---|---|---|---|
| **Vyavaharika Kannada** | | | |
| Course Code | **18KVK28/39/49** | CIE Marks | 100 |
| Teaching Hours/Week (L:T:P) | (0:2:0) | | |
| Credits | 01 | | |

**Course Learning Objectives:**
The course will enable the students to understand Kannada and communicate in Kannada language.

**Table of Contents:**
Chapter - 1: Vyavaharika kannada – Parichaya (Introduction to Vyavaharika Kannada).
Chapter - 2: Kannada Aksharamale haagu uchcharane ( Kannada Alpabets and Pronunciation).
Chapter - 3: Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication).
Chapter - 4: Kannada Grammar in Conversations (Sambhashaneyalli Kannada Vyakarana).
Chapter - 5: Activities in Kannada.

**Course Outcomes:**
At the end of the course, the student will be able to understand Kannada and communicate in Kannada language.

**¥ÀjÃPÉëAiÀÄ «zsÁ£À : ¤gÀAvÀgÀ DAvÀjPÀ ªÀiË®åªÀiÁ¥À£À -** CIE (**Continuous Internal Evaluation):**
PÁ¯ÉÃdÄ ªÀÄlÖzÀ°èAiÉÄ DAvÀjPÀ ¥ÀjÃPÉëAiÀÄ£ÀÄß 100 CAPÀUÀ½UÉ «±Àé«zÁå®AiÀÄzÀ
¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¤zÉðÃ±À£ÀzÀAvÉ £ÀqÉ¸ÀvÀPÀÌzÀÄÝ.

**Textbook (¥ÀoÀå¥ÀÄ¸ÀÛPÀ): ªÁåªÀºÁjPÀ PÀ£ÀßqÀ ¥ÀoÀå ¥ÀÄ¸ÀÛPÀ (Vyavaharika Kannada Text Book)**

**¸ÀÀA¥ÁzÀPÀgÀÄ**
**qÁ. J¯ï. wªÉÄäÃ±À**
**¥ÉÆæ. «. PÉÃ±ÀªÀªÀÄÆwð**
**¥ÀæPÀluÉ : ¥Àæ¸ÁgÁAUÀ, «±ÉéÃ±ÀégÀAiÀÄå vÁAwæPÀ «±Àé«zÁå®AiÀÄ, ¨É¼ÀUÁ«.**

**B. E. Common to all Programmes**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**SEMESTER - III**

**CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)**

| | | | |
|---|---|---|---|
| Course Code | **18CPC39/49** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (1:0:0) | SEE Marks | 60 |
| Credits | 01 | Exam Hours | 02 |

**Course Learning Objectives:** To

- know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

**Module-1**

**Introduction to Indian Constitution:**
The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.

**Module-2**

**Union Executive and State Executive:**
Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.

**Module-3**

**Elections, Amendments and Emergency Provisions:**
Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences.

**Constitutional special provisions:**
Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

**Module-4**

**Professional / Engineering Ethics:**

Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility. Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

**Module-5**

**Internet Laws, Cyber Crimes and Cyber Laws:**

Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.

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

CO 1: Have constitutional knowledge and legal literacy.

CO 2: Understand Engineering and Professional ethics and responsibilities of Engineers.

CO 3: Understand the the cybercrimes and cyber laws for cyber safety measures.

**Question paper pattern for SEE and CIE:**

- The SEE question paper will be set for 100 marks and the marks scored by the students will proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ).
- For the award of 40 CIE marks, refer the University regulations 2018.

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbook/s** | | | | |
| 1 | Constitution of India, Professional Ethics and Human Rights | Shubham Singles, Charles E. Haries, and et al | Cengage Learning India | 2018 |
| 2 | Cyber Security and Cyber Laws | Alfred Basta and et al | Cengage Learning India | 2018 |
| **Reference Books** | | | | |
| 3 | Introduction to the Constitution of India | Durga Das Basu | Prentice –Hall, | 2008. |
| 4 | Engineering Ethics | M. Govindarajan, S. Natarajan, V. S. Senthilkumar | Prentice –Hall, | 2004 |

**B. E. Common to all Programmes**
**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**
**SEMESTER - III**

**ADDITIONAL MATHEMATICS – I**

(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech programmes)

| | | | |
|---|---|---|---|
| Course Code | **18MATDIP31** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 0 | Exam Hours | 03 |

**Course Learning Objectives:**

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

**Module-1**

**Complex Trigonometry:** Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).
**Vector Algebra:** Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

**Module-2**

**Differential Calculus**: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

**Module-3**

**Vector Differentiation**: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.

**Module-4**

**Integral Calculus**: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof) and evaluation of these with standard limits-Examples. Double and triple integrals-Simple examples.

**Module-5**

**Ordinary differential equations (ODE's**. Introduction-solutions of first order and first degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.

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

- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.
- CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

| Sl No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbook** | | | | |
| 1 | Higher Engineering Mathematics | B.S. Grewal | Khanna Publishers | 43rd Edition, 2015 |
| **Reference Books** | | | | |
| 1 | Advanced Engineering Mathematics | E. Kreyszig | John Wiley & Sons | 10th Edition, 2015 |
| 2 | Engineering Mathematics | N.P.Bali and Manish Goyal | Laxmi Publishers | 7th Edition, 2007 |
| 3 | Engineering Mathematics Vol.I | Rohit Khurana | Cengage Learning | 1st Edition, 2015 |

## IV SEMESTER

**B. E. Common to all Programmes**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**SEMESTER - IV**

**COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS**

| | | | |
|---|---|---|---|
| Course Code | **18MAT41** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

**Course Learning Objectives:**

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

**Module-1**

**Calculus of complex functions:** Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in cartesian and polar forms and consequences. Construction of analytic functions: Milne-Thomson method-Problems.

**Module-2**

**Conformal transformations:** Introduction. Discussion of transformations: $w=z^2$ , $w=e^z$ , $w=z+\frac{1}{z},(z\neq 0)$ . Bilinear transformations- Problems.

**Complex integration**: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.

**Module-3**

**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

**Module-4**

**Curve Fitting:** Curve fitting by the method of least squares- fitting the curves of the form-

$y=ax+b, y=ax^b$ & $y=ax^2+bx+c.$

**Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.

**Module-5**

**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance.

**Sampling Theory:** Introduction to sampling distributions, standard error,Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

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

- CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO5: Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.

- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

| Sl No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbooks** | | | | |
| 1 | Advanced Engineering Mathematics | E. Kreyszig | John Wiley & Sons | 10th Edition,2016 |
| 2 | Higher Engineering Mathematics | B. S. Grewal | Khanna Publishers | 44th Edition, 2017 |
| 3 | Engineering Mathematics | Srimanta Pal et al | Oxford University Press | 3rd Edition,2016 |
| **Reference Books** | | | | |
| 1 | Advanced Engineering Mathematics | C. Ray Wylie, Louis C. Barrett | McGraw-Hill | 6th Edition 1995 |
| 2 | Introductory Methods of Numerical Analysis | S. S. Sastry | Prentice Hall of India | 4th Edition 2010 |
| 3 | Higher Engineering Mathematics | B.V. Ramana | McGraw-Hill | 11th Edition,2010 |
| 4 | A Textbook of Engineering Mathematics | N. P. Bali and Manish Goyal | Laxmi Publications | 6th Edition, 2014 |
| 5 | Advanced Engineering Mathematics | Chandrika Prasad and Reena Garg | Khanna Publishing, | 2018 |

**Web links and Video Lectures:**

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Signal Conditioning and Data Acquisition Circuits**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18 EI/BM/ML42** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3**

**Course Objectives:** This course will enable the students to

- Define and describe Op Amp, basic concepts, characteristics and specifications
- Gain knowledge about Linear and nonlinear applications op-amp.
- Design and develop circuits like, amplifiers, filters, Timers to meet industrial requirements.
- Get a firm grasp of basic principles of op-amp.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 – Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems).<br>**Operational Amplifier Characteristics**: DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR.<br>**Basic op-amp applications** – Scale changer/Inverter.<br>Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems). | 8 Hours | L1,L2, L3,L4 |
| | | |
| **Module -2**<br>**Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator.<br>**Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astable mutivibrator, Monostable multivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems). | 8 Hours | L1,L2, L3,L4 |
| | | |
| **Module -3**<br>**Voltage Regulators:** Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator.<br>**Active filters:** First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples). | 8 Hours | L1,L2, L3,L4 |
| | | |

| | | |
|---|---|---|
| **Module -4**<br>**555 Timer:**Description of Functional Diagram, Monostable operation, Applications of Monostable Multivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of Astable Multivibrator: FSK Generator and Pulse Position Modulation.<br>**Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation. | 8 Hours | L2,L3,L4, L5, L6 |
| | | |
| **Module -5**<br>**Data Acquisition Systems:** Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system.<br>**Data Converters:**<br>**Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only).<br>**Analog to Digital Converters:** Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications. | 8 Hours | L2, L3,L4, L5, L6 |
| | | |

**Course Outcomes:** After studying this course, students will able to:

1. Understand the basic principles and operation of op-amp.
2. Design and develop circuits to meet the practical applications
3. Implement and integrate the op-amp circuits in electronic gadgets.

**Graduate Attributes (as per NBA)**

- Engineering knowledge
- Problem analysis
- Design & development of solutions
- Investigation of Complex Problem

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI (Module-3)
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.(Module-5)

**Reference Books:**

1. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006
2. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
3. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Embedded Controllers**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18 EI/BM/ML 43** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total number of lecture hours | : 40 | | Exam hours | : 03 |

**Credits - 3**

**Course Objectives:**This course enables students to understand:

- Basics of Microprocessor and Microcontroller
- 8051 Microcontroller architecture and Pin description
- 8051 Addressing modes and instruction set
- Programming of on-chip peripherals in 8051
- Design and develop applications using 8051 Assembly language and C program.
- MSP 430 Microcontroller architecture
- On-chip peripherals and program using Assembly language and C.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Microprocessor and Microcontrollers:**<br>**Introduction: Microprocessor and Microcontroller**, Microprocessor survey, RISC and CISC, CPU Architecture, Harvard and Von-Neumann, CPU Architecture. 8051 Microcontroller Architecture. Pin functions organizations Input/ Output pins, ports and circuits. Internal and External memory Architecture. 8051 Reg. banks and stack, 8051 flag bits and PSW Register. Special function Registers. Timer /Counter, Serial data input/ output, Interrupts, program counter and ROM space in the 8051. | 8 Hours | **L1,L2** |
| | | |
| **Module -2**<br>**Addressing modes directives instruction set of 8051 Microcontroller**. Immediate and Register addressing modes. Accessing memory using various addressing modes. Bit addressing for I/o and RAM 8051 data types and directives. Jump Loop and CALL Instructions Arithmetic and Logic Instructions and programming I/o port programming. Assembly Language programs using various Instructions. | 8 Hours | **L1,L2** |
| | | |
| **Module -3**<br>**8051 programming in C and interfacing.** Data types and time delay in 8051 C, I/o programming, Logic operation, data conversion programs, accessing Code ROM Space, data serialization. **8051 interfacing** to LCD and key board, DAC, stepper motor, DC Motor, Parallel and serial ADC. Elevator. | 8 Hours | **L2,L3,L4** |
| | | |

| | | |
|---|---|---|
| **Module -4**<br>**Timer/ Counter, Serial communication and Interrupts in 8051**.<br>Programming 8051 timer/ counter, programming timer 0 and 1 in 8051 C, Basics of serial communication, 8051 connections to **RS-232.** 8051 serial port programming in C. 8051 Interrupts, Programming Timer Interrupts, External hardware Interrupts and serial communication Interrupts. Interrupts priority & Interrupt programming in C. | 8 Hours | **L2,L3,L4,L5** |
| | | |
| **Module -5**<br>**Introduction to Advanced Microcontrollers**. Salient Features of Advanced Microcontrollers. **MSP430F2013** Architecture and pin functions, Memory, Clock Generator, CPU Registers, Addressing modes, Instruction set and emulated Instruction set. Development Environment. Aspects of C for embedded system, Introduction to MSP 430 starter kit, parallel ports. | 8 Hours | **L1,L2,L3** |
| | | |

**Course Outcomes:**After studying this course , Student will be able to:

- Learn architecture of 8051 and MSP 430.
- Learn programming skills using Assembly language and C
- Design and interfacing of microcontroller based embedded systems.
- Build projects

**Graduate Attributes (as per NBA)**

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.


**Reference Books:**


1. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.
2. "The 8051 Microcontroller: Hardware, Software and Applications" V. Udhayashankara and MallikarjunaSwamy ,TMH., 2009.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Signals and Systems**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18ML44** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 03+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits - 4**

**Course Objectives:** This course will enable the students

- Coverage of continuous and discrete-time signals and systems, their properties and representations and methods that is necessary for the analysis of continuous and discrete-time signals and systems. Knowledge of time-domain representation and analysis concepts as they relate to difference equations, impulse response and convolution, etc.
- Knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools, Z-transform.
- Concepts of the sampling process.
- Mathematical and computational skills needed in application areas like communication, signal processing and control, which will be taught in other courses.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Introduction**: Definitions of a signal and a system, classification of signals, basic operations on signals, elementary signals, Systems viewed as interconnections of operations, properties of systems. Introduction to physiological signals. | **10 Hours** | **L1, L2, L3** |
| | | |
| **Module -2**<br>**Time-domain representations for LTI systems:** Convolution, Impulse response representation, Convolution Sum and Convolution Integral. Properties of impulse response representation, Differential and difference equation representations, Block diagram representations. The above concepts can be implemented by using Matlab. | **10 Hours** | **L1, L2, L3, L4** |
| | | |
| **Module -3**<br>**Fourier representation of signals:** Introduction, Discrete time, continuous time Fourier series Continuous Fourier transforms (derivations of transforms and properties are excluded). Discrete Fourier transforms (derivations of transforms and properties are excluded) and their properties. The above concepts can be implemented by using Matlab. | **10 Hours** | **L1, L2, L3, L4** |
| | | |
| **Module -4**<br>**Applications of Fourier representations:** Introduction, Frequency response | **10 Hours** | **L1, L2, L3, L4** |

| | | |
|---|---|---|
| of LTI systems, Fourier transforms representation of periodic signals, Fourier transform representation of discrete time signals. Synthesis of a physiological signal using Fourier series and Fourier transform**.** | | |
| | | |
| **Module -5**<br>**Z-Transform:** Introduction, properties of ROC, properties of Z-Transform, inversion of Z-transform, transform analysis of LTI Systems, transfer function, stability and causality, unilateral Z- Transform and its application to solve difference equations. Analysis of Physiological signals using ZT. | **10 Hours** | **L1, L2, L3, L4** |
| | | |

**Course Outcomes:** After studying this course, students will able to:

1. Characterize and analyze the properties of CT and DT signals and systems
2. Analyze CT and DT systems in Time domain using convolution and differential equation
3. Represent CT and DT systems in the Frequency domain using Fourier analysis tools like CTFS, CTFT, DTFS and DTFT.
4. Conceptualize the effects of sampling a CT signal and analyze CT and DT systems using Z Transforms

**Graduate Attributes (as per NBA)**

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions
- Interpretation of data

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2nd edition,2012
2. Suresh R. Devasahayam, Signals and systems in biomedical engineering, Plenum Publishers, 2000.


**Reference Books:**


1. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education \ Asia / PHI, 3nd edition, 1997. Indian Reprint 2011
2. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2011
3. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2010
4. Ganesh Rao and Satish Tunga, "Signals and Systems", Sanguine Technical Publishers, 2012.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Biomedical Transducers and Instrumentation**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18BM/ML45** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits - 3**

**Course Objectives:** This course will enable the students to

- Gain the knowledge of working principle and construction details of Biomedical Transducers.
- Acquire the knowledge of transducer applications to access the biological signals.
- Access the performance of various Biomedical Transducers.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**Fundamental Concepts & Basic Transducers:** Introduction, Classification of Transducers**,** Measurement, Signals and Noise in the measurement-Measurement, signals and noise, signal to noise ratio, different types of noise. Characteristics of Measurement system-Transducer and measurement system, static characteristics, dynamic characteristics, standard and calibration, accuracy and error. | 08 Hours | L1, L2, L3 |
| | | |
| **Module -2**<br>**Bioelectric Signals and Electrodes**:<br>Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes–Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes. | 08 Hours | L1, L2, L3 |
| | | |
| **Module -3**<br>**Pressure Measurement:** Pressure Transducers-LVDT pressure transducers and Strain gauge pressure transducers. Physiological pressure ranges and measurement sites, Direct pressure measurement-catheters for pressure measurement, diaphragm displacement transducers, catheter tip pressure transducers, implantable pressure transducers and pressure telemetering capsules. Indirect pressure measurement-Indirect measurement of systolic, diastolic, and mean blood pressure, Detection of Kortokoff sounds. | 08 Hours | L1, L2, L3 |

| | | |
|---|---|---|
| **Module -4**<br>**Temperature Measurement, Transducers and Sensors:** Requirements for measurement ranges, Temperature transducers – Thermistors, thermocouples, wire and thin film thermo-resistive elements, P-N junction diodes and transistors, infrared radiation thermometers, infrared thermography. Clinical thermometer probes, tympanic thermometers, telemetering capsules. Photoelectric Transducers: photovoltaic cells and photoemissive cells. Biosensors and Smart Sensors | 08 Hours | L1, L2, L3 |
| | | |
| **Module -5**<br>**Flow Measurement:** Requirements for measurement ranges – blood flow in a single vessel, tissue blood flow, and respiratory gas flow. Electromagnetic flowmeters – principle, methods of magnetic field excitation, perivascular probes, intravascular probes. Ultrasonic blood flowmeters– propagation of ultrasound in the tissue, ultrasonic Doppler flowmeters, blood flow measurement through Doppler imaging. Indicator dilution method – principle and working, thermodilution method, Fick method, thermistor velocity probe, impedance cardiography. | 08 Hours | L1, L2, L3 |
| | | |

**Course Outcomes:** After studying this course, students will able to:

1. Understand the working principle and construction details of Transducers.
2. Improve the measurement techniques through different approach.
3. Practically can implement the technology in measurement field.

**Graduate Attributes (as per NBA)**

- Engineering knowledge
- Modern tool usage
- Engineer and society
- Environment& sustainability
- Lifelong learning

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Biomedical Transducers and Instruments – Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
2. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.


**Reference Books:**


1. Biomedical Instrumentation and Measurement – Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India Pvt. Ltd., 2004.
2. Transducers and Instrumentation -D. V. S. Murty Prentice Hall India Pvt ltd. 2nd Edition

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Scientific and Analytical Instrumentation**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **18 EI/BM/ML 46** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | 40 | | Exam Hours | : 03 |

**Credits - 3**

**Course Objectives:**

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To impart various spectroscopic techniques and its instrumentation.
- To impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| Modules | Teaching Hours | Revised Bloom's Taxonomy (RBT)Level |
|---|---|---|
| **Module -1**<br>**An Introduction to Instrumental Methods:** Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1).<br>**IR Spectroscopy:** Basic Components of IR Spectrophotometers, monochromators- littrow mounting, Fourier Transform IR Spectroscopy (Text book 2). | 08 Hours | L1, L2 |
| | | |
| **Module -2**<br>**UV and Visible Spectrometers –Instrumentation**: Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules(Text book 1), Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 2) | 08 Hours | L1, L2 |
| | | |
| **Module -3**<br>**Flame Emission and Atomic Absorption Spectroscopy**: Introduction, Instrumentation for flame spectrometric methods, Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames & furnaces, applications, comparison of FES and AAS. (Text book 1). | 08 Hours | L1, L2 |
| | | |

| | | |
|---|---|---|
| **Module -4**<br>**Gas Chromatography:** Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column & capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2).<br>**HPLC Instrumentation**: Mobile –phase delivery system sample introduction, separation of columns, Detectors–Ultraviolet Photometers & Spectrophotometers, electrochemical detector (amperometric detector), Differential refractometer. (Text book 1). | 08 Hours | L1, L2, L3 |
| | | |
| **Module -5**<br>**Blood analyzer:** Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood $pCO_2$, $pO_2$ , A Complete blood gas analyzer.<br>**Air pollution monitoring instruments:** Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide ($SO_2$)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis,<br>**Water pollution monitoring instruments**. (Text book 2) | 08 Hours | L1, L2, L3, L4 |
| | | |

**Course Outcomes:**

1. The students get well versed with the principle, construction and working of various analytical instrumentation.
2. Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

**Graduate Attributes (as per NBA)**

- Engineering Knowledge
- Problem Analysis
- Life-long Learning

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Instrumental Methods of Analysis, 7th edition. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution (Module 1, Module 2, Module 3, Module 4HPLC)
2. Handbook of Instruments – R.S. Khandpur, Tata McGraw Hill (Module 1-IR Spectroscopy, Module 4, Module 5)

**Reference Books:**

1. Braun R.D., Introduction to Instrumental Analysis, McGraw –Hill Singapore,2006.
2. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.
3. Principles of Instrumental Analysis 5th Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - IV**

**Embedded Controllers Lab**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **18 EI/BM/ML L47** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | 02+02 | | SEE Marks | : 60 |
| Total Number of Practical Hours | 42 | | Exam Hours | : 03 |

**Credits - 2**

**Course Objectives:**
This laboratory course enables students to :

- Write 8051 Assembly language and C programs for 8051 and MSP430.
- Interface hardware modules to Microcontroller board.
- Develop applications based on Microcontroller 8051 and MSP430.

**Revised Bloom's Taxonomy Levels:**L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| **Laboratory Experiments**<br>Note: Software and Hardware program using KEIL software and MSP 430 IDE. | **Revised Bloom's Taxonomy (RBT)Level** |
|---|---|
| **Software program using 8051 µc**<br>Simple Assembly Language;<br>1. Program using 8051 in Block, Move, Exchange.<br>2. Program in sorting, finding largest and smallest element in an array.<br>3. Counters ---> For Hex and BCD up/ down count.<br>4. Boolean and Logical Instructions. (Bit Manipulation).<br>5. Subroutines using CALL and RETURN instructions.<br>6. Code Conversions ---> ASCII to Decimal, Decimal to ASCII, BCD to ASCII<br>7. Programs to generate delay, programs using serial port and on chip timer/ counter. | **L2, L3, L4** |
| **Software program using MSP 430 IDE**<br>8. Assembly program using MSP 430 for data transfer, Block Move in an array. | **L2, L3, L4** |
| **Hardware programming (using 8051)**<br>9. Stepper motor Interface to 8051 Microcontroller with C Program.<br>10. DC Motor Interface to 8051 Microcontroller with C Program<br>11. DAC Interface for to generate sine wave, square wave, triangular wave, Ramp wave through 8051Microcontroller with C Program.<br>12. Keyboard Interfacing.<br>13. ADC Interfacing and Elevator System | **L3, L4, L5** |

**Course Outcomes:** After the completion of this Laboratory course, students will be able to:

- Get hands-on exposure in 8051 and MSP430 platform.
- Enhance programming skills using Assembly language and C.
- Design and interfacing of microcontroller based embedded systems.
- Build projects

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage
- Individual and Team work

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Reference Books:**


1. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad AliMazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.
4. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester – IV**

**Physiological Measurements and Biomedical Instrumentation Lab**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18MLL48** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of practical Hours | :42 | | Exam Hours | : 03 |

**Credits - 2**

**Course Objectives:** This Lab course will enable the students to

- Impart the working principle of sensors and transducer
- Testing the response and plot the characteristics of different transducers
- Interpret and analyze experimental results with theoretical concepts.
- Calibrate the sensors/transducers
- Study and interpret data sheets of different transducers to select the suitable transducer for particular application and safe operation.
- Understand the basic concepts and procedure for the measurement of BP, solution concentration, pH and conductivity.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

| LIST OF EXPERIMENTS | Revised Bloom's Taxonomy (RBT) Level |
|---|---|
| 1. Measurement of blood pressure using sphygmomanometer and automatic digital BP instrument. Finding the systolic and diastolic values and calculate Mean Arterial Pressure (MAP) | **L1, L2, L3,L4** |
| 2. Measurement of unknown concentration of given solution/ body fluid using Spectrophotometer and Colorimeter | **L1, L2, L3,L4** |
| 3. (a) Measurement of pH of a given solution/body fluid using pH meter. (b) Determination of Conductivity of a given unknown solution/ body fluid using conductivity meter. | **L1, L2, L3,L4** |
| 4. Record and Trace ECG signal and labeling the amplitude and time components. Calculating Heart Rate | **L1, L2, L3,L4** |
| 5. Measurement of displacement using LVDT& determine its sensitivity and resolution | **L1, L2, L3,L4** |
| 6. Temperature measurement using RTD, Thermistor and Thermocouple, and to find their sensitivity. | **L1, L2, L3,L4** |
| 7. Temperature measurement using AD590 / LM34. | **L1, L2, L3,L4** |
| 8. Characteristics of LDR, Photodiode & Phototransistor by variable illumination & variable distance. | **L1, L2, L3, L4** |
| 9. Measurement of unknown resistance by Wheatstone bridge & finding the sensitivity of the bridge. | **L1, L2, L3** |
| 10. Measurement of self-inductance using Maxwell's bridge. | **L1, L2, L3** |
| 11. Measurement of unknown capacitance using Schering's bridge. | **L1, L2, L3** |
| 12. Characteristics of Load cell and Cantilever beam using Strain gauge | **L1, L2, L3, L4** |

| | |
|---|---|
| (Quarter, Half and Full bridge configuration) | |

**Course Outcomes:** After studying this course, students will able to:

- Analyze the response and plot the characteristics of temperature measurement transducers such as RTD, Thermistor, and Thermocouple & AD590.
- Analyze the response and plot the characteristics of displacement measuring transducers such as LVDT and Potentiometric transducer.
- Analyze the response and plot the characteristics of strain gauge type load cell.
- Analyze the response and plot the characteristics of pressure transducer.
- Measure unknown values of resistance, capacitance and Inductance using different bridges.
- Design , build and test the circuits for practical applications using transducers
- Measure BP, solution concentration, pH, conductivity & ECG for different biomedical applications.

**Graduate Attributes (as per NBA)**

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly)
- Interpretation of data

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 17% Marks allotted to the procedure part to be made zero.

**Reference Books:**


1. Electronic Instrumentation by H. S. Kalsi, TMH, 2004 (Module-2,3 & 4)
2. Electronic Instrumentation and Measurements by David A Bell, PHI / Pearson Education2006/ Oxford Higher Education, 2013. (Module 1& 3)
3. Measurement systems application and design by E.O. Doebline 4th Edition, TMH.
4. Instrumentation for Process Measurement by Norman. A. Anderson, 3rd Edition, CRC
5. Principle of Measurement System by John. P. Bentley, 3rd Edition, Pearson, 2007
6. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.

**B. E. Common to all Programmes**
**Outcome Based Education (OBE) and Choice Based Credit System (CBCS)**
**SEMESTER - IV**

**ADDITIONAL MATHEMATICS – II**

(Mandatory Learning Course: Common to All Programmes)

(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech. programmes)

| | | | |
|---|---|---|---|
| Course Code | **18MATDIP41** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (2:1:0) | SEE Marks | 60 |
| Credits | **0** | Exam Hours | 03 |

**Course Learning Objectives:**

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

**Module-1**

**Linear Algebra:** Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.

**Module-2**

**Numerical Methods:** Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

**Module-3**

**Higher order ODE's:** Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.*[Particular Integral restricted to* $R(x)= e^{ax}, \sin ax / \cos ax$ *for* $f(D)y = R(x)$. ]

**Module-4**

**Partial Differential Equations(PDE's):-** Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

**Module-5**

**Probability:** Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems.

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

CO1: Solve systems of linear equations using matrix algebra.
CO2: Apply the knowledge of numerical methods in modelling and solving engineering problems.
CO3: Make use of analytical methods to solve higher order differential equations.
CO4: Classify partial differential equations and solve them by exact methods.
CO5: Apply elementary probability theory and solve related problems.

**Question paper pattern:**

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

| Sl No | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|
| **Textbook** | | | | |
| 1 | Higher Engineering Mathematics | B.S. Grewal | Khanna Publishers | 43rd Edition, 2015 |
| **Reference Books** | | | | |
| 1 | Advanced Engineering Mathematics | E. Kreyszig | John Wiley & Sons | 10th Edition, 2015 |
| 2 | Engineering Mathematics | N. P. Bali and Manish Goyal | Laxmi Publishers | 7th Edition, 2007 |
| 3 | Engineering Mathematics Vol. I | Rohit Khurana | Cengage Learning | 1st Edition, 2015 |

## 5th Semester

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - V | | | | |
|---|---|---|---|---|
| **Technological Innovation Management and Entrepreneurship<br>(Common to EC/TC/EI/BM/ML)** | | | | |
| **Course Code** | : **18ES51** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |
| **Credits – 3 (Each Module – 8 Hours)** | | | | |

**Course Objectives:** This course will enable students to:

- Understand basic skills of Management
- Understand the need for Entrepreneurs and their skills
- Identify the Management functions and Social responsibilities
- Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding

**Module-1**

**Management:** Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1).

**Planning:** Planning**-**Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making(Selected topics from Chapters 4 & 5, Text 1). **L1, L2**

**Module-2**

**Organizing and Staffing: Organization**-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees–Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; **Staffing**-Need and Importance**,** Recruitment and Selection Process (Selected topics from Chapters 7, 8 & 11,Text 1).

**Directing and Controlling:** Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Selected topics from Chapters 15 to 18 and 9, Text 1). **L1, L2**

**Module-3**

**Social Responsibilities of Business:** Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Selected topics from Chapter 3, Text 1).

**Entrepreneurship**: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship (Selected topics from Chapter 2, Text 2). **L1, L2**

**Module-4**

**Family Business:** Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses(Selected topics from Chapter 4,(Page 71-75) Text 2). **L1, L2**

**Idea Generation and Feasibility Analysis-**Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities. (Selected topics from Chapter 6(Page No. 111-117)&Chapter 7(Page No. 140-142), Text 2)

**Module-5**

**Business model** – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails? (Selected topics from Chapter 8 (Page No 159-164, Text 2)

**Financing and How to start a Business?** Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise(Selected topics from Chapter 7(Page No 147-149),Chapter 5(Page No 93-99) &Chapter 8(Page No. 166-172) Text 2)

**Project Design and Network Analysis:** Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.
(Selected topics from Chapters 20, Text 3). **L1, L2, L3**

**Course Outcomes:** After studying this course, students will be able to:

- Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business
- Describe the functions of Managers, Entrepreneurs and their social responsibilities
- Understand the components in developing a business plan
- Awareness about various sources of funding and institutions supporting entrepreneurs

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.
3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.

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|---|
| **4.** Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd, "Entrepreneurship", 8th Edition, Tata Mc-Graw Hill Publishing Co.ltd.-new Delhi, 2012 |
| |
| **Reference Book:**<br>Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4. |

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**Control Systems**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18ML52** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 03+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits – 4 (Each module – 10 Hours)**

**Module -1**

**Modeling of Systems and Block diagram**: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modeling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.

**Module -2**

**Signal Flow graph**: Introduction to Signal flow graph (SFG), Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula.

**Time response analysis**: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.

**Module -3**

**Concepts of stability**: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion.

**The Root Locus Technique**: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.

**Module -4**

**Frequency domain Analysis**: Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots.

**Polar Plot**: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics

**Module -5**

**State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics.

**Solution of state equations**: Solutions of homogeneous and Non-homogeneous state equations. Properties of state transition matrix, computation of state transition matrix by matrix exponential and Laplace transform method. Numerical problems

**Course Outcomes:** After studying this course, students will be able to:

1. Apply modeling concepts in implementation physical systems.
2. Apply block diagram reduction and signal flow graph analysis techniques in control systems.
3. Evaluate the performance of a system based on various control parameters.
4. Develop a model a system by applying the concept of state space analysis.
5. Design, develop and analyze simple control systems.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. "Control Systems Engineering", I.J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. "Modern Control Engineering ", K. Ogata, Pearson Education Asia/ PHI, 4th Edition, 2002.

**Reference Books:**

1. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8th Edition, 2008.
2. "Feedback and Control System", Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

**Choice Based Credit System (CBCS)**
**Semester - V**

**Digital Signal Processing**

| | | | |
|---|---|---|---|
| Course Code | : **18ML53** | CIE Marks | : 40 |
| Number of Lecture Hours/Week | : 03+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | Exam Hours | : 03 |

**Credits – 4 (Each module – 10 Hours)**

**Module -1**

Review of discrete signal and systems, DFT, IDFT, and Properties of DFT.

**Computation of FFT:** Radix-2 Decimation in Time FFT, Radix-2 Decimation in Frequency FFT Examples

**Module -2**

**Computation of FFT** (Contd.): 4-point Inverse DFT only using DIT/DIF FFT Algorithm.

**Digital Filter Structures:** Basic IIR Filter Structures: Direct forms (I & II), cascade and parallel realizations, Basic FIR filter structures- Direct & cascade form structure. Examples

**Module -3**

**FIR Filters**: Properties, Filter Design using Windows (Rectangular, Hamming, Hanning and Kaiser Window), Filter design using Frequency sampling technique. Realization single stage Lattice structure only.

**Module -4**

**IIR Filters:** Specification and design techniques, Impulse Invariant and Bilinear Transformation techniques. Design of digital Butterworth and Chebyshev low pass filters using Analog filter design techniques, Transform of Low pass to High pass, Band pass and Band rejection filters, Comparison of IIR and FIR filters

**Module -5**

**Multirate Digital Signal Processing:** Introduction, Decimation and Interpolation process, Applications of multirate signal processing: Interfacing of digital systems with different sampling rate, Implementation of Digital filter banks, DFT filter banks, Quadrature Mirror filter banks.

**Adaptive Filters:** Adaptive filters, LMS adaptive algorithms, Recursive least square algorithms, Applications of Adaptive filters.

**Course Outcomes:** After studying this course, students will able to:

1. Visualize, Classify and perform computation on discrete time signals, systems and properties.
2. Perform the transformation techniques from time domain to other and vice versa, and analyze the system and properties (Z-Transform, DFT etc.)
3. Realize / implement the Direct/ cascade/ parallel/ lattice forms of the given digital system (IIR/ FIR)
4. ComputeDFT by FFT algorithms
5. Develop transformation from analog system to digital systemand design and implementIIR and FIR filters
6. Demonstrate the advanced concepts of signal processing (Multirate and Adaptive filtering) and architecture of DSP processor

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Digital Signal Processing- PROAKIS and MANOLAKIS, 3rd Edition, Prentice Hall of India / Pearson.
2. Real Time Digital Signal Processing: Fundamentals, Algorithms and implementation using TMS Processor- V.Udayashankara, Prentice Hall of India, New Delhi, 2010.


**Reference Books:**


1. Digital Signal Processing- S K MITRA, 4th Edition, McGraw-Hill. Theory and Application of DSP- RABINAR L R and GOLD B, Prentice Hall of India, 1999.
2. Introduction to digital signal processing- JOHNSON, Prentice Hall of India 1999.
3. Digital Signal Processing-ALAN V OPPENHEIM, Prentice Hall of India.
4. DSP using Matlab-Prokis& Ingle 1st Edition, Cengage Learning

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**Diagnostic and Therapeutic Equipment's**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18ML54** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module-1**

**Patient monitoring systems: S**ystem concepts, cardiac monitors, bedsidemonitors, central monitors

**Arrhythmia & ambulatory monitoring equipment's**: Cardiac arrhythmia, arrhythmia monitors, QRS detection, exercise-stress testing, ambulatory monitoring equipment's.

**Module-2**

**Oximeters**: Oximetry, ear oximeters, pulse oximeters, skin reflectance oximeters, intravascular oximeters,

**Audiometer**: Mechanism of hearing, measurement of sound, basic audiometers, pure tone audiometer, speech audiometer, Bekesy systemaudiometers, evoked response audiometry, calibration of audiometers, hearing aids.

**Module-3**

**Cardiac pacemakers: E**xternal pacemakers, implantable pacemakers, pacing systems.

**Cardiac defibrillators**: Need, DC defibrillator, implantable defibrillator, pacer-cardioverter-defibrillator.

**Neurological equipment's:** Clinical significance of EEG, EEG recording systems and associated pathology.

**EMG:** Recording system and analysis of EMG. Nerve conduction study.

**Module-4**

**Ventilators:** mechanics of respiration, artificial ventilation, ventilators, types of ventilators, classification of ventilators, pressure-volume-flow graphs, modern ventilators, high frequency ventilators, humidifiers, nebulizers, aspirators

**Module-5**

**Physiotherapy &Electrotherapy equipment's:** high frequency heat therapy, shortwave and microwave diathermy, ultrasonic therapy, electro-diagnosis, electrical stimulation, bladder stimulators, cerebellar stimulators

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the design and working of patient monitoring systems and arrhythmia and ambulatory Equipments.
2. Comprehend and relate the construction, working and applications of oximeters and audiometers.
3. Interpret the importance of cardiac pacemakers and neurological equipments in healthcare.
4. Recognize the need for ventilators and their types in intensive care.
5. Analyze the working of instruments used in physiotherapy and electrotherapy.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

1. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications.

**Reference Books**

1. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications
2. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition –CRC Press, 2006.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Pearson Education, New Delhi, 2007.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**Rehabilitation Engineering**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18BM/ML55** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module 1:**

**Introduction to Rehabilitation:**

What is Rehabilitation, Medical Rehabilitation, Preventive Rehabilitation, Impairment, Disability and Handicap, Sociovocational Rehabilitation

**Rehabilitation Team:** Classification of members, Medical, The Rehabilitation team – The medical team, Physical therapist, Occupational therapist, Prosthetist-Orthotist, Rehabilitation nurse, Speech pathologist, Psychologist and child development Specialist, Horticultural Therapist, Music therapist, Creative Movement Therapist, Dance and play Therapist, Recreational therapist, Biomedical engineer.

(Text 1: Chapter 1, Chapter 2)

**Module 2:**

**Therapeutic Exercise Technique:** Coordination Exercises, Balance Training, Gait, Pathological Gaits, Gait Training – Crutch Walking: Patterns of Gait, Relaxation exercises, Methods for training Relaxation, Strengthening exercises, Mobilization exercises

**Principles in Management of Communication:** Communication, Speech, Language, Aphasia, Dysarthria, Speech therapy, Dysphagia, Communication for Visually impaired, Types of visual aids, Writing aids,

(Text 1: Chapter 3, Chapter 5)

**Module 3:**

**Orthotic Devices in Rehabilitation Engineering:** Definition, General Principles of Orthosis, Biomechanics of Orthosis, Classification, Material and fabrication for lower limb Orthosis, Calipers – Foot Orthoses, Ankle-Foot Orthosis, Knee-Ankle-Foot Orthosis, Hip-Knee-Ankle-Foot Orthoses, Functional Electrical Stimulation, Spinal Orthosis- Cervical, Head cervical Orthosis, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacro-orthosis, Splints-its functions & types.

(Text 1: Chapter 7)

**Module 4:**

**Amputation:** General Principles of Amputation Surgery, Levels of Amputation in Upper limb and Lower limb, Rehabilitation of Lower limb amputations

**Prosthetics:** Classification, Components of Prosthesis, Upper limb Prosthetics – Terminal Devices, Myoelectric Prosthesis, Lower extremity Prosthesis – Transfemoral prosthesis, Prosthesis for hip disarticulation.

(Text 1: Chapter 8)

**Module 5:**

**Mobility Aids:** Functions, Parallel bars, Walking frames – types, Walking stick, Tripods, Quadripods, Crutches – types, Wheel chairs – parts and maintenance

(Text 1: Chapter 9)

**Course Outcomes:** After studying this course, students will be able to:

1. Define rehabilitation and explain the composition of rehabilitation team.
2. Discuss the engineering principles of rehabilitation engineering.
3. Apply engineering skills in the development of prosthetic and orthotic devices.
4. Evaluate the orthopedic design and applications.
5. Apply the principles of engineering in the development of mobility aids for physically handicap.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Rehabilitation Medicine – By Dr. S. Sunder, 3rd Edition, Jaypee Medical Publications, Reprint 2004.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**VLSI Design**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18 EI/BM/ML 56** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

Moore's law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.

**Basic Electrical Properties of MOS And BiCMOS Circuits:** Drain to source current versus voltage characteristics, threshold voltage, transconductance.

**Module -2**

**Basic Electrical Properties of MOS And BiCMOS Circuits:** nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, BiCMOS inverters, latch up.

**Basic Circuit Concepts:** Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers.

**Module -3**

**MOS and BiCMOS Circuit Design Processes**: MOS layers, stick diagrams, nMOS design style, CMOS design style, design rules and layout, λ - based design.

**Scaling of MOS Circuits:** scaling factors for device parameters, limitations of scaling.

**Module -4**

**Subsystem Design and Layout-1 :** Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.

**Subsystem Design and Layout-2 :** Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.

**Module -5**

**Design Process-Computational Elements:** Regularity, design of ALU subsystem, ALU using adders, carry look ahead adders, Multipliers, serial parallel multipliers, Braun array, Bough – Wooley multiplier.

**Memory, Register and Aspects of Timing:** Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

**Course Outcomes:** After studying this course, students will able to;

1. Identify the CMOS layout levels, and the design layers used in the process sequence.
2. Describe the general steps required for processing of CMOS integrated circuits.
3. Design static CMOS combinational and sequential logic at the transistor level.
4. Demonstrate different logic styles such as complementary CMOS logic, pass-transistorLogic, dynamic logic, etc.

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|---|
| **5.** Interpret the need for testability and testing methods in VLSI. |
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| **Question Paper Pattern:**<br>• The question paper will have TEN questions.<br>• Each full question carry 20 marks<br>• There will be TWO full questions (with maximum of THREE sub questions) from each module.<br>• Each full question will have sub questions covering all the topics under a module.<br>• The students will have to answer FIVE full questions, selecting ONE full question from each module. |
| |
| **Text Books:**<br>1. Basic VLSI Design -3rd Edition, Douglas APucknell, KamaranEshraghian, Prentice Hall of India publication, 2005. |
| |
| **Reference Books:**<br>1. CMOS Digital Integrated Circuits, Analysis And Design, 3rd Edition, Sung – Mo (Steve) Kang, Yusuf Leblbici, Tata McGraw Hill, 2002.<br>2. VLSI Technology - S.M. Sze, 2nd edition Tata McGraw Hill, 2003. |

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**Signal Conditioning Circuits and Data Acquisition Lab**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18 EI/BM/ML L57** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Practical Hours | : 42 | | Exam Hours | : 03 |

**Credits - 2**

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 –Analyzing, L5 – Evaluating, and L6 - Creating

| **Laboratory Experiments:**<br>**Note:** Standard design procedure to be adopted<br>Students should build the circuit using discrete components and ICs (models are not to be used) | **Revised Bloom's Taxonomy (RBT)Level** |
|---|---|
| 1. To design and implement<br>• Inverting Amplifier and Inverting Attenuator<br>• Non-Inverting Amplifier and Voltage Follower | L3, L4 |
| 2. To realize<br>• Full wave Precision rectifier<br>• Voltage regulator using IC 723 | L3, L4 |
| 3. To design and implement<br>• Butterworth I order Low-pass filter<br>• Butterworth II order High-pass filter | L3, L4 |
| 4. To design and implement<br>• RC Phase shift oscillator<br>• Wein Bridge oscillator | L3, L4 |
| 5. To realize<br>• ZCD<br>• Positive and Negative Voltage level detectors | L3, L4 |
| 6. To design and implement<br>• AstableMultivibrator using 555 timer<br>• Mono-stable Multivibrator using 555 timer | L3, L4 |
| 7. To realize<br>• Sample and Hold circuit using discrete components | L3, L4 |
| 8. To realize<br>• Programmable Gain Amplifier using Analog Mux | L3, L4 |
| 9. To design and implement<br>• 4 bit R-2R DAC using discrete components | L3, L4 |
| 10. To design and implement<br>• 8-bit DAC using IC (DAC 0800) | L3, L4 |
| 11. To design and implement<br>• 8-bit ADC using IC (ADC 0809) | L3, L4 |
| 12. To design and implement<br>• 3 bit Flash ADC using ICs | L3, L4 |
| | |

**Course Outcomes:** After studying this course, students will able to;

1. Sketch/draw circuit schematics, construct circuits on breadboards, analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources.
2. Memorizeand reproduce the manufacturer's data sheets of IC 555 timer, IC µa741 op-amp and data converters like IC ADC 0800 and IC DAC 0809.
3. Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.
4. Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.
5. Design and evaluate different resolution data converters using discrete components and ICs.

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**Reference Books:**


1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International.
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI.
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, DhanpatRai Publications, 19th edition, 2011.
4. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin &Fred. F. Driscoll, PHI/Pearson, 2006
5. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
6. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - V**

**Diagnostic and Therapeutic Equipment's Lab**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18MLL58** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Practical Hours | : 42 | | Exam Hours | : 03 |

**Credits - 2**

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 –Analyzing, L5 – Evaluating, and L6 - Creating

| **Title of the Experiments** | **Revised Bloom's Taxonomy (RBT)Level** |
|---|---|
| 1. Measurement of Operational Amplifier parameters: I/P Offset current, I/P bias current, Slew rate, I/P offset Voltage, PSRR, CMRR & offset nulling. | L3, L4 |
| 2. Design and Test the Operational Amplifier as: (i) Adder, (ii) Substractor, (iii) Integrator, and (iv) Differentiator. | L3, L4, L5, L6 |
| 3. Conduct an experiment to perform Operational Amplifier as: (i) Comparator (ii) Schmitt Trigger. | L3, L4 |
| 4. Design and Test the bio-potential amplifiers for ECG/ or EEG/ or EMG | L3, L4, L5, L6 |
| 5. Design and Test the Notch Filter for 50 Hz and 60 Hz. | L3, L4, L5, L6 |
| 6. Design and Testing of Instrumentation amplifier for different gains. | L3, L4, L5, L6 |
| 7. Recording and analysis of EEG in time and frequency domains. | L3, L4 |
| 8. Recording and analysis of EMG in time and frequency domain. Determination of nerve conduction velocity. | L3, L4 |
| 9. Quantification and assessment of hearing thresholds using audiometers. | L3, L4 |
| 10. Simulation and analysis of Pacemaker & Defibrillator Circuits. | L3, L4 |
| 11. Measurement, analysis and interpretation of physiological parameters using patient monitoring system. | L3, L4 |
| 12. Measurement and analysis of Lung Volumes and Lung Capacities using spirometer. | L3, L4 |
| 13. Measurement and analysis of Oxygen Saturation and Pulse rate from Pulse Oximeter. | L3, L4 |
| 14. Study of stimulator circuits: a) Nerve stimulatorb) bladderstimulator | L3, L4 |

**Course Outcomes**: After studying this course, students will able to;

1. Measure the Op-amp parameters and design the circuits using opamp for various applications.
2. Design and verify the different bio amplifiers & filters.
3. Acquire and analyze the ECG, EEG and respiratory signals
4. Analyze the visual ability and audibility using appropriate instruments.
5. Demonstrate the working of different diagnostic and therapeutic hospital equipment's.
6. Install and operate different types of hospital instruments.

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of

marks.

4. Change of experiment is allowed only once and 17% Marks allotted to the procedure part to be made zero.

**Reference Books**


1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International.
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI.
3. John G Webster, "Medical Instrumentation-Application and design", 3rd edition, John Wiley Publications
4. R S Khandpur, "Handbook of biomedical Instrumentation", 2nd edition, Tata McGraw Hill publications
5. Joseph D. Bronzino, "Medical Devices and Systems - The Biomedical Engineering Handbook", Third Edition – CRC Press, 2006.

**B. E. COMMON TO ALL PROGRAMMES**
**Choice Based Credit System (CBCS) and Outcome Based Education (OBE)**
**SEMESTER – V**

**ENVIRONMENTAL STUDIES**

| | | | |
|---|---|---|---|
| Course Code | **18CIV59** | CIE Marks | 40 |
| Teaching Hours / Week (L:T:P) | (1:0:0) | SEE Marks | 60 |
| Credits | 01 | Exam Hours | 02 |

**Module - 1**

**Ecosystems** (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
**Biodiversity:** Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

**Module - 2**

**Advances in Energy Systems** (Merits, Demerits, Global Status and Applications)**:** Hydrogen, Solar, OTEC, Tidal and Wind.
**Natural Resource Management** (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

**Module - 3**

**Environmental Pollution** (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies)**:** Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
**Waste Management & Public Health Aspects:** Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

**Module - 4**

**Global Environmental Concerns** (Concept, policies and case-studies):Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

**Module - 5**

**Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications):** G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs.
**Field work:** Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

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

- CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- CO3: Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
- CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

**Question paper pattern:**

- The Question paper will have 100 objective questions.
- Each question will be for 01 marks
- Student will have to answer all the questions in an OMR Sheet.
- The Duration of Exam will be 2 hours.

| Sl. No. | Title of the Book | Name of the Author/s | Name of the Publisher | Edition and Year |
|---|---|---|---|---|

**Textbook/s**

| | | | | |
|---|---|---|---|---|
| 1 | Environmental Studies | Benny Joseph | Tata Mc Graw – Hill. | 2nd Edition, 2012 |
| 2. | Environmental Studies | S M Prakash | Pristine Publishing House, Mangalore | 3rd Edition, 2018 |
| 3 | Environmental Studies – From Crisis to Cure | R Rajagopalan | Oxford Publisher | 2005 |
| **Reference Books** | | | | |
| 1 | Principals of Environmental Science and Engineering | Raman Sivakumar | Cengage learning, Singapur. | 2nd Edition, 2005 |
| 2 | Environmental Science – working with the Earth | G.Tyler Miller Jr. | Thomson Brooks /Cole, | 11th Edition, 2006 |
| 3 | Text Book of Environmental and Ecology | Pratiba Sing, Anoop Singh& Piyush Malaviya | Acme Learning Pvt. Ltd. New Delhi. | 1st Edition |

## 6th SEMESTER

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**Analog and Digital Communication Systems**
**(Common to EI, BM &ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18EI/BM/ML61** | | CIE Marks | : 40 |
| Number of Lecture Hours / Week | : 04 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits – 4 (Each module – 10 Hours)**

**Module -1**
Introduction to analog and Digital Communication, Historical Background and Applications.
**Amplitude Modulation:** Amplitude Modulation, Virtues, Limitations, and Modifications of AM,DSBSC Modulation, Costas Receiver, Single Side band Modulation, Vestigial Sideband Modulation, Theme Examples.(Text 1:1.1,1.2,3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.9)

**Module -2**
**Angle Modulation:** Basic Definitions, Properties of Angle-Modulated Waves, Relationship between PM and FM Waves, NBFM, WBFM, Transmission Bandwidth of FM Waves, Generation of FM waves, Demodulation of FM Signals, Theme Example.(Text 1:Chapter 4 )

**Module -3**
**Pulse Modulation: Transition from Analog to Digital Communications:** Sampling Process, PAM, Completing the Transition from Analog to Digital, Quantization Process, PCM, Delta Modulation, Theme Examples.(Text 1: 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 5.10)

**Module -4**
**Digital Band-Pass Modulation Techniques:** Binary Amplitude Shift Keying (BASK): Generation and Detection, Binary Phase Shift-Keying (BPSK): Generation and Detection, Quadriphase Shift Keying (QPSK): Generation and Detection, Binary Frequency Shift Keying (BFSK), Minimum-Shift Keying (MSK), Differential Phase Shift Keying (DPSK): Generation and Detection, Theme Examples.
(Text 1: 7.2, 7.3, 7.4, 7.6, 7.9)
**[Note: Excluding Computer Experiments in all the above Modules]**

**Module -5**
**Wireless Personal Area Networks (WPAN):**Network Architecture, WPAN Components, WPAN Technologies and protocols (Bluetooth &Zigbee), WPAN Applications.(Text2: 4.1, 4.2, 4.3, 4.4, 4.5)

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the basics concepts of analog modulation techniques.
2. Discuss the basic concepts of digital modulation techniques.
3. Describe the basic concepts of digital data and pulse communication.
4. Explain and analyze different digital modulation techniques.
5. Describe different wireless area networks and their applications.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Book:**


1. Simon Haykin, John Wiley & sons, "Introduction to Analog and Digital Communications"-Second Edition, 2012, ISBN 978-81-265-3653-5.
2. Dr. SunilKumarS.Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocols", John Wiley & sons, 2014 Edition, ISBN 978-81-265-2069-5.


**Reference Books:**


1. John G Proakis and MasoudSalehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
2. Ian A Glover and Peter M Grant, "Digital Communications", Pearson Education, Third Edition, 2010, ISBN 978-0-273-71830-7.
3. B. P. Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 4th Edition, 2010, ISBN: 978-0-198-07380-2.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**Medical Image Processing**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML62** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : 04 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits – 4 (Each module – 10 Hours)**

**Module -1**

**Introduction**: Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIPsystem, Image sensing and acquisition, A simple image formation model, Image sampling and quantization.Basic relationship between pixels,Colour image processing fundamentals and models.

**Text**: Chapter 1, 2.3, 2.4, .2.5, 6.1, 6.2

**Module -2**

**Image Enhancement in Spatial Domain:** Background, Point processing – Image negatives, Logtransformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logicoperations – Image subtraction, Image averaging. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters

**Text**: 3.1, 3.2, 3.3, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 3.4, 3.5, 3.6

**Module -3**

**Image Enhancement In Frequency Domain:** Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basicsof filtering in the frequency domain.

Image smoothing using frequency domain filters – Ideal lowpass filters, Butterworth lowpass filters, Gaussian lowpassfilters; Image sharpening using frequency domain filters – Ideal highpass filters, Butterworth highpass filters, Gaussian highpass filters, Homomorphic filtering.

**Text:** 4.1, 4.2, 4.5.5, 4.6, 4.7,4.8, 4.9

**Module -4**

**Image Restoration:** Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter.

**Image Compression:** Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding.

**Text:** 5.1, 5.2, 5.3.1, 5.3.2, 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5

**Module -5**

**Image Segmentation:** Fundamentals, Point detection, Line detection, Edge models, Edge detection, Cannyedgedetector. Thresholding, Region based segmentation.

**Text**: 10.1, 10.2.1 – 10.2.6, 10.3, 10.4

**Course Outcomes:** After studying this course, students will be able to,

1. Define the general terminology of digital image processing.
2. Identify the need for image transforms and their types both in spatial and frequency domain.
3. Identify different types of image degradation and apply restoration techniques.
4. Describe image compression models and learn image compression techniques.
5. Explain and apply various methodologies for image segmentation.
6. Implement image processing and analysis algorithms.6

Note: It is suggested to give assignments / hands-on-experience on the above image processing concepts using Matlab / C programming on medical images like x-ray / CT / MRI.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.

**Reference Books:**

1. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
2. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**JAVA Programming**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| **Course Code** | **: 18EI/BM/ML63** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : 04 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 50 | | Exam Hours | : 03 |

**Credits – 4 (Each module – 10 Hours)**

**Course objectives: This course will enable students to**

- Understand object oriented programming concepts, and apply them in solving problems.
- Set up Java JDK environment to create, debug and run simple Java programs.
- Introduce the concepts of exception handling and multithreading.
- Introduce the design of Graphical User Interface using applets and swing controls.

**Module -1**

**Object Oriented Programming and JAVA:** Object Oriented Paradigm, basic concepts, benefits and applications of OOPs. JAVA history and features, How java differs from C and C++, JAVA and Internet, JAVA and World Wide Web, Web browsers, JAVA support systems, JAVA environment. JAVA program structure, Tokens, Statements, JAVA Virtual Machine.

**Overview of JAVA Language:** Simple Java Program, Math functions, An application with two classes, Java program structure, Java Tokens, Java Statement, Implementing a Java Program, Java Virtual Machines, Command and Line Arguments, Programming Style.

**Module -2**

**Constants, Variables, Data Types:** Declaration and scope of Variables, Symbolic constants, Type Casting, Standard Default values.

**Operators and Expression:** Arithmetic, Relational, Logical, Assignment, Increment, Decrement, Conditional, Bitwise, Special Operators, Arithmetic Expressions, Evaluation, Procedure of Operators, Type Conversion in Expressions, Mathematical functions.

**Decision Making, Branching and Looping:** If Statement, If….Else statement, Nesting of statements, Switch Statement, Operator, While Statement, Do statement, For statement, Jump in Loops.

**Module-3**

**Classes, Objects and Methods:** Class definition and declaration, Creating Object, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting Methods, Inheritance, Overriding Methods, Final Variables and Methods, Final Classes, Finalizer Methods, Abstract Methods and Classes, Visibility Control.

**Arrays, Strings and Vectors:** One and two dimensional arrays, Strings, Vectors, Wrapper Classes

**Module -4**

**Interfaces:** Definition, Extending and Implementing Interfaces, Accessing Interface variables.

**Packages:** JAVA API Packages, Using System packages, Naming conventions, Creating, Accessing and Using a package, Adding a class to a Package, Hiding Classes.

**Multithreaded Programming :** Creating and Extending Thread Class, Stopping, Blocking and Life

Cycle of Thread, Using Thread Methods, Thread Exceptions and Priority, Synchronization, Implementing runnable Interface.

**Module -5**

**Applet Programming:** Introduction, How Applets Differ from Applications, Preparing to write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable Applet , Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, Passing Parameters to Applets, Aligning the Display, More about HTML Tags, Displaying Numerical Values, Getting Input from the User, Event Handling.

**Course Outcomes**: After studying this course, students will be able to

- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.
- Develop multithreaded applications with synchronization.
- Develop applets for web applications.
- Design GUI based applications.

**Question Paper Pattern**

- The question paper will have TEN questions
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Graduate Attributes**

- Programming Knowledge
- Design/Development of Solutions
- Conduct Investigations of Complex Problems
- Life-Long Learning

**Text Books:**

1. E. Balaguruswamy – Programming with JAVA – A Primer – 5th Edition, McGraw Hill
2. Herbert Schildt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2007.

**Reference Books:**

1. Object oriented programming in TURBO C++ - Robert Lafore, Galgotia Publications, 2002.
2. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, Pearson Education, 2008.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**Medical Physics**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18ML641** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**
Heat and cold in medicine: Introduction, Physical basis of heat and temperature Thermography and temperature scales, mapping of body's temperature, heat therapy, Use of cold in medicine, Cryosurgery and safety aspects. Energy, work, power and pressure: Conservation of energy in the body, energy changes in the body, work and power, heat losses from the body.

**Module -2**
Measurement of pressure in the body, pressure inside skull, eye, digestive system, skeleton & urinary bladder, Hyper baric Oxygen Therapy, Physics of lung and breathing: Introduction, the air ways, blood & lung interaction, measurement of lung volumes, pressure-air flow-volume relationship of the lungs, Physics of alveoli, breathing mechanism, air-way resistance, work of breathing, physics of some common lung diseases.

**Module -3**
Physics of cardiovascular system: Introduction to cardiovascular system, major components of cardiovascular system, oxygen and carbon dioxide exchange in the capillary system, work done by the heart, blood pressure and its measurements, transmural pressure, Bernoulli's principle applied to cardiovascular system, Blood flow-laminar & turbulent, heart sounds, physics of some cardiovascular diseases.
Electricity within the body: The nervous system & neurons. Electrical potential of nerves, electromyogram, electrocardiogram, electroencephalogram, electroretinogram, electrooculogram, magneto cardiogram & magneto encephalogram Electric shock, high frequency and low frequency electricity in medicine, magnetism in medicine.

**Module -4**
Sound in medicine: General properties of sound, body as a drum, the stethoscope, Ultrasound picture of the body, Ultrasound to measure motion, physiological effects of ultrasound in therapy, the production of speech.
Physics of ear and hearing: The outer ear, the middle ear and the inner ear, Sensitivity of ears, testing hearing, Deafness & hearing aids.

**Module -5**
Light in medicine: Measurement of light & its units, applications of visible light in medicine Applications of UV &IR in medicine, LASERs in medicine, applications of microscopes in medicine.
Physics of eyes and vision: Focusing elements of the eye, the retina, diffraction effects of the eye, optical illusion, defective vision & correction, color vision & chromatic aberration, Instrument used in ophthalmology.

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the effects of physiological parameters on human body.
2. Explain the function of cardio vascular system and respiratory system.
3. Illustrate the process of generation and propagation of electricity within the human body.
4. Examine the physics of auditory and visual system in human body.
5. Analyze the physiological functioning of different body parts.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Medical Physics-John R. Cameron, James G. Skofronick, 1978.

**Reference Books:**

1. Physics of the Human Body- Herman I.P., Springer

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VI**

**Hospital Design, Planning & Management**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML642** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module-1**

**Planning & Building a New Hospital:** Role of Hospital in Health Care, Hospital Planning & Design, Guiding principle in Hospital facilities & services, Functional Plans for Hospital construction, Design items, Functional program & design stage, Planning the Hospital building.

**Module-2**

**Effective Hospital Management**: Planning, Organization, Directing & Leading, Controlling, Financial Management

**Administrative Service:** Medical Record, Hospital Infection, Hospital Utilization Statistics, Material Management, Evaluation of Hospital services.

**Module-3**

**Planning & Designing Medical Services:** Out Patient service, Emergency service, Clinical laboratories, Radiology services, Radiation Therapy Department, Surgical Department, Nursing Department, Operation Theater, CSSD Nursing services.

**Module-4**

**Planning & Designing Engineering Services:** Engineering Department, Maintenance management, Clinical [Bio-medical] Engineering, Electrical System, Air Condition System, Water supply & sanitary system, Centralized Medical Gas System, Telecommunication System, Environmental Control, Safety & Security System, Disposal of Hospital Wastes.

**Module-5**

**Planning & Design of Supportive Services:** Admitting Department, Medical Record Department, Centralized Sterilization & Supply department, Pharmacy Material Management, Food service Department, Laundry & Linen Services, House Keeping & Val entry Department.

**Course Outcomes:** After studying this course, students will able to;

1. Design and construct the hospital with an effective administration and financial management.
2. Plan and develop an effective hospital supportive system for all types of hospital services.
3. Evaluate the proper functioning and services provided by the hospitals.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Textbook**

1. Principles of Hospital Administration & Planning - by B. M.Sakharkar, Jaypee Publications,

1998.
2. Hospital Facilities, Planning & Management - by G. D. Kunders, TataMcGraw Hill, 2004.

**REFERENCE BOOKS:**

1. Hospital Administration & Management - by S. L. Goel& R. KumarDeep& Deep Publications
2. Applied Clinical Engineering - by Barry N. Feinberg, Prentice Hall,1984.
3. Clinical Engineering Principle & Practices - By John G. Webster &Albert M. Cook, Prentice Hall.

| Choice Based Credit System (CBCS)<br>Semester - VI | | | | |
|---|---|---|---|---|
| **Medical Electronics Design** | | | | |
| Course Code | : **18ML643** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

Introduction, Definition of Medical Device, Medical Device Life cycle, Medical Device design cycle, Bio-potential Amplifier: Characteristics, Single ended Bio-potential Amplifier, Single ended Bio-potential Amplifier Arrays, Body Potential drivers.

**Module -2**

Differential amplifiers, Simple Differential Bio-potential Amplifier, Op-amp Instrumentation amplifier, Instrumentation Bio-potential Amplifier, Switched capacitor based Bio-potential Instrumentation Bio-potential Amplifier.

**Module -3**

Band pass Selection for Bio-potential amplifier introduction, Wide band Bio-potential amplifier, Bio-potential amplifier with dc rejection, AC-coupled Instrumentation Bio-potential Amplifier front end, , Passive filter, Active filter, 50-60 Hz notch filter, Switched-capacitor filters: fourth, fifth ,eighth -order Butterworth low-pass .

**Module -4**

Radiated Emission: Fields radiated by a loop; straight wire. Differential mode radiation and common mode radiation. Radiation from non-sinusoidal sources and broadband sources.

**Module -5**

Standards and Regulations Background: What are standards? Voluntary and mandatory standards, Standards development process, Conformity assessment with standards, National and international standards systems, Identification of standards, Current trends in the use of standards in medical device regulations.

The ISO 9000 Series of Standards, The ISO 14000 Series of Standards, EN 46001, The ISO 13485 Standards, ISO 9000-3, IEC 601-1-4. The Medical Devices Directives, Choosing the appropriate directive, Identifying the applicable essential requirements, Identification of corresponding harmonized standards, Essential requirements, Classification of the device based on conformity, Medical Devices Directives, Active Implantable Medical Devices Directives, *In-vitro* Diagnostic Medical Devices Directives.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the basic requirements for the design of medical devices.
2. Design and demonstrate different amplifier circuits for the medical device
3. Design and demonstrate different filter circuits for the medical device
4. Discuss safety hazards of ionizing radiation
5. Discuss various global level regulatory bodies for medical device design

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Book(s):**

1. "Design and development of Medical Electronic Instrumentation", David Prutchi, Wileypublishers.(2005)
2. "The Designer's Guide to Electromagnetic Compatibility", Daryl Gerke and Bill Kimmel,Kimmel Gerke Associates Publishers ". (2002)
3. "Medical device regulations: global overview and guiding principles" , Michael Cheng,World Health Organization publishers.(2003)

**Reference Books:**

1. "Handbook of medical device design", Richard C. Fries, 1st edition, CRC Press. (2000)
2. "Execution, and Management of Medical Device Clinical Trials",Salah Abdel-aleem, Wiley Publishers.(2009)
3. "Pharmaceutical and Medical Device Validation by Experimental Design", Lynn D.Torbeck(2007)

**Choice Based Credit System (CBCS)**
**Semester - VI**

**Virtual Bio-Instrumentation**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18BM/ML644** | | CIE Marks | : 40 |
| Number of Lecture Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module-1**

**Graphical System Design (GSD):** Introduction, GSD model, Design flow with GSD, Virtual Instrumentation, Virtual Instrumentation and traditional instrumentation, Hardware and software in virtual instrumentation, Virtual Instrumentation for test, control and design, GSD using LabVIEW, Graphical programming and textural programming.

**Introduction to LabVIEW:** Introduction, Advantages of LabVIEW, Advantages of LabVIEW, Software environment, Creating and saving a VI, Front panel toolbar, Block diagram toolbar, Palettes, Shortcut menus, Property dialog boxes, Front panel controls and indicators, Block diagram, Data types, Data flow program, LabVIEW documentation resources, Keyword shortcuts.

**Module-2**

**Modular Programming:** Introduction, Modular Programming in LabVIEW, Build a VI front panel and block diagram, ICON and connector pane, Creating an icon, Building a connector pane, Displaying subVIs and express Vis as icons or expandable nodes, Creating subVIs from sections of a VI, Opening and editing subVIs, Placing subVIs on block diagrams, Saving subVIs, Creating a stand-alone application.

**Data Acquisition:** DAQ software architecture, DAQ assistant, Channels and task configurations, Selecting and configuring a data acquisition device, Components of computer based measurement system.

**Module-3**

**General Goals of Virtual Bio-Instrumentation (VBI):** Definition of VBI and importance, General Goals of VBI applications. Basic Concepts: DAQ basics, LabVIEW basics, BioBench basics.

**Neuromuscular Electrophysiology (Electromyography):** Physiological basis, Experiment set up, Experiment descriptions, Trouble shooting the nerve –Muscle Preparation.

**Cardiac Electrophysiology (Electrocardiology):**Physiological basis, Experiment descriptions.

**Cardiopulmonary Applications:** Cardiopulmonary measurement system, How the Cardiopulmonary measurement system works, Clinical Significance

**Module-4**

**Medical Device Development Applications: The Endotester –** A Virtual Instrument –BasedQuality control and Technology, Assessment System for surgical video Systems: Introduction, Materials and Methods, Endoscope Tests, Results, Discussion.

**FluidSenseInnovative IV PumpTesting:** Introduction, The test System, Training Emulator.

**Module-5**

**Healthcare Information management Systems:**

**MedicalInformatics:** Defining medical informatics, Computers in medicine, ElectronicMedical record, Computerized physician order entry, Decision support.

Information Retrieval, Medical Imaging, Patient Monitoring, Medical Education, Medical Simulation.

Managing Disparate Information: ActiveX, ActiveX Data Objects(ADO), Dynamic Link Libraries, Database Connectivity, Integrated Dash boards.

**Course Outcomes**: After studying this course, students will able to:

1. Describe the Graphical System Design approach & basic features and techniques of LabVIEW.
2. Use the Modular Programming concepts for creation of VIs & employ DAQ assistant for configuration of hardware devices.
3. Discuss the basic concepts of DAQ Systems, LabVIEW , and BioBench software.
4. Describe the LabVIEW and BioBench software for EMG, ECG, and Cardiopulmonary system analysis.
5. Discuss the Medical Device Development Applications for Surgical Video Systems and IV Pumps.
6. Explain the Healthcare Information Management Systems using Information Science and Technology.

**Note:** Wherever possible students should be given appropriate hands on training with Virtual Instrumentation LabVIEW software.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Textbook:**

1. Virtual Instrumentation using LabVIEW by Jovitha Jerome, PHI Learning Private Limited, 2010. (Module 1 & 2)
2. "Virtual Bio-Instrumentation" Biomedical, Clinical, and Healthcare Applications in Lab VIEW. ,by Jon B. Olansen and Eric Rosow, Prentice Hall Publication, 2002.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**Medical Image Processing Lab**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/MLL66** | | CIE Marks | : 40 |
| Number of Tutorial + Practical Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Practical Hours | : 42 | | Exam Hours | : 03 |

**Credits – 2**

**Title of the Experiments**

1. Display of an image, negative of an image.
2. Contrast stretching of a low contrast image.
3. Display of a histogram, and histogram equalization.
4. Bit plane slicing of an image.
5. Image enhancement by Intensity/Gray level slicing.
6. Implementation of FT for an image.
7. Implementation of High pass, Low pass filtering.
8. Mean and Median filtering of an image.
9. Implementation of image sharpening filters and edge detection usinggradient filters.
10. Image Rotation (Clockwise and anticlockwise) and Flipping (Horizontaland Vertical)
11. Canny edge detection.
12. Image compression by DCT.
13. Implementation of image segmentation techniques.

(Note: It is suggested to carry out the above experiments by Matlab / C programming on diagnostic images such as x-ray / CT / MRI / Ultrasound)

**Course Outcomes**: After studying this course, students will get hands on exposure to:

1. Implement and analyze image enhancement techniques.
2. Implement and analyzeImage segmentation and image compression techniques.
3. Develop and analyzeImage processing algorithms in practical applications/case studies.

**Conduct of Practical Examination:**

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VI

**JAVA Programming Lab**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18 EI/BM/ML L67** | | CIE Marks | : 40 |
| Number of Tutorial+ Practical Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total No. of Practical hours | : 42 | | Exam Hours | : 03 |

**Credit-2**

1) a. Write a java Program to illustrate the creation of variables of basic types and effect of type conversions.
   b. Write a java Program that display the roots of a quadratic equation ax2+bx=0. Calculate the discriminate D and based on value of D, describe the nature of root.
2) a. Write a java program to demonstrate creation and accessing of objects and methods.
   b. Write a java program to illustrate use of constructor overloading and method overloading.
3) a. Write a java Program to demonstrate the concept of single Inheritance.
   b. Write a java program to implement multi level Inheritance.
4) Write a simple Program on Java to illustrate the implementation of the concept of multiple inheritance using interfaces.
5) a. Write a java program to demonstrate StringMethods used for manipulating strings like accessing, inserting, modifying and appending.
   b. Write a java program to illustrate use of most commonly used wrapper class methods.
6) Write a Java program to implement the concept of importing classes from user defined package and creating packages.
7) Write a Java program using Synchronized Threads, which demonstrates Producer Consumer concept.
8) a. Write a Java program for creation of Java Built-in Exceptions.
   b. Write a Java program for creation of User Defined Exceptions.
9) Complete the following:
   i. Create a package named shape.
   ii. Create some classes in the package representing some common shapes like Square, Triangle, and Circle.
   iii. Import and compile these classes in other program
10) a. Write a Java program to copy bytes from one file to another using FileInputStream and File Output Stream.
    b. Write a Java program to illustrate the process of file concatenation and buffering.
11) Write a Java applet program, which handles keyboard event.
12) Write an Applet that displays ―Hello World‖ (Background color-black, text color-blue and your name in the status window.).
13) Write a Java Program to demonstrate Mouse events.
14) Write programs for using Graphics class
    i. To display basic shapes and fill them
    ii. Draw different items using basic shapes
    iii. set background and foreground colors.

**Assignment:** Create simple JAVA or Android Calculator console application which performs both basic and scientific operation.

Course Outcome: After the completion of this Laboratory course, students will be able to:

1. To Understand OOPs concepts and basics of Java programming.
2. To Create Java programs using inheritance and polymorphism.
3. To Implement error-handling techniques using exception handling and multithreading.
4. To Develop GUI using Applets and Swing components.
5. Analyze, design and develop solutions to real-world problems applying OOPs concepts through JAVA.

**Conduct of Practical Examination:**

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
**Semester - VI**

**Mini Project**

| | | | |
|---|---|---|---|
| Course Code | : **18MLMP68** | CIE Marks | : 40 |
| Number of Practical Hours /Week | : 02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : -- | Exam Hours | : 03 |

**Credits – 2**

**Mini-project work:**
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

**CIE procedure for Mini-project:**

**(i) Single discipline:**The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

**SEE for Mini-project:**

**(i) Single discipline:** Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

**(ii) Interdisciplinary:**Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - VI |
| --- |
| **Internship** |
| **Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. |

## 7th SEMESTER

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Biomedical Digital Signal Processing**
(Common to BM & ML)

| | | | |
|---|---|---|---|
| **Course Code** | **: 18BM/ML71** | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. **Text-1:** 1.1, 1.3, 1.4, 1.5

Neurological Signal processing: Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation. **Text-2:** 4.1 to 4.9

**Module -2**

**Filtering for Artifacts Removal :** Random noise, structured noise and physiological interference, stationary versus non-stationary processes, typical case study, time domain filters with application: Synchronized averaging, moving-average filters

Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Weiner filter.

**Text-1:** 3.1, 3.1.1, 3.1.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.4, 3.4.1, 3.4.2, 3.4.3, 3.5.

**Module-3**

Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging. **Text-**3: 9.1 to 9.5

Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wave Transitions, Hypnogram Model Parameters.

**Text-2:** 5.1 to 5.4

**Module -4**

ECG Parameters and their estimation, A review of wiener filtering problem, Principle of an adaptive filter, the steepest descent algorithm, Adoptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancellation of Electrocardiographic signals from the electrical activity of chest muscles, Cancelling of maternal ECG in Fetal ECG, Cancellation of higher frequency noise in electro-surgery.

**Text-2**: 7.4, 6.1, 6.2, 6.3, 6.5, 6.6.

**Module -5**

Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

**Text-2**: 8.1 to 8.5

Note: Assignments can be given on analysis other important biomedical signals like EMG, ERG, EOG, Evoked potentials.

**Course Outcomes:** After studying this course, students will be able to:

1. Analyze the nature of Biomedical signals and related concepts
2. Apply filters to remove noise from biomedical signals.
3. Apply averaging technique on biomedical signals and extract the features of EEG signals.
4. Analyze event detection techniques for EEG and ECG signals.
5. Apply signal compression techniques on biomedical signals.
6. Write simple algorithms for biomedical signal processing

**Question Paper Pattern**

The question paper will have TEN questions.

- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.


**Reference Books:**


1. Biomedical Signal Processing -Akay M, , Academic: Press 1994
2. Biomedical Signal Processing (Vol. I Time & Frequency Analysis) - Cohen.A,, CRC Press, 1986.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**ARM Processor**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| **Course Code** | : **18 EI/BM/ML72** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 2+2 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

**ARM Embedded Systems**

Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware - AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications.

**ARM Processor Fundamentals**

ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.

**Module -2**

**Introduction to the ARM Instruction set:**

Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

**Module -3**

**Introduction to the THUMB instruction set:**

Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.

**Efficient C Programming:**

Overview of C Compilers and optimization, Basic C Data types, C looping structures.

**Module -4**

**Exception and Interrupt Handling:**

Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset, Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Scheme- Non nested Interrupt Handler, Nested Interrupt Handler, Reentrant Interrupt Handler, Prioritized Simple Interrupt Handler, Prioritized Standard Interrupt Handler, Prioritized Direct Interrupt Handler, Prioritized Grouped Interrupt Handler.

**Embedded Operating Systems:**

Fundamental Components, SLOS Directory Layout, Memory Interrupts and Exceptions handling, scheduler, Context Switch, Device Driver Framework.

**Module -5**

**CACHES:**

The memory Hierarchy and caches memory-caches and memory management units, Cache Architecture-basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.

**Memory Management Units:**

Moving from an MPU to an MMU**,** Virtual memory Working-Defining regions using pagers, multitasking and

the MMU, Memory organization in a virtual memory system, page tables Translational look aside buffer.

**Note:** Two or four tutorial classes need to be conducted (in a semester) to discuss the Embedded ARM Applications, such as GSM Chip and Bluetooth controller & assignment should be based on applications only.

**Course Outcomes:** After studying this course, students will be able to:

1. Depict the organization, architecture, bus technology, memory and operation of the ARM microprocessors
2. Employ the knowledge of Instruction set of ARM processors to develop basic Assembly Language Programs
3. Recognize the importance of the Thumb mode of operation of ARM processors and develop C programs for ARM processors
4. Describe the techniques involved in Exception and Interrupt handling in ARM Processors and understand the fundamental concepts of Embedded Operating Systems
5. Develop embedded C programs to interact with Built in Peripherals
6. Design, analyze and write programs using RTOS (MicroC/OS) on ARM based development boards.

**Question Paper Pattern**

- The Question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Andrew N Sloss, Dominic System and Chris Wright," ARM System Developers Guide", Elsevier, Morgan Kaufman publisher, 1st Edition, 2008/,ISBN:1758608745.

**Reference Books:**

1. David Seal, "ARM Architecture Reference Manual", Addison- Wesley, 2nd Edition, 2009, ISBN:978-0201737196.
2. Furber S, "ARM System on chip Architecture", Addison Wiley, 2nd Edition 2008, ISBN:978-0201675191
3. Rajkam, "Embedded System", Tata McGraw-Hill Publishers, 2nd Edition, 2008, ISBN: 0070494703.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Database Management System in Healthcare**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| **Course Code** | **: 18BM/ML731** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 2+2 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**Database and Database Users:** Introduction, Characteristics of the Database Approach, Advantages of Using the DBMS Approach. ( **Text Book** 2 : 1.1, 1.3, 1.6 )

**Database System Concepts and Architecture:** Data models, Schemas, and Instances, Three – Schema Architecture and Data Independence, Database Languages and Interfaces, Classification of Database Management Systems. ( Text Book 2 : 2.1, 2.2, 2.3, 2.6 )

**Patient Database:** Patient Database strategies for HIS, data acquisition, patient admission, transfer, discharge, evaluation & management. Computer based patient record, clinical decision support systems. ( Text Book 3 )

**Overview of Database Systems:** A Historical Perspective, File Systems versus a DBMS, Describing and Storing Data in a DBMS, Queries in a DBMS, Transaction Management, Structure of a DBMS.( **Text Book** 1 : 1.2, 1.3, 1.5, 1.6, 1.7, 1.8 )

**Module -2**

**Data Modeling using the Entity – Relationship (ER) Model**: Using High – Level Conceptual Data Models for Database Design, An Example Database Application; Entity Types, Entity Sets, Attributes and Keys, Relationship types, Relationship Sets, Roles and Structural Constraints, Weak Entity Types, Refining the ER Design for the COMPANY Database, ER Diagrams, Naming Conventions and Design Issues. (**Text Book**2 : 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7 )

**Relational Model:** Relational Model Concepts, Relational Model Constraints and Relational Database Schemas, Update Operations, Transactions, and Dealing with Constraint Violations. (Text Book 2 : 5.1, 5.2, 5.3 )

**Relational Algebra and Relational Calculus:** Unary Relational Operations: SELECT and PROJECT. ( **Text Book**2 : 6.1 )

**Module -3**

**Relational Algebra and Relational Calculus:** Relational Algebra Operations from Set Theory, Binary Relational Operations: JOIN and DIVISION, Additional Relational Operations. (**Text Book**2 : 6.2, 6.3, 6.4 )

**SQL – 99:** SQL Data Definition and Data Types, Specifying Constraints in SQL, Schema
Change Statements in SQL, Basic Queries in SQL, More Complex SQL Queries, INSERT, DELETE and UPDATE Statements in SQL, Specifying Constraints as Assertions and Triggers, Views (Virtual Tables ) in SQL , Additional Features of SQL. (**Text Book**2 : 8.1, 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9 )

**Module -4**

**Database Design Theory and Methodology:** Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms Based on Primary Keys, General Definitions of Second and Third Normal Forms, Boyce-Codd Normal Form. (**Text Book**2 : 10.1, 10.2, 10.3, 10.4, 10.5 )

**Relational Database Design Algorithms and Further Dependencies:** Properties of Relational

Decompositions, Algorithms for Relational Database Schema Design, Multi valued Dependencies and Fourth Normal Form, Join Dependencies and Fifth Normal Form, Inclusion Dependencies, Other Dependencies and Normal Forms. (**Text Book**2 : 11.1, 11.2, 11.3, 11.4, 11.5, 11.6 )

**Module -5**

**Overview Of Transaction Management:** The ACID Properties, Transactions and Schedules, Concurrent Execution of Transactions, Lock-Based Concurrency Control, Performance of Locking, Transaction Support in SQL, Introduction to Crash Recovery. ( **Text Book** 1 : Chapter 16 )

**Concurrency Control :** 2PL, Serializability and Recoverability, Introduction to Lock Management, Lock Conversions, Dealing with Deadlocks, Specialized Locking Techniques, Concurrency Control without Locking.( Text Book 1 : Chapter 17 )

**Crash Recovery :** Introduction to ARIES, The Log, Other Recovery- Related Structures, The Write-Ahead Log Protocol, Check-pointing, Recovering from a System Crash, Media Recovery.( **Text Book** 1 : 18.1, 18.2, 18.3, 18.4, 18.5, 18.6, 18.7 )

Note: Assignment may be given on the topics on semantic web and natural language processing (NLP) for semantic web, software for the hospital database management.

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the basic concepts of DBMS, languages, and DBMS architecture.
2. Describe the concept of ER model and Relational Model.
3. Apply the Relational operations and Structured Query Languages for RDBMS.
4. Analyze the data model based on normalization theory.
5. Discuss database transactions management and data recovery from system crash.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**


1. Database Management Systems - by Raghu Ramakrishna and Johannes Gehrke, (3rd Edition), McGraw Hill, 2003.
2. Fundamentals of Database Systems - by RamezElmasri and Shamkant B.Navathe (5th Edition), Pearson Education, 2007.
3. The Biomedical Engineering Handbook-Volume II (2nd Edition) – by Joseph D. Bronzino, CRC/IEEE Press, 2000.


**Reference Books:**


1. Data base System Concepts - by Silberschatz, Korth and Sudharshan. (4th Edition), McGraw Hill, 2002.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Ergonomics**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML732** | | CIE Marks | : 40 |
| Number of Lecture Hours/Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**The Design of Work Places:** Working heights, Room to grasp and move things, Seating at work.
**Heavy Work:** Physiological principles, Energy consumptions at work, Limits and norms of energy consumption at work, Organization of heavy work.
**Handling loads:** Lifting, Carrying a burden.

**Module -2**

**Skilled work:** Acquiring skill, Maximum control of skilled movements, Facilitating skilled work.
**Mental activity:** Uptake of information, Memory, Sustained alertness.
**Fatigue:** Fatigue in industrial practice, Measuring fatigue.

**Module -3**

**Boredom:** Boredom from the standpoint of psychology, Problems of monotonous, repetitive work.
**Working hours and eating habits:** Flexible and continuous working schedules, Rest pauses, Nutrition and work.
**Night work and shift work:** Night work and health, Organization of shift work.

**Module -4**

**Man – machine systems:** Visual perception, Perception of sound, Display equipment, Controls, Relationship between controls and display instruments.
**Light and colour in surroundings:** Light measurement and light sources, Physiological requirements of artificial lighting, Lighting for the work place, Daylight, Colour in the work room.

**Module -5**

**Noise and Vibration:** Measurement and sources of noise, Damage to hearing through noise, Physiological and psychological effects of noise, Protection against noise, Music and work, Vibrations.
**Indoor climate:** Thermal regulation in man, Comfort, Dryness of the air during heating periods, Recommendations for comfort indoors, Air pollution and ventilation, Heat in industry.

**Course Outcomes:** After studying this course, students will able to:

1. Define the principles of Ergonomics.
2. Describe the work places in order to suit the physical and psychological requirements of the Workers.
3. Employ the principles of Ergonomics in design of work places.
4. Evaluate the work places based on efficiency, accuracy, and safety measures.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Book:**

1. Fitting the Task to the Man – An ergonomic approach, by E. Grandjean, 3rd Edition, Taylor & Francis Ltd, London.

**Reference Books:**

1. Fitting the Task to the Human - A Text Book of Occupational Ergonomics by H. E. Kroemer and Etienne Grandjean, 5th Edition, Taylor & Francis Ltd, London.
2. Human Factors in Engineering and Design - by Mark S. Sanders and Ernest J. McCormick, 1993.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Biomechanics and Biodynamics**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML733** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits –3 (Each module – 08 Hours)**

**Module -1**

**Biomechanics Applications to Joint Structure and Function:** Introduction to Kinematics, Displacement in space, Force vectors and gravity, Linear forces and concurrent forces. Kinetics of rotary and translatory forces. Classes of levers. Close chain force analysis.

**Constitutive Equations:** Equations for Stress and Strain, Non-viscous fluids, Newtonian viscous fluids, Elastic solids. Visco-elasticity andits applications in biology.

**Module -2**

**Joint Structure and Function:** Properties of connective tissues; Human Joint design; Joint Function and changes in disease.

**Integrated Functions:** Kinetics and Kinematics of Postures; Staticand Dynamic Postures; Analysis of Standing, Sitting and Lying Postures.

**Module -3**

**Gait Analysis:** Gait cycle and joint motion; Ground reaction forces; Trunk and upper extremity motion; internal and external forces, moments and conventions; Gait measurements and analysis.

**Force Platform and Kinematic Analysis:** Design of forceplatforms, Integrating force and Kinematic data; linked segment, free-bodyanalysis.

**Module -4**

**Bio-Viscoelastic Fluid:** Viscoelasticity, Viscoelastic Models: Maxwell, Voigt and Kelvin Models Response to harmonic variation. Use of viscoelastic models. Bio-Viscoelastic fluids: Protoplasm. Mucus, saliva, semen, synovial fluids.

**Module -5**

**Rheology of Blood in Microvessels**: Fahreus· Lindqulst effect and inverse effect, hematocrit in very narrow tube.

**Finite Element Analysis in Biomechanics:** Model creation, Solution, Validation of results and applications of FEA.

**Course Outcomes:** After studying this course, students will be able to:

1. Analyze the types of forces applied to joints & derive the basic constitutive equations for solid andliquid bio-elements.
2. Describe the properties, structures and functions of human joints for normal & diseased.
3. Analyze static &dynamic postures, gait, integrating force, and kinematic data.
4. Develop model for bio-fluids and explain their uses.
5. Discuss the rheology of blood in microvessels
6. Develop simple FEA models for biomechanics problems.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 16 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Biomechanics: Mechanical Properties of living tissues by Y. C. Fung, 2nd Edition, Springer Verlag, 1993.
2. Joint Structure and Function, A Comprehensive Analysis – by Pamela K. Levangie and Cynthia C. Norkin, Jaypee Publications, 4th Edition, 2006.

**Reference Books:**

1. Biomechanics of Human Motion - by T. McClurg Anderson, Sports Pub., 2007.
2. Biomechanics, Structures and Systems - by A. A. Biewener, Sports Publication.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Biometric Systems**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| **Course Code** | : **18BM/ML734** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

**Introduction to Biometrics:** Introduction, Identification Methods, Biometrics, Biometrics Technology Overview, Biometrics technologies: A Comparison, Automatic Identification, Research Issues – Acquisition, Representation, Feature Extraction, Matching, Search, Organization and Scalability, Privacy, Novel Applications.(**Text** 1: Chapter 1)

**Module -2**

**Finger Print Verification:** Matching – Verification and Identification, Feature type, Image Processing and Verification, System Issues, Recognition Rate, Multi-modal Biometrics

**Face Recognition:** Introduction, Approaches, The SHOSLIF.(**Text** 1: Chapter 2, Chapter 3)

**Module -3**

**Hand Geometry Base Verification:** Introduction, System Operation, Implementation Issues, Applications.

**Recognizing By Iris Patterns:** Introduction, Iris Patterns – Complex Phenotypic Features, Statistical Recognition Principle, Decidability of Iris Based personal Identification, Identification versus Verification, Stability of Iris Pattern Overtime.(**Text** 1: Chapter 4, Chapter 5)

**Module -4**

**Retina Identification:** Retina/Choroid as Human Descriptor, Background, Technology, Eye Signature, RI Camera, Signal Acquisition and Computing Subsystem, System Operation, Performance.

**Key stroke Dynamics Based Authentication:** Introduction, Types of Security Attacks, Predicting Human Characteristics, Applications of Keystroke Dynamics using Interkey Times and Hold Times as Features.(**Text** 1: Chapter 6, Chapter 10)

**Module -5**

**Multimodal Biometrics:** Introduction, Decision Fusion, Experimental Results.

**Biometrics: Identifying Law & Policy Concerns:** Introduction, Definition and Advantages, Biometric Applications, Context of Biometrics, Privacy Concerns, Biometrics as Privacy's Foe-Criticisms, Biometric Centralization vs. Biometric Balkanization.(**Text** 1: Chapter 16, Chapter 19)

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the general principles of designing biometric-based systems.
2. Analyze various biometric systems, their characteristics and performance.
3. Discuss the online identification biometric techniques.
4. Recognize some of the personal privacy and security implications of biometrics based identification technology.
5. Analyze the privacy and security issues of biometrics.
6. Develop simple model of biometric system.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. "Biometrics, Personal Identification in Networked Society", Anil Jain, Ruud Bolle, SharathPankanti, Kluwer Academic Publishers, 2002

**Reference Books:**

1. "Biometrics -Identity verification in a networked World", Samir Nanavathi, Michel Thieme, and Raj Nanavathi, Wiley Eastern, 2002.
2. "Implementing Biometric Security", John Chirillo and Scott Blaul, Wiley Eastern Publications, 2005.
3. "Biometrics for Network Security", John Berger, Prentice Hall, 2004.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Biostatistics**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML741** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**Getting Acquainted With Biostatistics:** Introduction, Some Basic Concepts, Measurement and Measurement Scales, Sampling and Statistical Inference, The Scientific Method and The Design of Experiments, Computers and Bio statistical Analysis. (Text Book 1 : Chapter 1)

**Strategies For Understanding The Meanings Of Data:** Introduction, The Ordered array, Grouped Data : The Frequency Distribution, Descriptive Statistics : Measure of Central Tendency, Descriptive Statistics : Measure of Dispersion. (**Text Book** 1 : Chapter 2)

**Module -2**

**Probability: The Basis Of Statistical Inference:** Introduction, Two Views of Probability: Objective and Subjective, Elementary Properties of Probability, Calculating the Probability of an Event. ( Text Book 1 : 3.1, 3.2, 3.3, 3.4 )

**Probabilistic Features Of Certain Data Distributions:** Introduction, Probability Distributions of Discrete Variables, The Binomial Distribution, The Poisson Distribution, Continuous Probability Distributions, The Normal Distribution, The Normal Distribution Applications. (**Text Book** 1 : Chapter 4)

**Module -3**

**Probabilistic Features Of The Distributions Of Certain Sample Statistics:** Introduction, Sampling Distribution, Distribution of the Sample Mean, Distribution of the Difference Between Two Samples Means, Distribution of the Sample Proportion, Distribution of the Difference Between Two Sample Proportions. (T**ext Book** 1 : Chapter 5)

**Using Sample Data To Make Estimates About Population Parameters :** Introduction, Confidence Interval for a Population Mean, The *t* Distribution, Confidence Interval for the Difference Between Two Population Means, (**Text Book** 1 : 6.1, 6.2, 6.3, 6.4)

**Module -4**

**Using Sample Data To Make Estimates About Population Parameters: C**onfidence Interval for a Population Proportion, Confidence Interval for the Difference Between Two Population Proportions, Determination of Sample Size for Estimating Means, Determination of Sample Size for Estimating Proportions, Confidence Interval for the Variance of a Normally Distributed Population, Confidence Interval for the Ratio of the Variances of Two Normally Distributed Populations. ( **Text Book**1 : 6.5, 6.6, 6.7, 6.8, 6.9, 6.10)

**Using Sample Statistics To Test Hypotheses About Population Parameters:** Introduction, Hypotheses Testing : A Single Population Mean. (**Text Book** 1 : 7.1, 7.2)

**Module -5**

**Using Sample Statistics To Test Hypotheses About Population Parameters:** Hypotheses Testing :The

Difference Between Two Population Means, Paired Comparisons, Hypotheses Testing : A Single Population Proportion, Hypotheses Testing : The Difference Between Two Population Proportions, Hypotheses Testing : A Single Population Variance, Hypotheses Testing : The Ratio of Two Population Variances. The Type II Error and the Power of a Test, Determining Sample Size to Control Type II Errors. (**Text Book**1 : 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10)

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the basic statistical terms, concepts, procedures and statistical measures.
2. Apply probability concepts and probability distributions for statistical inferences.
3. Apply sampling distribution concepts and estimation procedures for population parameters.
4. Select and apply appropriate hypotheses tests for statistical analysis.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Biostatistics: Basic Concepts and Methodology for the Health Sciences – by Wayne W. Daniel, John Wiley & Sons Publication, 9th Edition, 2009.

**Reference Books:**

1. Principles of Biostatistics - by Marcello Pagano and Kimberlee Gauvreu, Thomson Learning Publication, Indian Edition, 2007.
2. Biostatistics - by Ronald N Forthofer, EunSul Lee and M. Hernandez, Academic Press, 2007.
3. Basic Biostatistics and its Applications - by Animesh K. Dutta, 2006.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Lasers and Optical Fibers in Medicine**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| **Course Code** | **: 18BM/ML742** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

**Applications Of Lasers In Therapy & Diagnosis:**Introduction, laser assisted diagnosis and therapy-fundamentals, interactionof laser beams and materials-principles (except 3.3.4), laser interaction withtissue-principles, laser assisted diagnostics-principles, applications of lasers in diagnosis and imaging-advances, laser surgery and therapy-principles photo-thermal & photomechanical mechanisms, thermal interaction between laser and tissue-advances.

**Module -2**

**Single Optical Fibers:** Introduction, historical background, optical fibers-fundamentals, light transmission in optical fibers-principles, optical properties of optical fibers-advances, fabrication of optical fibers-principles, optical fibers for UV, visible, IR light-principles, power transmission through optical fibers-principles, modified fiber ends and tips-principles, fiber lasers advances.

**Module -3**

**Optical Fiber Bundles:** Introduction, non-ordered fiber-optic bundles for light guides-fundamentals & principles, ordered fiber-optic bundles for imaging devices-fundamentals & principles, fiber-scopes and endoscopes fundamentals, fiber optic imaging systems-advances.

**Module -4**

**Endoscopy:** Introduction, endoscopic imaging systems-fundamentals, principles, advances, endoscopic diagnostics-advances, endoscopic therapy fundamentals, endoscopic ultrasound imaging-principles.

**Module -5**

**Clinical Applications Of Fiber Optic Laser Systems:** Introduction, fiber-optic laser systems in cardiovascular disease (except 9.2.6), gastroenterology, gynecology, neurosurgery, oncology, ophthalmology, orthopedics, otolaryngology (ENT), urology, flow diagram for laser angioplasty & photodynamic therapy.

**Course Outcomes**: After studying this course, students will be able to:

1. Explain the basics and principles of LASERS in Medicine.
2. Discuss the fundamentals and properties of optical fibers for UV, IR, power transmission and advancement.
3. Describe the working of optical fibre bundles for imaging devices applying the light guided fundamentals & principles.
4. Explain and demonstrate the working of endoscopic therapy, diagnostic & imaging principles.
5. Outline the clinical applications of fiber optic Lasers systems.

**Question Paper Pattern**

- The question paper will have TEN questions.

- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

**Reference Books:**

1. Lasers in Medicine - by Ronal W. Waynant, CRC Press, 2002.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Medical Informatics and Expert Systems**
**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML743** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module- 1:**

**Medical Informatics**: Aim and scope, salient feature, Introduction, history, definition of medical informatics, bio-informatics, online learning, introduction to health informatics, prospectus of medical informatics.

**Hospital Management And Information Science**: Introduction, HMIS: need, Benefits, capabilities, development, functional areas. Modules forming HMIS, HMIS and Internet, Pre-requisites for HMIS-client server technology, PACS, why HMIS fails, health information system, disaster management plans, advantages of HMIS.**Text**1: (Section I - 1 and 2, Section II-3 )

**Module-2** :

**Hospital Management And Information Systems-Structure And Functions :**Central Registration Module, OPD / Consultant Clinic / Polyclinic Module, Indoor Ward Module, Patient Care Module, Procedure Module, Diet Planning Module, MLC Register Module, Pathology Laboratory Module, Blood Bank Module, Operation Theatre Module, Medical Stores Module, Pharmacy Module, Radiology Module, Medical Records Index Module, Administration Module, Personal Registration Module, Employee Information Module, Financial modules, Health & Family Welfare, Medical Examination, Account Billing, Medical Research, Communication, General Information. **Text** 1: (Section II-6)

**Module–3:**

**Computer Assisted Medical Education:** CAME, Educational software, Simulation, Virtual Reality, Tele-education, Tele-mentoring.

**Computer Assisted Patient Education:** CAPE, patient counseling software. Computer assisted surgery (CAS), Limitations of conventional surgery, 3D navigation system, intra-operative imaging for 3D navigation system, merits and demerits of CAS.**Text**1: (Section III – 7 & 8)

**Module–4:**

**Telecommunication Based Systems:** Tele-Medicine, Need, Advantages, Technology- Materials and Methods, Internet Tele-Medicine, Applications.

**Tele-Surgery:** Tele-surgery, Robotic surgery, Need for Tele-Surgery, Advantages, Applications.**Text**1: (Section V- 13 & 14)

**Module–5:**

**Knowledge Based And Expert Systems**: Introduction, Artificial Intelligence, Expert systems, need for Expert Systems, materials and methods- knowledge representation & its methods, production rule systems, algorithmic method, OAV, object oriented knowledge, database comparisons, statistical pattern classification, decision analysis, tools, neural networks, advantages of ES, applications of ES. **Text 1**: (Section II – 4)

Note: Assignments may be given on topics, rule based techniques for prediction, SNOMED standards, International classification of Diseases (ICD) codes.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the basics and importance of medical informatics in hospital management.
2. Describe the different modalities functions exist in the hospital for effective management.
3. Explain the role of technology both hardware & software in training the medical personalities.
4. Discuss the role of telecommunication, tele-surgery, robotics in healthcare.
5. Explain the decision making concepts used in healthcare and their applications.
6. Apply information and communication technology in healthcare.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Medical Informatics: A Primer - by Mohan Bansal, 1st Print, Tata McGraw Hill, Publications, 2003.

**Reference Books:**

1. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2nd Edition, Springer Verlag, 2000.
2. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 2000.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Internet of Things**
**(Common to EI, BM &ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18EI/BM/ML744** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 2+2 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Course Objectives:** This course will enable the students to

- Assess the genesis and impact of IoT applications, architectures in real world
- Illustrate diverse methods of deploying smart objects and connect them to network
- Compare different application protocols for IoT
- Infer the role of Security in IoT
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry

**Module -1**
**Introduction and IoT:** Introduction to IoT, IoT Ecosystem, IoT Reference model
Text 1-Chapter 1

**Module -2**
**Transducers, Sensors and Actuators:** Defining Transducers, Sensors and Actuators, Introduction to Transducers, Introduction to Sensors, Introduction to Actuators, Interfacing Concepts to Embedded Systems, Wireless Sensor Networks and its Technologies
Text 1-Chapter 2

**Module -3**
**IoT Protocols**: Protocol Classification, MQTT, XMPP, DDS, AMQP, COAP, Representational State Transfer( REST), Comparison of the Protocols
Text 1-Chapter 3

**Module -4**
**Domain Specific IoT**: Introduction, Home automation, Smart Cities, Environment, Retail, Logistics, Agriculture, Health and Life style
Text 1-Chapter 4
**Public Safety** : Overview of Public Safety, an IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT Public Safety Information Processing, School Bus Safety.
Text 2-Chapter 15

**Module -5**
**IoT Platform Design Methodology**: Introduction to IoT Platform Design Methodology, Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Developments
Text 1-Chapter 5

Note: As a part of assignments, the students (in a group of 3 or 4) advised to carry out mini / hobby project using IoT technology.

**Course Outcomes:** After studying this course, students will be able to:

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network
- Appraise the role of IoT protocols for efficient network communication
- Elaborate the need for security in IoT
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in industry

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books**


1. Srinivasa K G , Siddesh G M, Hanumantha Raju R, "Internet of Things" Cengage Learning India Pvt Ltd (ISBN : 978-93-86858-95-5).
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals : Networking Technologies, Protocols and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint)( ISBN: 978-9386873743).


**Reference Books**


1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-approach)", 1st Edition, VPT, 2014(ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017(ISBN: 978-9352605224)

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**Biomedical DSP Lab**
(Common to BM & ML)

| | | | |
|---|---|---|---|
| Course Code | **: 18 BM/ML L76** | CIE Marks | : 40 |
| Number of Tutorial + Practical Hours /Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 42 | Exam Hours | : 03 |

**Credits – 2**

**Write programs in C or Matlab or Scilab:**

1. Write a program to Compute Linear & Circular convolution, Cross & Auto correlation using a biomedical signal
2. Write a program to Compute DFT, FFT, Power spectrum and power spectral density of a biomedical signal.
3. Write a program to Display Static and Moving ECG signal.
4. Write a program to Implement 50Hz notch filter for ECG signal and display PSD.
5. Write a program to Implement IIR filters for ECG (LPF,HPF,BPF)
6. Write a program to Implement Low-Pass FIR filter for ECG
7. Write a program to Implement FIR Filter using Kaiser Window.
8. Write a program to detect QRS complex and measure the heart rate of a given ECG signal
9. Write a program to improve the SNR using signal averaging technique
10. Write a program to obtain the DCT & IDCT of ECG signal
11. Write a program to down sample the given ECG signal
12. Write a program to obtain Adaptive noise cancelling
13. Write a program to compress the data using Turning point & FAN algorithm

**Course Outcomes:** After studying this course, students will be able to:

1. Apply the signal processing techniques on biomedical signals and evaluate their performance.
2. Develop/Write signal processing algorithms for the analysis of biomedical signals

**Conduct of Practical Examination:**

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

**B.E. Medical Electronics (ML)**
**Choice Based Credit System (CBCS)**
**Semester - VII**

**ARM Processor Lab**
**(Common to EI, BM & ML)**

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18 EI/BM/MLL77** | | CIE Marks | : 40 |
| Number of Tutorial + Practical Hours /Week | : 2+2 | | SEE Marks | : 60 |
| Total No. of Practical hours | : 42 | | Exam Hours | : 03 |

**Credits – 2**

**PART-A:** Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

1. Write an ALP to multiply two 16 bit binary numbers.
2. Write an ALP to find the sum of first 10 integer numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5. Write an ALP to add two 64 bit numbers.
6. Write an ALP to find the square of a number(1 to 10) using look-up table.
7. Write an ALP to find the largest/smallest number in an array of 32 numbers.
8. Write an ALP to arrange a series of 32 bit numbers in ascending/descending order.
9. Write an ALP to count the number of ones and zeros in two consecutive memory locations.
10. Write an ALP to Scan a series of 32 bit numbers to find how many are negative.

**PART-B:** Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

1. Display “Hello World” message using Internal UART.
2. Interface and Control a DC Motor.
3. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
5. Interface a DAC and generate Triangular and Square waveforms.
6. Interface a 4x4 keyboard and display the key code on an LCD.
7. Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
8. Demonstrate the use of an external interrupt to toggle an LED On/Off.
9. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
10. Interface a simple Switch and display its status through Relay, Buzzer and LED.

**Note:**

1. More weightage should be given for PART-B experiments in the evaluation of Internal Assessment and Laboratory Examinations.
2. Introduction class on instruction set of Cortex M3 LPC1768 need to be conducted before start of hardware experiments.

**Conduction of Practical Examination:**

1. All laboratory experiments (Part-A + Part-B) are to be included for practical examination.
2. Students are allowed to pick & execute one experiment from each part.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part to be made zero.

**Course Outcomes:** After studying this course, students will able to;

1. Write ALP for implementation of specific arithmetic or logical operations.
2. Write programs to demonstrate functioning of various devices interfaced to ARM processor.
3. Develop programs for ARM processors to implement real world problems.
4. Design and develop mini projects.

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - VII | | | | |
|---|---|---|---|---|
| **Project Work Phase-1** | | | | |
| Course Code | : **18MLP78** | | CIE Marks | : 100 |
| Number of Practical Hours /Week | : 02 | | SEE Marks | : -- |
| Total Number of Lecture Hours | : -- | | Exam Hours | : -- |
| **Credits – 1** | | | | |

**Project Work Phase-1:**
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

**CIE procedure for Project Work Phase - 1:**

**(i) Single discipline:** The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.

**(ii) Interdisciplinary:** Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report(covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - VII |
| --- |
| **Internship** |
| **Internship:** All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. |

## 8th SEMESTER

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - VIII | | | | |
|---|---|---|---|---|
| **Medical Imaging Systems**<br>(Common to BM & ML) | | | | |
| **Course Code** | **: 18BM/ML81** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |
| **Credits – 3 (Each module – 08 Hours)** | | | | |

**Module -1**

**X-Ray Imaging:** Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation.

**X-Ray Diagnostic Methods:** Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography.

**Computed Tomography**: Conventional tomography, Computed tomography – Projection function, Algorithms for image reconstruction, CT number, Spiral CT. Recent developments – Digital radiography, Digital subtraction angiography (DSA), Dynamic spatial reconstructor (DSR),

**Module -2**

**Ultrasound Imaging:** Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, Doppler effect. Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution, Focusing, Arrays.

**Ultrasonic Diagnostic Methods:** Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.

**Module -3**

**Radionuclide Imaging:** Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.

**Module - 4**

**Basics of Magnetic Resonance Imaging:** Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.

**MRI System & Imaging Methods:** Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic

fields, Imaging safety, Functional MRI (brief introduction only).

**Module 5 :**

**Thermal Imaging:** Medical thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelectric vidicon camera, Thermal camera based on IR sensor with digital focal plane array.

**Advances in Medical Imaging:** Image guided intervention- Introduction, Stereotactic neurosurgery, Stereotactic neurosurgery based on digital image volumes- image acquisition, planning and transfer, Intraoperative Imaging- Intraoperative diagnostic imaging, transfer by matching preoperative with intraoperative images, augmented reality.

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the fundamentals of x-ray radiography and computed tomography, and analyze the system requirements.
2. Explain principles of ultrasound imaging and diagnostic methods and analyze the system requirements.
3. Discuss the fundamentals of radionuclide imaging, MRI, thermal imaging and analyze the system requirements.
4. Describe the concepts of image Guided Intervention and image guided surgery.
5. Design and develop prototype of simple medical imaging system.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Principles of Medical Imaging – by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic Press, 1992.
2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. Fundamentals of Medical Imaging – by Paul Suetens, Cambridge University Press, 2002.


**Reference Books:**


1. The Physics of Medical Imaging – by Steve Webb (Editor), Adam Hilger, Bristol and Philadelphia Publications, 1988.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Bio-MEMS**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML821** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module -1**

**Overview of MEMS and Micro systems:** MEMS and Microsystems, Typical MEMS and Microsystem Products, Evolution of Microfabrication, Micro systems and Microelectronics, Multidisciplinary nature of Microsystem design and Manufacture, Microsystems and Miniaturization, Applications of Microsystem in Health-care Industry. (**Text** 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.8.1)

Bio-MEMS: Fabrication of Bio-MEMS, Structure, The Driving Force behind Biomedical Application, Biocompatibility, Reliability consideration. (Text 2: 1.1, 1.1.1, 1.1.2, 1.2, 1.3, 1.4)

**Microsensors:** Acoustic wave sensor, Biomedical Sensors and Biosensors, Chemical Sensors, Optical Sensors, Pressure sensors, Thermal sensors.(**Text** 1: 2.2)

**Module -2**

**Microactuation:** Principal means of Microactuation, MEMS with Microactuators, Microaccelrometer, Microfluidic. (Text 1: 2.3, 2.4, 2.5, 2.6)

**Engineering Science for Microsystem Design and Fabrication:**Ions and Ionization, The Diffusion Process, Plasma Physics, Electrochemistry, Quantum Physics. (**Text** 1: 3.3, 3.6, 3.7, 3.8, 3.9)

**Scaling Laws:** Scaling in Geometry, Scaling in Rigid body Dynamics, Scaling in Electrostatic force, Electricity, Fluid mechanics, Heat Transfer.(**Text** 1: 6.2, 6.3, 6.4, 6.6, 6.7, 6.8)

**Module -3**

**Engineering Mechanics for Microsystem Design:** Static Bending of Thin plates – Circular Plates, Rectangular Plates, Square Plates with all Edges Fixed, Mechanical vibrations – General Formulation, Resonant Vibration, Design theory of Accelerometers. (**Text** 1: 4.2, 4.2.1, 4.2.2, 4.2.3, 4.3, 4.3.1, 4.3.2, 4.3.4)

**Detection and Measurement methods:** Detection Scheme – Electrochemical Detection, Chemiluminescence and Bioluminescence, Fluorescence, Molecular Beacons, Measurement Systems.
(**Text** 2: 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.3)

**Module -4**

**Materials for MEMS and Microsystems:** Substrates and wafers, Active Substrate materials, Silicon as a Substrate material – Ideal Substrate, Crystal Structure, Mechanical Properties of Silicon, Silicon Compounds, Silicon Peizoresistors, Gallium Arsenide, Quartz, Polymers, Packaging Materials.
(**Text 1**: 7.2, 7.3, 7.4.1, 7.4.3, 7.4.5, 7.5, 7.6, 7.7, 7.8, 7.10, 7.11)

**Emerging Bio-MEMS Technology:** Minimally invasive Surgery, Cardiovascular, Diabetes, Endoscopy, Oncology, Ophthalmology, Tissue Engineering, Cell-Based Biosensors, Home land Security.
(**Text** 2: 13.2, 13.4, 13.5, 13.6, 13.8, 13.9, 13.11, 13.12, 13.13)

**Module -5**

**Microsystem Fabrication Process:** Photolithography, Ion Implantation, Diffusion, Oxidation, Chemical Vapour Deposition, Physical Vapour Deposition, Deposition By Epitaxy, Etching, The LIGA Process, Design Consideration Overview, Design Constraints. (**Text 1**: 8.2, 8.3, 8.4, 8.5, 8.6, 8.7, 8.8, 8.9, 9.4, 10.2,

10.2.1)

**Course Outcomes:** After studying this course, students will be able to:

1. Discuss MEMS with current and potential markets for types of Microsystems.
2. Identify the suitable material to develop a microsystem.
3. Explain the principles of emerging Bio-MEMS technology.
4. Apply the principles of microsensors and microactuators to design microsystem.
5. Illustrate micro-manufacturing techniques.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. **"**MEMS & Microsystems: Design and Manufacture", Tai-Ran Hsu, Tata McGraw-Hill, 2002.
2. "Fundamentals of Bio-MEMS and Medical Microdevices**",** Steven S. Saliterman**,** Wiley Interscience, 2006.

**Reference Books:**

1. "Introduction to Bio-MEMS", Albert Folch, CRC Press, 2012.
2. "Bio-MEMS: Technologies and Applications", Wanjun Wang, Steven A. Soper, CRC Press, 2006.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Computer Communication Networks in Healthcare**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| **Course Code** | **: 18BM/ML822** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**Computer Networks In Health Care:** Introduction, history, impact of clinical data, information types, platforms, current technologies, identifier standards, communication (message format) standards.

**Introduction To Computer Networks:** Uses of Computer Networks: Business Applications, Home Applications, Mobile Users. Network Hardware: Local Area Networks, Metropolitan Area Networks, Wide Area Networks, Wireless Networks. Network Software: Design Issues for the Layers, Connection – Oriented and Connectionless Services, Service primitives. The Relationship of Services to Protocols. Reference Models: The OSI Reference3 Model, The TCP/IP Reference Model, A Comparison of the OSI and TCP/IP Reference Models. Example Networks: Internet Usage, Architecture of the Internet, Connection– Oriented Networks: X.25, Frame Relay, and ATM.

**Module -2**

**The Physical Layer**: The Theoretical Basis For Data communication: Bandwidth Limited Signals, The Maximum Data Rate of a Channel. Guided Transmission Media: Magnetic Media, Twisted Pair, Coaxial Cable, Fiber Optics. Wireless Transmission: The Electromagnetic Spectrum, Radio Transmission, Microwave Transmission, Infrared and Millimeter Waves, Light wave Transmission. The Public Switched Telephone Network: Structure of the Telephone System. Trunks and Multiplexing: FDM, WDM&TDM, Switching, Internet over Cable

**Module -3**

**The Data Link Layer**: Data Link Layer Design Issues: Services Provided to the Network Layer, Framing, Error Control, Flow Control. Elementary Data Link Protocols: A Simplex Stop–and–Wait Protocol. Sliding Window Protocols: A One – Bit Sliding Window Protocol, A Protocol Using Go Back N, A Protocol Using Selective Repeat, HDLC –High – Level Data Link Control, The Data Link Layer in the Internet.

**Module -4**

**The Medium Access Control Sublayer**: Multiple Access Protocols: ALOHA, Carrier Sense Multiple Access Protocols, Wireless LAN Protocols. Ethernet: Ethernet Cabling, Manchester Encoding, The Ethernet MAC Sublayer Protocol, The Binary Exponential Backoff Algorithm, Ethernet Performance. Wireless Lans: The 802.11 Protocol Stack, The 802.11 Physical Layer, The 802.11 MAC Sublayer Protocol, The 802.11 Frame Structure, Services.

**Module -5**

**Blue Tooth**: Blue tooth Architecture, Bluetooth Applications. Data Link Layer SWITCHING: Local Internet Working, Repeaters, Hubs, Bridges, Switches, Routers, and Gateways, Virtual LANs.

**The Network Layer**: Network Layer Design Issues: Store-and- Forward Packet Switching, Services Provided to the Transport Layer, Implementation of Connectionless Service, Implementation of Connection –Oriented Service. Routing Algorithms: The Optimality Principle, Shortest Path Routing, Distance Vector Routing, Link

State Routing, Hierarchical Routing, Broadcast Routing, CONGESTION control Algorithms: General Principles of Congestion Control. Quality of Service: Requirements, Techniques for Achieving Good Quality of Service-leaky bucket algorithm, token bucket algorithm. Internetworking: How Networks Differ, How Networks Can Be Connected. The Network layer In The Internet: The IP Protocol, IP Address Formats, IPV6 Header Format.

Note: Assignments may be given on the computer networking in the hospital and connecting to hospital database.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the different formats of data generated in clinical field or Medical field.
2. Discriminate the functionality between the layers in OSI model and TCP/IP suite.
3. Discuss the concept of physical and data link layer.
4. Distinguish the IEEE standards designed to understand the interconnectivity between different LANs.
5. Apply different algorithms to route a packet to the destination for process to process delivery.
6. Discuss the concepts of Bluetooth technology, and transport & application layer.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. The Biomedical Engineering Handbook-Volume II (2nd Edition) – by Joseph D. Bronzino, CRC/IEEE Press, 2000.
2. Computer Networks – Andrew S. Tanenbaum, 4$^{th}$Edn, Pearson Education / PHI, 2004.


**Reference Books:**


1. Data and Computer Communication – William Stallings, 7th Edition, Pearson Education, 2004.
2. Data Communications and Networking – Behrouz A Forouzan, 4$^{th}$ Edition, Tata McGraw Hill, 2006.
3. Computer Networking – Kurose and Ross, Pearson Education, 2004.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Biomaterials and Artificial Organs**
(Common to BM & ML)

| | | | | |
|---|---|---|---|---|
| Course Code | **: 18BM/ML823** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**Biomaterials**: Introduction to biomaterials, uses of biomaterials, biomaterials in organs & body systems, materials for use in the body, performance of biomaterials.

**Metallic Biomaterials**: Introduction, Stainless steel, Cobalt- Chromium alloy, Titanium alloys, Titanium-Nickel alloys, Dental metals, Corrosion of metallic implants, Manufacturing of implants.

**Ceramic Biomaterials**: Introduction, non-absorbable/relatively bioinert-bioceramics, biodegradable/resorbable ceramics, bioreactive ceramics, deterioration of ceramics, bioceramic-manufacturing techniques

**Module -2**

**Polymeric Biomaterials**: Introduction, polymerization and basic structure, polymers used as biomaterials, sterilization, surface modifications to for improving biocompatibility.

**Composite Biomaterials**: Structure, bounds on properties, anisotropy of composites, particulate composites, fibrous composites, porous materials, biocompatibility.

**Biodegradable Polymeric Biomaterials**: Introduction, Glycolide based biodegradable homopolymers polyesters, non-glycolide linear aliphatic polyesters, aliphatic and aromatic polycarbonates, and biodegradation properties of synthetic biodegradable polymers. TISSUE DERIVED BIOMATERIALS: Structure and properties of collagen and collagen-rich tissues, biotechnology of collagen, design of resorbable collagen-based medical implant.

**Module -3**

**Hard Tissue Replacements**: Bone repair and joint implants-long bone repair and joint replacements, dental implants- effects of material selection, effects of surface properties, surface chemistry.

**Preservation Techniques For Biomaterials**: Phase behavior, nonfreezing storage-hypothermic, freeze-thaw technology, freezedrying, and vitrification.

**Artificial Organs: Introduction**: Substitutive medicine, outlook for organ replacement, design consideration, evaluation process.

**Module - 4**

**Artificial Heart And Circulatory Assist Devices**: Engineering design, Engg design of artificial heart and circulatory assist devices, blood interfacing implants – introduction, total artificial hearts & ventricular assist devices, vascular prostheses, Non-blood interfacing implants for soft tissues- sutures and allied augmentation devices, percutaneous and skin implants, maxillofacial implants, eye and ear implants.

**Cardiac Valve Prostheses**: Mechanical valves, tissue valves, current types of prostheses, tissue versus mechanical, engineering concerns and hemodynamic assessment of prosthetic heart valves, implications for thrombus deposition, durability, current trends in valve design, vascular grafts-history, synthetic grafts, regional patency, thrombosis, neointimal hyperplasia, graft infections.

**Artificial Kidney**: Functions of the kidneys, kidney disease, renal failure, renal transplantation, artificial kidney, dialyzers, membranes for haemodialysis, haemodialysis machine, peritoneal dialysis equipment-

therapy format, fluid and solute removal.

**Module 5 :**

**Artificial Blood**: Artificial oxygen carriers, flurocarbons, hemoglobin for oxygen carrying plasma expanders, hemoglobin based artificial blood.

**Artificial Lungs**: Gas exchange systems, Cardiopulmonary bypass (heart-lung machine)-principle, block diagram and working, artificial lung versus natural lung. Liver functions, hepatic failure, liver support systems, general replacement of liver functions.

**Artificial Pancreas**: Structure and functions of pancreas, endocrine
pancreas and insulin secretion, diabetes, insulin, insulin therapy, insulin administration systems. Tracheal replacement devices, laryngeal replacement devices, artificial esophagus Artificial Skin: Vital functions of skin, current treatment of massive skin loss, design principles for permanent skin replacement.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the principle and biology underlying the design of implants and artificial organs.
2. Differentiate classes of materials used in medicine.
3. Discuss the application of biomaterials in medicine.
4. Discuss concept of biocompatibility and the methods of biomaterial testing.
5. Discuss the design process in some of the prominent artificial organs.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**


1. Biomedical Engineering Handbook-Volume1 (2nd Edition) by J.D.Bronzino (CRC Press / IEEE Press, 2000).
2. Biomedical Engineering Handbook-Volume 2 (2nd Edition) by J.D.Bronzino (CRC Press / IEEE Press, 2000)
3. Handbook of Biomedical Instrumentation (2nd Edition) by R.S.Khandpur (Tata McGraw Hill, 2003).

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Artificial Intelligence and Machine Learning**
**(Common to EI, BM &ML)**

| | | | | |
|---|---|---|---|---|
| **Course Code** | **:18EI/BM/ML824** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 2+2 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08Hours)**

**Module -1**
Artificial Intelligence: The AI Problems, the underlying Assumption, what is an AI technique? (Text 1- 1.1,1.2,1.3)
Natural Language Processing: Introduction, Steps in the Process. (Text 1- 15.1,15.1.1)

**Module – 2**
Parallel and Distributed AI: Psychological Modeling, Parallelism in Reasoning Systems, Distributed Reasoning Systems: Coordination and Cooperation.
(Text1-16.1,16.2,16.3,16.3.1)
Connectionist Models: Introduction: Hopfield Networks, Connectionist AI and Symbolic AI. (Text 1- 18.1,18.6)

**Module – 3**
Genetic Algorithms (Gas): Learning: Generalization of an Input-Output table, Significance of the Genetic operators, Ant Algorithms (Text 1- 23.2,23.2.2,23.3,23.8)
Multilayer Perceptrons: The Perceptron, multilayer Perceptrons, Learning time – Time delay networks, Recurrent networks, Deep Learning (Text 2-11.1.2,11.2,11.5,11.12,11.13)

**Module -4**
Machine Learning: Introduction, Examples of Machine learning Applications.
Supervised Learning: Learning a class from examples, Noise, Learning Multiple classes, Regression, Model selection and Generalization, Dimensions of a supervised Machine learning Algorithm. (Text 2- 1.1,1.2,2.1,2.4,2.5,2.6,2.7,2.8)

**Module -5**
Dimensionality Reduction: ntroduction, Subset selection, Principal Component analysis.
Kernel Machines: Introduction, Optimal separating hyperplane (SVM).
(Text 2- 6.1,6.2,6.3,13.1,13.2)

**Course Outcomes:** After studying this course, students will be able to

- Appraise the basics of Artificial intelligence and concepts of natural language processing.
- Illustrate the working of Parallel, Distributed and connectionist models of AI.
- Discuss the fundamentals of Genetic algorithms.
- Escalate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised learning.
- Explore the associated parameters of the Machine Learning algorithms viz., dimensionality reduction, classification, etc.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books**


1. Artificial Intelligence – Elaine Rich,Kevin Knight,Shivashankar B Nair, McGraw Hill Education, 3rd Edition, 2016.ISBN 978-0-07-008770-5.
2. Introduction to Machine Learning – Ethem Alpaydin, PHI Learning,3rd Edition,2018. ISBN 978-81-203-5078-6.


**Reference Books**


1. Introduction to Artificial Intelligence – Eugene Charnik, Drew McDermott,Pearson Education India, 1st edition, ISBN - 978-8131703069

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Project Work Phase-2**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18MLP83** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : -- | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : -- | | Exam Hours | : 03 |

**Credits – 8**

**Course objectives:**

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

**Project Work Phase - II:** Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

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

- Describe the project and be able to defend it.
- Develop critical thinking and problem solving skills.
- Learn to use modern tools and techniques.
- Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
- Develop skills to work in a team to achieve common goal.
- Develop skills of project management and finance.
- Develop skills of self learning, evaluate their learning and take appropriate actions to improve it.
- Prepare themselves for life-long learning to face the challenges and support the technological changes to meet the societal needs.

**Evaluation Procedure:**

- **As per University guidelines**
- **Internal Marks:** The Internal marks (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.
- **Semester End Examination:** SEE marks for the project (100 marks) shall be based on Project report, Presentation and Demonstrationof the actual/model/prototype of the project, as per the University norms by the examiners appointed VTU.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Technical Seminar**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18MLS84** | | CIE Marks | : 100 |
| Number of Lecture Hours /Week | : -- | | SEE Marks | : -- |
| Total Number of Lecture Hours | : -- | | Exam Hours | : 03 |

**Credits – 1**

**Course objectives:**

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas. Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey, organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

**Course outcomes:**

At the end of the course the student will be able to:

- Develop knowledge in the field of Electronics &Instrumentation Engineering and other disciplines through independent learning and collaborative study.
- Identify and discuss the current, real-time issues and challenges in engineering & technology.
- Develop written and oral communication skills.
- Explore concepts in larger diverse social and academic contexts.
- Apply principles of ethics and respect in interaction with others.
- Develop the skills to enable life-long learning.

**Evaluation Procedure:**

- As per University guidelines.
- The Internal Assessment marks for the seminar shall be awarded based on the relevance of the seminar topic, quality of the report, presentation skills, participation in the question and answer, and attendance in the seminar classes/sessions.

**B.E. Medical Electronics (ML)**
Choice Based Credit System (CBCS)
Semester - VIII

**Internship**

| | | | | |
|---|---|---|---|---|
| Course Code | : **18MLI85** | | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : -- | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : -- | | Exam Hours | : 03 |

**Credits – 3**

**Course objectives:**
Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory into practice
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

**Internship/Professional practice:** Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.
**Seminar:** Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

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

- Acquire practical experience within industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Recognize the areas for future knowledge and skill development.
- Acquire the basic knowledge of administration, marketing, finance and economics.
- Develop the skills to enable lifelong learning.

**Evaluation Procedure:**

- **As per University guidelines.**
- **Evaluation of CIE Marks:** The Internal Assessment marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentation.
- **Semester End Examination**: The marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentationas per the University norms by the examiners appointed VTU.

# B.E. - MEDICAL ELECTRONICS (ML)
# OPEN ELECTIVES (REVISED)

| Semester - VI | | | |
|---|---|---|---|
| **OPEN ELECTIVE - A** | | | |
| Course Code | **18ML65X** | CIE Marks | 40 |
| TeachingHours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

Students can select any one of the open electivesoffered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

| Sl.No. | Board and the Department offering the Electives | | Course Sl. No. | Course code under 18BM65X | Course Title |
|---|---|---|---|---|---|
| 01 | EI/ BM/ ML | Medical Electronics | 1 | 18ML651 | Biomedical Transducers and Medical Instrumentation |
| | | | 2 | 18ML652 | Fundamentals of Medical Imaging Techniques |
| | | | 3 | 18ML653 | Rehabilitation Engineering and Assistive Technology |

**Semester –VI: Open Elective-A**

## Biomedical Transducers and Medical Instrumentation

**(Common to BM & ML)**

| | | | |
|---|---|---|---|
| Subject Code | : **18BM651/18ML651** | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours/Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hrs)**

**Course Objectives:** This course will enable the students to

- Gain the knowledge of working principle and construction details of Biomedical Transducers.
- Acquire the knowledge of transducer applications to access the biological signals.
- Access the performance of various Biomedical Transducers.

**Revised Bloom's Taxonomy Levels:** L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

**Modules**

**Module -1**

**Fundamental Concepts and Basic Transducers:** Introduction, Classification of Transducers,

Classification of transducers, Perfomance characteristics of Transducers, Displacement, Position and Motion Transducers, Pressure Transducers, Photoelectric Transducers, Optical fibre sensors and Smart sensors.

**Module -2**

**Bioelectric Signals and Electrodes**:

Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes–Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.

**Module -3**

**Recording Systems:** Basic recording system, General considerations for signal conditioners, Preamplifiers, Biomedical signal analysis techniques, Signal processing techniques, Writing systems, Direct writing recorders, Ink Jet recorders, Potentiometric Recorders, Tape Recorders and Digital Recorders.

**Module -4**

**Clinical Laboratory Instruments:** Clinical thermometer probes, tympanic thermometers, telemetering capsules. Photoelectric Transducers: photovoltaic cells and photoemissive cells. Spectrophotometer, Colorimeter, Automated Biochemical Analysis Systems, Clinical Flame Photometers and Selective-ion Electrodes Based Electrode Analysers. Blood Cell Counters.

**Module -5**

**Flow Measurement:** Requirements for measurement ranges – blood flow in a single vessel, tissue blood flow, and respiratory gas flow. Electromagnetic flowmeters – principle, methods of magnetic field excitation, perivascular probes, intravascular probes. Ultrasonic blood flowmeters– propagation of ultrasound in the tissue, ultrasonic Doppler flowmeters, blood flow measurement through Doppler imaging. Cardiac Output Measurement - Indicator dilution method, Dye Dilution method, Thermal Dilution Method, impedance cardiography.

**Course Outcomes:** After studying this course, students will able to:

1. Understand the working principle and construction details of Transducers.
2. Improve the measurement techniques through different approach.
3. Practically can implement the technology in measurement field.

**Graduate Attributes (as per NBA)**

- Engineering knowledge
- Modern tool usage
- Engineer and society
- Environment& sustainability
- Lifelong learning

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. **Biomedical Transducers and Instruments –** Tatsuo Togawa, Toshiyo Tamura and P. Ake Oberg, CRC Press, 1997.
2. **Handbook of Biomedical Instrumentation**- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003.

**Reference Books:**

1. **Biomedical Instrumentation and Measurement** – Leslie Cromwell, Fred J Weibell and Erich A. Pfeiffer, 2nd Edition, Prentice-Hall India Pvt. Ltd., 2004.
2. **Transducers and Instrumentation** -D. V. S. Murty Prentice Hall India Pvt ltd. 2nd Edition

**Semester – VI: Open Elective-A**

## Fundamentals of Medical Imaging Techniques

(Common to BM & ML)

| | | | |
|---|---|---|---|
| **Subject Code** | **: 18BM652/18ML652** | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

**X-Ray Machines and Radiography:** Fundamentals of X-ray – Electromagnetic radiation, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors, Biological effects of ionizing radiation.

**X-Ray Diagnostic Methods:** Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography and Xeroradiography.

**Module -2**

**Computed Tomography**: Principle of CT, System components, Gantry geometry, Patient dose in CT scanners. Algorithms for image reconstruction, CT number, Spiral CT. Recent developments .Digital Radiography- Digital subtraction angiography (DSA), Dynamic spatial reconstructor (DSR), Image artifacts and Image characteristics.

**Module -3**

**Ultrasound Imaging:** Fundamentals of acoustic propagation - Characteristic impedance, Intensity, Reflection and refraction, Attenuation, Doppler effect. Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution, Focusing, Arrays. Ultrasonic Diagnostic Methods:Pulse echo systems- Amplitude mode (A-mode), Brightness mode (Bmode), Motion mode (M-mode), Doppler methods, Duplex imaging, Tissue characterization, Colour Doppler flow imaging, Image characteristics – Ultrasonic texture or speckle, Speckle reduction, Compensation of phase aberration, Biological effects of ultrasound.

**Module -4**

**Radionuclide Imaging:** Introduction, Fundamentals of Radioactivity – Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Radionuclide generators, nuclear radiation detectors, Collimators, Diagnostic methods using radiation detector probes – Thyroid function test, Renal

function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT, PET.

**Module - 5**

**Basics of Magnetic Resonance Imaging:** Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Spin density, Relaxation times, Pulse sequences.

**MRI System & Imaging Methods:** Introduction, Magnet, NMR Coil/Probe, Transmitter, Receiver, Data acquisition. Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging- Gradient echo imaging, Characteristics of MRI images- Spatial resolution, image contrast. Biological effects of magnetic fields- Static magnetic fields, Radio-frequency fields, Gradient magnetic fields.

**Course Outcomes:** After studying this course, students will be able to:

1. Describe the fundamentals of x-ray radiography and analyze the system requirements.
2. Explain principles and applications of Computed Tomography system requirements.
3. Discuss the fundamentals of Ultrasonic imaging and analyze the system requirements.
4. Describe the fundamental concepts of Radionuclide Imaging and analysis of the system.
5. Understand physics and Instrumentation of MR imaging system.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Principles of Medical Imaging – by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic Press, 1992.
2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. Fundamentals of Medical Imaging – by Paul Suetens, Cambridge University Press, 2002.

**Reference Books:**

1. The Physics of Medical Imaging – by Steve Webb (Editor), Adam Hilger, Bristol and Philadelphia Publications, 1988.

## Semester – VI: Open Elective-A

# Rehabilitation Engineering and Assistive Technology

**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Subject Code | : 18BM/ML 653 | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 8 Hours)**

**Module 1**

**Introduction to Rehabilitation:** Introduction Types of physical impairments, Principles of Rehabilitation, Motor, Sensor and Communication disorders. Intelligent prosthetic knee & arm. Advanced automatic prosthetics and orthotics. Prevention and cure of visual impairment, Electronics travel appliances, path sounder, laser cane, ultrasonic torch and guide, light probes, obstacle sensors, electro cortical prosthesis, classification.

**Module 2**

**Therapeutic Exercise Technique:** Coordination Exercises, Balance Training, Gait, Pathological Gaits, Gait Training – Crutch Walking: Patterns of Gait, Relaxation exercises, Methods for training Relaxation, Strengthening exercises, Mobilization exercises.

**Principles in Management of Communication:** Communication, Speech, Language, Aphasia, Dysarthria, Speech therapy, Dysphagia, Communication for Visually impaired, Types of visual aids, Writing aids.

**Module 3**

**Orthotic Devices in Rehabilitation Engineering:** Definition, General Principles of Orthosis, Biomechanics of Orthosis, Classification, Material and fabrication for lower limb Orthosis, Calipers – Foot Orthoses, Ankle-Foot Orthosis, Knee-Ankle-Foot Orthosis, Hip-Knee-Ankle-Foot Orthoses, Functional Electrical Stimulation, Spinal Orthosis- Cervical, Head cervical Orthosis, Head cervical thoracic orthosis, Thoraco lumbar sacral orthosis, Lumbosacro-orthosis, Splints-its functions & types.

**Module 4**

Subjective and objective measurement methods. Characterizing human systems, and assertive devices. Biomaterials outlook for organ transplant, design considerations evaluation process. Engineering design of artificial heart and circulatory assist devices, Implementation and implantation aspects.

**Module 5**

Computer application in rehabilitation engineering; Interfaces in compensation for visual perception and improvement of orientation and mobility, rehabilitation aids for mentally impaired. Physical therapist, Occupational therapist, Prosthetist-Orthotist, Rehabilitation nurse, Speech pathologist, Psychologist and child development Specialist, Horticultural Therapist, Music therapist, Creative Movement. Therapist, Dance and play Therapist, Recreational therapist, Biomedical engineer.

**Course Outcomes:** After studying this course, students will be able to:

1. Define rehabilitation and explain the composition of rehabilitation team.
2. Discuss the engineering principles of rehabilitation engineering.
3. Apply engineering skills in the development of prosthetic and orthotic devices.
4. Evaluate the orthopedic design and applications.
5. Apply the principles of engineering in the development of mobility aids for physically

handicap.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Rehabilitation Medicine - By Dr. S. Sunder, 3rd Edition, Jaypee Medical Publications, Reprint 2004.
2. Biomedical Engg., Handbook, Bronzino J. D., CRC press (New York),1995

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester - VII | | | |
|---|---|---|---|
| **OPEN ELECTIVE - B** | | | |
| Course Code | **18ML75X** | CIE Marks | 40 |
| Teaching Hours/Week (L:T:P) | (2:2:0) | SEE Marks | 60 |
| Credits | 03 | Exam Hours | 03 |

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

| **Sl. NO.** | **Board and the Department offering the Electives** | | **Course** | | **Course Title** |
|---|---|---|---|---|---|
| | | | **Sl. No.** | **code under 18BM75X** | |
| | **EI/ BM/ ML** | Medical Electronics | 1 | 18ML751 | Biomedical Signal Processing |
| | | | 2 | 18ML752 | Biomedical Image Processing |
| | | | 3 | 18ML753 | Medical Informatics |

| B.E. Medical Electronics (ML)<br>Choice Based Credit System (CBCS)<br>Semester – VII: Open Elective-B | | | | |
|---|---|---|---|---|
| **Biomedical Signal Processing**<br>(Common to BM & ML) | | | | |
| **Subject Code** | **: 18BM751/18ML751** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |
| **Credits – 3 (Each module – 08 Hours)** | | | | |

**Module -1**

Signal processing: Review of Discrete time signals and systems - LTI systems - Response of LTI systems – Convolution - Difference equation representation of discrete systems Z transform - Transform analysis of LTI system – DFT. STFT - Introduction to wavelets - CWT and DWT with Haar wavelet. Introduction to biosignals: Computers in medicine. Human anatomy and physiology - Cell structure - Origin of bioelectric potentials - Biomedical signals - The Brain and its potentials. Electrophysiological origin of brain waves. EEG signal and its characteristic- ECG signal origin and characteristics.

**Module -2**

Neurological signal processing: EEG analysis - Parametric modelling - Linear prediction theory; Autoregressive (AR) method; Recursive estimation of AR parameters. Cardiological signal processing: ECG parameters and their estimation - Arrhythmia analysis monitoring - ECG data reduction techniques

**Module-3**

Adaptive interference / Noise cancellation: Types of noise in biosignals; Digital filters - IIR and FIR - Notch filters - Optimal and adaptive filters. Weiner filters - steepest descent algorithm - LMS adaptive algorithm - Adaptive noise canceller - cancellation of 50 Hz signal in ECG - Cancellation of maternal ECG in foetal electrocardiography.

**Module -4**

Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging. Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wave Transitions, Hypnogram Model Parameters.

**Module -5**

Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

Note: Assignments can be given on analysis other important biomedical signals like EMG, ERG, EOG, Evoked potentials.

**Course Outcomes:** After studying this course, students will be able to:

1. Analyze the nature of Biomedical signals and related concepts
2. Apply filters to remove noise from biomedical signals.
3. Apply averaging technique on biomedical signals and extract the features of EEG signals.
4. Analyze event detection techniques for EEG and ECG signals.
5. Apply signal compression techniques on biomedical signals.

**Question Paper Pattern**

The question paper will have TEN questions.

- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Biomedical signal analysis- A case study approach, RangayyanRangaraj, Wiley (IEEE Press)-2005
2. Biomedical Signal Processing- Principles and Techniques - D.C.Reddy, Tata McGraw-Hill, 2005.
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI, 2000.

**Reference Books:**

1. Biomedical Signal Processing -Akay M, , Academic: Press 1994
2. Biomedical Signal Processing (Vol. I Time & Frequency Analysis) - Cohen.A,, CRC Press, 1986.

**Semester – VII: Open Elective-B**

## Biomedical Image Processing

**(Common to BM & ML)**

| | | | |
|---|---|---|---|
| Subject Code | **: 18BM752/18ML752** | CIE Marks | : 40 |
| Number of Lecture Hours /Week | : 02+02 | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module -1**

Fundamentals of Digital image, Image formation, visual perception, CCD & CMOS Image sensor, Image sampling: Two dimensional Sampling theory, Nonrectangular grid and Hexagonal sampling, Optimal sampling, Image quantization, Non uniform Quantization, Image formats. Types of pixel Operations, Types of neighborhoods, adjacency, connectivity, boundaries, regions, 2D convolution, Color models.

**Module -2**

**Image Enhancement in Spatial Domain:** Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logic operations – Image subtraction, Image averaging. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters.

**Module -3**

**Image Enhancement In Frequency Domain:** Background, 2D-Discrete Fourier Transform and its Inverse, Basic properties of the 2D-Discrete Fourier Transform, Basics of filtering in the frequency domain. Image smoothing using frequency domain filters – Ideal low pass filters, Butterworth low pass filters, Gaussian low pass filters; Image sharpening using frequency domain filters – Ideal high pass filters, Butterworth high pass filters, Gaussian high pass filters, Homo-morphic filtering.

**Module -4**

Image Segmentation Detection of discontinuities, Point-line- edge detection, Linear and Circular Hough Transform, Basic Global and Adaptive Thresholding, Region Based segmentation, K-Means Clustering.

**Module -5**

**Image Restoration:** Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter.

**Image Compression:** Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding.

**Course Outcomes:** After studying this course, students will be able to,

1. Define the general terminology of digital image processing.
2. Identify the need for image transforms and their types both in spatial and frequency

domain.
3. Identify different types of image enhancement techniques.
4. Describe image segmentation models and learn image segmentation techniques.
5. Explain and apply various methodologies for image compression.

Note: It is suggested to give assignments / hands-on-experience on the above image processing concepts using Matlab / C programming on medical images like x-ray / CT / MRI.

**Question Paper Pattern**

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

**Text Books:**

1. Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.

**Reference Books:**

1. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
2. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning.

**Semester – VII: Open Elective-B**

## Medical Informatics

**(Common to BM & ML)**

| | | | | |
|---|---|---|---|---|
| Subject Code | **: 18BM753/18ML753** | | CIE Marks | : 40 |
| Number of Lecture + Tutorial Hours /Week | : 02+02 | | SEE Marks | : 60 |
| Total Number of Lecture Hours | : 40 | | Exam Hours | : 03 |

**Credits – 3 (Each module – 08 Hours)**

**Module- 1**

Introduction, history, definition of medical informatics, bio-informatics, online learning, introduction to health informatics, prospectus of medical informatics. Impact of Systems on Health Care, Care Providers and Organizations, mobile health care technologies.

**Module-2**

Hospital Management Need for HMIS, Capabilities & Development of HMIS, functional area, modules forming HMIS, (like Pathology Lab, Blood bank, Pharmacy, Diet planning). Maintenance and development of HMIS-Ideal Features and functionality of CPR, Development tools for CPR.

**Module–3**

**Computer Assisted Medical Education:** CAME, Educational software, Simulation, Virtual Reality, Tele-education, Tele-mentoring.
**Computer Assisted Patient Education:** CAPE, patient counseling software. Computer assisted surgery (CAS), Limitations of conventional surgery, 3D navigation system, intra-operative imaging for 3D navigation system, merits and demerits of CAS.

**Module–4**
**Telecommunication Based Systems:** Tele-Medicine, Need, Advantages, Technology- Materials and Methods, Internet Tele-Medicine, Applications. Tele-surgery, Robotic surgery, Need for Tele-Surgery, Advantages, Applications. Real-time Telemedicine. Data Exchange: Network Configuration, circuit and packet switching, H.320 series (Video phone based ISBN) T.120, H.324. Video Conferencing.

**Module–5**
**Knowledge Based And Expert Systems**: Introduction, Artificial Intelligence, Expert systems, need for Expert Systems, materials and methods- knowledge representation & its methods, production rule systems, algorithmic method, OAV, object oriented knowledge, database comparisons, statistical pattern classification, decision analysis, tools, neural networks, advantages of ES, applications of ES.

**Course Outcomes:** After studying this course, students will be able to:

1. Explain the basics and importance of medical informatics in hospital management.
2. Describe the different modalities functions exists in the hospital for effective management.
3. Discuss the role of telecommunication, tele-surgery, robotics in healthcare.
4. Explain the decision making concepts used in healthcare and their applications.
5. Apply information and communication technology in healthcare.

**Question Paper Pattern:**

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Medical Informatics: A Primer - by Mohan Bansal, 1st Print, Tata McGraw Hill, Publications, 2003.
2. A.S. Tanenbaum, “Computer Networks”, 2012, 5th Edition, Pearson Education, London.
3. Kenneth R. Ong, “Medical Informatics: An Executive primer”, 2015, 1st Edition, HIMSS Publishing, Chicago

**Reference Books:**

1. Medical Informatics: Computer Applications in Health Care and Biomedicine by E.H.Shortliffe, G. Wiederhold, L.E.Perreault and L.M.Fagan, 2nd Edition, Springer Verlag, 2000.
2. Handbook of Medical Informatics by J.H.VanBemmel, Stanford University Press/ Springer, 2000.