# University of Mumbai

No. AAMS(UG)/ 11 of 2022-23

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/54 of 2021 dated 21st January, 2021 relating to **revised scheme (Rev-2019 'C' Scheme) for the B.E. in Bio-medical Engineering (Sem. III & VIII).**

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Bio-medical Engineering at its meeting held on 13th November, 2021 and subsequently passed by the Board of Deans at its meeting held on 27th December 2021 vide item No. 6.3 have been accepted by the Academic Council at its meeting held on 28th December, 2021 **vide** item No. 6.3 and that in accordance therewith, the reduced syllabus for B.E. (Bio-medical Engineering) (Rev-2019 'C' Scheme) for Direct Second Year (Sem.III) as Direct Second Year (DSE) students admission is delayed by the six months due to COVID-19 situation, has been brought into force with effect from the academic year 2021-22 only. (The same is available on the University's website www.mu.ac.in).

(Sudhir S. Puranik)
REGISTRAR

MUMBAI – 400 032
4th May, 2022

To

The Principals of the Affiliated Colleges, and Directors of the Recognized Institutions in Faculty of Science & Technology.

**A.C/6.3/28/12/2021**

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No. AAMS(UG)/ 11 -A of 2022-23 4th May, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies Bio-medical Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Sudhir S. Puranik)
REGISTRAR

**Copy for information and necessary action :-**

1. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
2. **College Teachers Approval Unit (CTA),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA)**
5. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
6. **The Deputy Registrar, Executive Authorities Section (EA)**
   **He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.**
7. **The Deputy Registrar, PRO, Fort, (Publication Section),**
8. **The Deputy Registrar, Special Cell,**
9. **The Deputy Registrar, Fort Administration Department (FAD) Record Section,**
10. **The Deputy Registrar, Vidyanagari Administration Department (VAD),**

**Copy for information :-**

1. **The Director, Dept. of Information and Communication Technology (DICT), Vidyanagari,**
   **He is requested to upload the Circular University Website**
2. **The Director of Department of Student Development (DSD),**
3. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**
4. **All Deputy Registrar, Examination House,**
5. **The Deputy Registrars, Finance & Accounts Section,**
6. **The Assistant Registrar, Administrative sub-Campus Thane,**
7. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
8. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
9. **P.A to Hon'ble Vice-Chancellor,**
10. **P.A to Pro-Vice-Chancellor,**
11. **P.A to Registrar,**
12. **P.A to All Deans of all Faculties,**
13. **P.A to Finance & Account Officers, (F & A.O),**
14. **P.A to Director, Board of Examinations and Evaluation,**
15. **P.A to Director, Innovation, Incubation and Linkages,**
16. **P.A to Director, Department of Lifelong Learning and Extension (DLLE),**
17. **The Receptionist,**
18. **The Telephone Operator,**

**Copy with compliments for information to :-**

19. **The Secretary, MUASA**
20. **The Secretary, BUCTU.**

**AC – 28/12/2021**
**Item No. - 6.3**

# UNIVERSITY OF MUMBAI

## Bachelor of Engineering
## (Bio-medical Engineering)

**Direct Second Year (Sem. III) Admitted Students for the current Academic Year 2021-22 Only due to Covid Pandemic**

**(REV- 2019 'C' Scheme) from Academic Year 2019 – 20**

**Under**
**FACULTY OF SCIENCE & TECHNOLOGY**

**Program Structure for Second Year Engineering**
**Semester III & IV**
**UNIVERSITY OF MUMBAI**
**(With Effect** from 2020-2021)

## Semester III

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | **Theory** | **Pract.** | **Tut.** | **Theory** | **Pract.** | **Tut.** | **Total** |
| BMC301 | Engineering Mathematics - III | 3 | -- | 1 | 3 | -- | 1 | 4 |
| BMC302 | Human Anatomy and Physiology for Engineers | 3 | | -- | 3 | | -- | 3 |
| BMC303 | Medical Sensors | 3 | -- | -- | 3 | -- | -- | 3 |
| BMC304 | Electronic Circuits Analysis and Design | 4 | -- | -- | 4 | -- | -- | 4 |
| BMC305 | Digital Electronics | 3 | -- | -- | 3 | -- | -- | 3 |
| BML301 | Human Anatomy and Physiology for Engineers Lab | -- | 2 | -- | -- | 1 | -- | 1 |
| BML302 | Medical Sensors Lab | -- | 2 | -- | -- | 1 | -- | 1 |
| BML303 | Electronic Circuits Analysis and Design Lab | -- | 2 | -- | -- | 1 | -- | 1 |
| BML304 | Electronics Lab (SBL) | -- | 4 | -- | -- | 2 | -- | 2 |
| BMM301 | Mini Project – 1 A | -- | 4$ | -- | -- | 2 | -- | 2 |
| **Total** | | **16** | **14** | **1** | **16** | **07** | **1** | **24** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **Theory** | | | | | | | |
| | | **Internal Assessment** | | | **End Sem. Exam** | **Exam. Duration (in Hrs)** | **Term Work** | **Pract/ oral** | **Total** |
| | | **Test 1** | **Test 2** | **Avg.** | | | | | |
| BMC301 | Engineering Mathematics - III | 20 | 20 | 20 | 80 | 3 | 25 | -- | 125 |
| BMC302 | Human Anatomy and Physiology for Engineers | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| BMC303 | Medical Sensors | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| BMC304 | Electronic Circuits Analysis and Design | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| BMC305 | Digital Electronics | 20 | 20 | 20 | 80 | 3 | -- | -- | 100 |
| BML301 | Human Anatomy and Physiology for Engineers Lab | -- | -- | -- | -- | -- | 25 | -- | 25 |
| BML302 | Medical Sensors Lab | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| BML303 | Electronic Circuits Analysis and Design Lab | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| BML304 | Electronics Lab (SBL) | -- | -- | -- | -- | -- | 25 | 25 | 50 |
| BMM301 | Mini Project – 1 A | -- | -- | -- | -- | -- | 25 | -- | 25 |
| **Total** | | **--** | **--** | **100** | **400** | **--** | **150** | **75** | **725** |

$ indicates work load of Learner (Not Faculty), for Mini Project - 1 A.
Faculty Load :1 hour per week per 4 mini project groups.

## Semester – III

| Course Code | Course Name | Teaching Scheme (Contact Hours) | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | TW/Pract | Tut. | Total |
| BMC301 | Engineering Mathematics-III | 03 | - | 01 | 03 | - | 01 | **04** |

| Course Code | Course Name | Examination Scheme | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | Term Work | Pract | Oral | Total |
| | | Internal Assessment | | | End Sem Exam | | | | |
| | | Test1 | Test2 | Avg of Test 1 & 2 | | | | | |
| BMC301 | Engineering Mathematics-III | 20 | 20 | 20 | 80 | 25 | - | - | **125** |

**Pre-requisite:** Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and Vector product of three and four vectors.

| Course Code | Course Name | Credits |
|---|---|---|
| **BMC301** | **Engineering Mathematics - III** | **04** |
| **Course Objectives** | • To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.<br>• To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills<br>• To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.<br>• To understand the basics of Linear Algebra and its applications<br>• To use concepts of vector calculus to analyze and model engineering problems. | |
| **Course Outcomes** | On successful completion of course learner will be able to:<br>• Apply the concept of Laplace transform to solve the real integrals in engineering problems.<br>• Apply the concept of inverse Laplace transform of various functions in engineering problems.<br>• Expand the periodic function by using Fourier series for real life problems and complex engineering problems.<br>• Find orthogonal trajectories and analytic function by using basic concepts of complex variables.<br>• Illustrate the use of matrix algebra to solve the engineering problems.<br>• Apply the concepts of vector calculus in real life problems. | |

| Module | Detailed Contents | Hrs. |
|---|---|---|
| **1.** | **Module: Laplace Transform**<br>1.1 Definition of Laplace transform, Condition of Existence of Laplace Transform.<br>1.2 Laplace Transform (L) of standard functions like $e^{at}$, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and $t^n, n \geq 0$.<br>1.3 Properties of Laplace Transform: Linearity, First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof).<br>1.4 Evaluation of integrals by using Laplace Transformation.<br><br>**Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function. | **07** |
| **2.** | **Module: Inverse Laplace Transform**<br>2.1 Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace Transform using derivatives.<br>2.2 Partial fractions method to find inverse Laplace Transform.<br>2.3 Inverse Laplace Transform using Convolution theorem (without proof).<br><br>**Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations. | **06** |
| **3.** | **Module: Fourier Series:**<br>3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).<br>3.2 Fourier series of periodic function with period $2\pi$ and $2l$.<br>3.3 Fourier series of even and odd functions.<br>3.4 Half range Sine and Cosine Series.<br><br>**Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform. | **07** |
| **4.** | **Module: Complex Variables:**<br>4.1 Function *f*(z) of complex variable, limit, continuity and differentiability of *f*(z)Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof).<br>4.2 Cauchy-Riemann equations in cartesian coordinates (without proof).<br>4.3 Milne-Thomson method to determine analytic function *f*(z)when real part (u) or Imaginary part (v) or its combination (u+v or u-v) is given.<br>4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories.<br><br>**Self-learning Topics:** Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations. | **07** |
| **5.** | **Module: Linear Algebra: Matrix Theory**<br>5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof).<br>5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix.<br>5.3 Similarity of matrices, Diagonalization of matrices, Functions of square matrix.<br><br>**Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.** | **06** |
| **6.** | **Module: Vector Differentiation and Integra**l<br>6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without | **06** |

| | | |
|---|---|---|
| | Proof).<br>6.2 **Properties of vector field:** Solenoidal and Irrotational (conservative) vector fields.<br>6.3 **Vector integral:** Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation.<br><br>**Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus. | |

## Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of marks for term work shall be as follows:

Class Tutorials on entire syllabus : 10 Marks
Mini project : 10 Marks
Attendance (Theory and Tutorial) : 5 Marks

## Assessment:

**Internal Assessment Test:**

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approximately 40% syllabus is completed and second class test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

**End Semester Theory Examination:**

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

**References:-**

1. Advanced engineering mathematics, H.K. Das, S.Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
7. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BMC302 | Human Anatomy and Physiology for Engineers (Abbreviated as HAPE) | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | Duration (hrs) | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | | |
| BMC302 | Human Anatomy and Physiology for Engineers (Abbreviated as HAPE) | 20 | 20 | 20 | 80 | 03 | -- | -- | -- | -- | 100 |

| Course Code | Course Name | Credits |
|---|---|---|
| BMC302 | Human Anatomy and Physiology for Engineers | 03 |
| Course Objectives | • To understand the anatomical structures of the human body and their relationship to each other.<br>• To understand the different physiological processes taking place inside the human body. | |
| Course Outcomes | Learners will be able to:<br>• Explain the organization of the human body, homeostasis and its maintenance, structure and functions of a cell and basic tissues.<br>• Explain the components of blood and their functions.<br>• Explain the anatomical parts and physiological processes of the cardiovascular system and respiratory system.<br>• Explain the anatomical parts and physiological processes of the alimentary system and renal system.<br>• Explain the structure and functions of nervous system, eye and skin along with the secretions and functions of all endocrine glands. | |

| Module | Contents | Hours |
|---|---|---|
| **1.** | **Introduction to the Human Body:** Levels of structural organization; Characteristics of living human organism; Homeostasis and its maintenance.<br>**Cells and Tissues**: Structure and functions of a cell; Transport across the plasma membrane | **04** |
| **2.** | **Cardiovascular System**: Anatomy of the heart; Heart valves, systemic and pulmonary circulation; Conduction system of the heart; Cardiac action potential, electrocardiogram (ECG); Cardiac cycle; Cardiac output; Blood pressure. | **05** |
| **3.** | **Blood:** Blood cells and their functions and ABO Blood Grouping | **02** |
| **4.** | **Renal System:** Anatomy of the renal system; Functions of kidney (urine formation, electrolyte balance and *pH* balance); composition of urine; Micturition. | **05** |
| **5.** | **Nervous System:** Structure and functions of the brain and spinal cord.. | **03** |
| **6.** | **Endocrine System:** All Glands of the endocrine system, their secretions and functions. | **03** |

**Assessment:**
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:**

**Text books:**
1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Publication)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

**Reference Books:**
1. Physiology of Human Body: Guyton. (Prism Book)
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper collin Pub.)
4. Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

**NPTEL/Swayam Course:**
*Course*: Animal Physiology by Prof. Mainak Das - IIT Kanpur
*https://nptel.ac.in/courses/102/104/102104058/*
*https://swayam.gov.in/nd1_noc20_bt42/preview*

**Theory Examination:**
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub-questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BMC303 | Medical Sensors (Abbreviated as MS) | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | Dur-ation (hrs) | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | | |
| BMC303 | Medical Sensors (Abbreviated as MS) | 20 | 20 | 20 | 80 | 03 | -- | -- | -- | -- | 100 |

| Course Code | Course Name | Credits |
|---|---|---|
| BMC303 | Medical Sensors | 03 |
| **Course Objectives** | • To provide the knowledge of basic concepts such as generalized medical instrumentation system, input transducer properties, and instrument characteristics.<br>• To provide a thorough understanding of principle and working of transducers and sensors used for measuring displacement, motion, force, pressure, temperature, bio-potentials, biochemical concentrations.<br>• To study the medical applications of the above transducers and sensors.<br>• To perform experiments based on some of the above transducers and sensors. | |
| **Course Outcomes** | The learner will be able to :<br>• Explain different components of a generalized medical instrumentation system, input transducer properties, and instrument characteristics.<br>• Apply the knowledge of principles of various types of transducers and sensors including motion, displacement, force, pressure sensors to different medical applications.<br>• Apply the knowledge of principles of various types of temperature sensors to different medical applications.<br>• Apply the knowledge of the various biopotential electrodes for measuring different types of biopotentials.<br>• Apply the principles of various chemical sensors for measuring concentration of biochemical analytes.<br>• Explain the principles of various biosensors and their medical applications. | |

| Module | Contents | Hours |
|---|---|---|
| **1.** | **Introduction**: Generalized medical instrumentation system; Static characteristics: Accuracy, precision, resolution, reproducibility, sensitivity, drift, hysteresis, linearity, input impedance and output impedance; Dynamic characteristics: Transfer functions, first order and second order systems | **03** |
| **2.** | **Displacement, Motion and Force Sensors and their Medical Applications:** Displacement measurement: Strain gauges, bridge circuits, inductive sensor – L.V.D.T., capacitive sensors; Acceleration and force measurement: Piezoelectric sensor, load cell | **05** |
| **3.** | **Temperature Sensors and their Medical Applications**: Temperature measurement: Thermistor, thermocouple, resistive temperature detector; IC-based temperature measurement; Radiation sensors: Quantum sensors | **04** |
| **4.** | **Biopotential electrodes**: Half-cell potential, polarization, polarizable and non-polarizable electrodes, calomel electrode; Electrode circuit model, electrode-skin interface and motion artefacts; Body surface electrodes | **03** |
| **5.** | **Chemical Sensors and their Medical Applications**: Blood gas and acid- base physiology; pH, $Pco_2$ , $Po_2$ electrodes; ISFETs; Transcutaneous arterial $O_2$ and $CO_2$ tension monitoring | **04** |
| **6.** | **Introduction**: Generalized medical instrumentation system; Static characteristics: Accuracy, precision, resolution, reproducibility, sensitivity, drift, hysteresis, linearity, input impedance and output impedance; Dynamic characteristics: Transfer functions, first order and second order systems | **03** |

**Books Recommended:**

**Text Books:**


1. Medical Instrumentation-Application and Design, John G. Webster, Wiley India Private Limited.
2. Instrument Transducers: An Introduction to Their Performance and Design, Hermann K. P. Neubert, Oxford University Press.
3. Biomedical Sensors: Fundamentals and Applications, Harry N. Norton, Noyes Publications.
4. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamura and P. Ake Öberg, CRC Press.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog, Prentice-Hall of India Pvt. Limited.
6. Biosensors: Fundamentals and Applications, Bansi Dhar Malhotra and Chandra Mouli Pandey, Smithers Rapra Technology.


**Reference Books:**


1. Principles of Applied Biomedical Instrumentation, L.A. Geddes and L.E. Baker, Wiley India Pvt Ltd.
2. Biomedical Instrumentation and Measurements, Leslie Cromwell, Erich A. Pfeiffer and Fred J. Wiebell, Prentice-Hall of India Pvt. Ltd.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merril Publishing Company.
4. Measurement Systems, Application and Design, Ernest O. Doeblin, McGraw Hill Higher Education.
5. Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, Springer Publishing Company.
6. Transducers for Biomedical Measurements: Principles and Applications, Richard S. C. Cobbold, John Wiley & Sons.

**NPTEL/Swayam Course:**

*Course*: Industrial Instrumentation by Prof. Alok Barua - IIT Kharagpur

*https://nptel.ac.in/courses/108/105/108105064/*

**Assessment:**

Internal Assessment consists of two tests out of which, one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Theory Examination:**

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on the entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BMC304 | Electronic circuit analysis and design (Abbreviated as ECAD) | 04 | -- | -- | 04 | -- | -- | 04 |

| Course Code | Course Name | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | Duration (hrs) | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | | |
| BMC304 | Electronic Circuit Analysis and Design (ECAD) | 20 | 20 | 20 | 80 | 03 | -- | -- | -- | -- | 100 |

| Course Code | Course Name | Credits |
|---|---|---|
| BMC304 | Electronic Circuit Analysis and Design | 04 |
| **Course Objectives** | • To understand transfer characteristics of semiconductor devices and to analyse basic application circuits.<br>• To make learners aware about the mathematical models of BJT and its use in analysing the circuits.<br>• To make the learners aware about different types of coupling and the concept of multistage amplifiers.<br>• Learners will be able to design power amplifier.<br>• To learn types and applications of MOSFET. | |
| **Course Outcomes** | Learner will be able to:<br>• Explain the transfer characteristics in analysing the electronic circuits which use diode, BJT etc.<br>• Explain equivalent circuits of BJT and apply them to analyse and design BJT based amplifier circuits<br>• Apply the knowledge of mathematical model to analyse multistage amplifiers.<br>• Design and analyse power amplifiers.<br>• Apply the concept of transfer characteristics, D.C. load line, A.C. load line to analyse MOSFET amplifiers. | |

| Module | Contents | Hours |
|---|---|---|
| 1. | **Basics of Diodes:** Construction, Working, Characteristics, Current Equation & Equivalent circuits of P-N Junction Diode as well as Zener Diode, Applications of Diode: Clipper & Clamper | 04 |
| 2. | **Basics & DC analysis of BJT:** Construction, Working and Characteristics of 3 different configurations of BJT.( Circuits, formulas and applications)<br>Quiescent point, DC load line, BJT Biasing need and types. Voltage Divider biasing configuration (include stability factor), BJT as a switch. | 05 |
| 3. | **BJT as an Amplifier:** A.C. Equivalent Model: $r_e$ model(for analysis) h-parameter model (Exact and Approximate) and Hybrid-$\pi$ model(Only concept and relationship) A.C. Analysis (Using $r_e$ model): A.C. load line, A.C. Effects of $R_S$ & $R_L$. Low frequency and High frequency analysis of Single stage amplifiers | 05 |
| 4. | **Multistage Amplifier:**<br>Concept of cascading, Types of coupling, cascade configuration, cascode amplifier, Darlington amplifier | 03 |
| 5. | **Power Amplifiers**:<br>Classes of Power amplifiers, Class-A Power Amplifiers analysis (Direct coupled and Transformer coupled), Class-B Power Amplifiers analysis Crossover distortion, Class-AB Push Pull and Complementary Symmetry Power amplifier, Class-C Power Amplifier, Heat Sinks | 04 |
| 6. | **MOSFET:**<br>Comparison of BJT & FET, Classification, Characteristics, Biasing of MOSFET, MOSFET as an amplifier, MOSFET as a switch. | 05 |

**Assessment:**
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:**
**Textbooks:**
1. Electronics Circuit. Analysis & Design, 2nd ed., Donald A. Neamen, McGraw Hill, 2001
2. Electronics Devices & Circuits Theory, by by Robert L. Boylestad and Louis Nashelsky, Pearson Education.
3. Semiconductor Data Manual, BPB Publications.

**Reference Books:**
1. Electronic Principles, by Albert Paul Malvino 6th edition, McGraw Hill
2. Electronic Devices and Circuits, by Jacob Milliman McGraw Hill.
3. Electronic Design, by Martin Roden, Gordon L.Carpenter, William Wieseman, Fourth edition, Shroff Publishers & Distributors Pvt. Ltd..
4. Electronic Circuits Discrete and Integrated, by Donald Schilling & Charles Belove, Third edition, McGraw Hill.

**NPTEL/Swayam Course:**
*Course*: Analog Electronic Circuits by Prof. Pradip Mandal - IIT Kharagpur
*https://nptel.ac.in/courses/108/105/108105158/*

**Theory Examination:**
1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules.

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BMC305 | Digital Electronics (Abbreviated as DE) | 03 | -- | -- | 03 | -- | -- | 03 |

| Course Code | Course Name | Examination Scheme | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | Term work | Pract | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | Duration (hrs) | | | | | |
| | | Test 1 | Test 2 | Avg | | | | | | | |
| BMC305 | Digital Electronics (DE) | 20 | 20 | 20 | 80 | 03 | -- | -- | -- | -- | 100 |

| Course Code | Course Name | Credits |
|---|---|---|
| BMC305 | Digital Electronics | 03 |
| **Course Objectives** | • To make learner aware of basics of Digital circuits, logic design, various Logic Families and Flip-flops.<br>• Learner should be able to design various counters, registers and know their applications.<br>• Learner should be able to design sequential circuits as a state machine. | |
| **Course Outcomes** | Learner will be able to:<br>• Describe various number systems, logic gates and logic families.<br>• Apply Boolean algebra, K-maps for Logic reduction and implementations in SOP and POS form<br>• Develop combinational circuits such as code converter circuits, parity generator checker circuits and magnitude comparator circuits. Also, circuits using multiplexers, de-multiplexers, and decoders.<br>• Design synchronous sequential circuits and asynchronous counters using flip flops<br>• Design various registers using flip flops. | |

| Module | Contents | Hours |
|---|---|---|
| **1.** | **Fundamentals of Digital Design:**<br>**Introduction:** Number system: Binary, Octal, Hexadecimal and other. Conversion from One system to another.<br>**Logic Gates and Families:** AND, OR, NOT, XOR, XNOR, operation NAND, NOR used of the universal gate for performing different operations. | **04** |
| **2.** | **Combinational Logic Design:**<br>**Logic Reduction Techniques**: K-MAPS and their use in specifying Boolean Expressions, Minterm, Maxterm, SOP and POS Implementation. | **03** |
| **3.** | **MSI Combinational Circuits:**<br>**Binary Arithmetic Circuits**: Laws of Boolean algebra**,** Binary Addition, Binary Subtraction (ones and twos complement).<br>**Elementary Designs:** Parity Generator and Parity Checker (3 bit), (Half & Full) Adders, (Half & Full) Subtractors, Magnitude Comparators. | **04** |
| **4.** | **Use of Multiplexers in Logic Design:** Multiplexer, De- Multiplexers. | **03** |
| **5.** | **Fundamentals of Sequential Logic Circuits:**<br>**Flip-Flops:** Flip-Flops, SR, T, D, JK. (Truth table and excitation table) | **03** |
| **6.** | **Counters:** Modulus of a counter, Designing of synchronous and asynchronous counter using flip flop.<br>**Registers:** Serial input serial output, serial input parallel output, Left Right shift register, Bidirectional shift register, Universal shift register. | **05** |

**Assessment:**
Internal Assessment consists of two tests out of which; one should be compulsory class test (on minimum 02 Modules) and the other is either a class test or assignment on live problems or course project.

**Books Recommended:**

**Text Books:**

1. Modern Digital Electronics, by R.P.Jain Tata McGraw Hill, 1984
2. Digital Design,by M Morris Mono Prentice Hall International-1984.
3. Digital Principal and Applications, by Malvino& Leach, Tata McGraw Hill, 1991.
4. Digital Electronics, by Malvino, Tata McGraw Hill, 1997.
5. Digital Logic: Applications and Design,by John Yarbourugh Cengage Learning
6. Fundamentals of Digital Circuits,by A. Anand Kumar, Prentice-Hall of India Pvt.Ltd;
7. Digital Design: Principles & Practices, by John F. Wakerly, Prentice Hall

**Reference Books:**

1. Digital Electronics, by James Bignell& Robert Donovan, Delmar, Thomas Learning,
2. Logic Circuits,by Jog N.K, 2nd edition, Nandu Publisher & Printer Pvt .Ltd. 1998.
3. Introduction to Logic Design, by Alan b. Marcovitz McGraw Hill International 2002.

**NPTEL/Swayam Course:**
*Course*: 1. Digital Circuits by Prof. Santanu Chattopadhyay - IIT Kharagpur
*https://nptel.ac.in/courses/108/105/108105113/*
*https://swayam.gov.in/nd1_noc20_ee70/preview*

*Course*: 2. Switching Circuits and Logic Design by Prof. Indranil Sengupta - IIT Kharagpur
*https://nptel.ac.in/noc/courses/noc20/SEM2/noc20-cs67/*
*https://swayam.gov.in/nd1_noc20_cs67/preview*

**Theory Examination**:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
2. Total four questions need to be solved.
3. Q.1 will be compulsory, based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining question will be randomly selected from all the modules

| Course Code | Course Name | Teaching Scheme | | | Credit Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BML301 | Human Anatomy and Physiology for Engineers (HAPE) | -- | 02 | -- | -- | 01 | -- | 01 |

| Course Code | Course Name | Examination Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | |
| BML301 | Human Anatomy and Physiology for Engineers (HAPE) | -- | -- | -- | -- | 25 | -- | -- | -- | 25 |

| Course Code | Course Name | Credits |
|---|---|---|
| BML301 | Human Anatomy and Physiology for Engineers | 01 |
| Course Objective | • To understand the anatomical structures of the human body and their relationship to each other.<br>• To gain the knowledge of measurement of various physiological parameters of the human body. | |
| Course Outcome | The learner will be able to :<br>• Demonstrate measurement of blood pressure using occlusive cuff method.<br>• Apply blood cell counting principles for measuring blood composition.<br>• Demonstrate the measurement of electrical activity of heart and the related parameters.<br>• Demonstrate the measurement of various lung volumes and capacities.<br>• Appropriately utilize laboratory equipment, such as microscopes, general lab ware, and virtual simulations.<br>• Locate and identify anatomical structures. | |

**Syllabus: Same as that of BMC302, Human Anatomy and Physiology for Engineers.**

**List of Laboratory Experiments: (Any Seven)**

1. To measure blood pressure using sphygmomanometer.
2. To find the total red blood cell count using pre-prepared slides.
3. To find the total white blood cell count using pre-prepared slides.
4. To study the conduction system of the heart.
5. To study the twelve lead electrode scheme and operation of the ECG Machine.
6. To record ECG and measure its various parameters (amplitude, intervals/segment).
7. To record lung volumes and capacities using a spirometer.
8. Visit to the anatomy department of a hospital to view specimens (cardiovascular & respiratory systems).
9. Visit to the anatomy department of a hospital to view specimen (alimentary & renal systems).
10. Visit to the anatomy department of a hospital to view specimen (nervous system).
11. Present a case study on a given disease/abnormality that requires medical instruments for diagnosis/treatment.
12. Present case a study on a given disease/abnormality that requires medical instruments for diagnosis/treatment.

Any other experiment/visit to the hospital/case study based on syllabus which will help learner to understand a topic/concept.

**Assessment:**

**Term Work:**

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Books Recommended:**

**Text books:**

1. Anatomy and Physiology in Health and Illness: Ross and Wilson. (ELBS Pub.)
2. Essentials of Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

**Reference Books:**

1. Physiology of Human Body: Guyton. (Prism Book )
2. Review of Medical Physiology: William Ganong. (Prentice Hall Int.)
3. Principles of Anatomy and Physiology: Tortora and Grabowski. (Harper Collin Pub.)
4. Anatomy and Physiology: Elaine N Marieb. (Pearson Education)

**NPTEL/Swayam Course:**

*Course*: Animal Physiology by Prof. Mainak Das - IIT Kanpur
*https://nptel.ac.in/courses/102/104/102104058/*
*https://swayam.gov.in/nd1_noc20_bt42/preview*

| Course Code | Course Name | Teaching Scheme | | | Credits Assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BML302 | Medical Sensors (Abbreviated as MS) | -- | 02 | -- | -- | 01 | -- | 01 |

| Course Code | Course Name | Examination Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | | | | | |
| | | Internal Assessment | | | End Sem | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Test 1 | Test 2 | Avg. | | | | | | |
| BML302 | Medical Sensors (Abbreviated as MS) | -- | -- | -- | -- | 25 | -- | 25 | -- | 50 |

| Course Code | Course Name | Credits |
|---|---|---|
| BML302 | Medical Sensors | 01 |
| Course Objectives | • To analyse the transient response of a first-order system.<br>• To measure displacement using various displacement sensors.<br>• To measure pressure using a pressure sensor.<br>• To measure force using a force sensor.<br>• To measure temperature using various temperature sensors.<br>• To measure pH of a solution using a pH electrode. | |
| Course Outcomes | The learner will be able to:<br>• Analyse step response of a first-order system.<br>• Demonstrate the measurement of displacement using various displacement sensors.<br>• Demonstrate the measurement of force and pressure using a force sensor and a pressure sensor respectively.<br>• Demonstrate the measurement of temperature using various temperature sensors.<br>• Distinguish various biopotential electrodes.<br>• Demonstrate the measurement of pH of a solution using a pH electrode. | |

**Syllabus: Same as that of BMC303 Medical Sensors.**

**List of Laboratory Experiments: (Any seven)**

1. To study the transient response of a first-order system.
2. To study the resistance versus temperature characteristics of a thermistor.
3. To study the thermistor linearization technique.
4. To study the characteristics of a light dependent resister.
5. To study the principle and working of a thermocouple.
6. To study principle and working of L.V.D.T.
7. To study principle and working of a capacitive sensor.
8. To study principle and working of a strain gage sensor.
9. To study principle and working of a pressure sensor.
10. To study the principle and working of a force sensor.
11. To study the various biopotential electrodes.
12. To study the pH electrode.

Any other experiment/student presentation based on the syllabus which will help the learner to understand a topic/concept.

**Books Recommended:**

**Text Books:**


1. Medical Instrumentation-Application and Design, John G. Webster, Wiley India Private Limited.
2. Instrument Transducers: An Introduction to Their Performance and Design, Hermann K. P. Neubert, Oxford University Press.
3. Biomedical Sensors: Fundamentals and Applications, Harry N. Norton, Noyes Publications.
4. Biomedical Transducers and Instruments, Tatsuo Togawa, Toshiyo Tamura and P. Ake Öberg, CRC Press.
5. Electronics in Medicine and Biomedical Instrumentation by Nandini K. Jog, Prentice-Hall of India Pvt. Limited.
6. Biosensors: Fundamentals and Applications, Bansi Dhar Malhotra and Chandra Mouli Pandey, Smithers Rapra Technology.


**Reference Books:**


1. Principles of Applied Biomedical Instrumentation, L.A. Geddes and L.E. Baker, Wiley India Pvt Ltd.
2. Biomedical Instrumentation and Measurements, Leslie Cromwell, Erich A. Pfeiffer and Fred J. Wiebell, Prentice-Hall of India Pvt. Ltd.
3. Principles of Biomedical Instrumentation and Measurement, Richard Aston, Merril Publishing Company.
4. Measurement Systems, Application and Design, Ernest O. Doeblin, McGraw Hill Higher Education.
5. Handbook of Modern Sensors – Physics, Design and Application, Jacob Fraden, Springer Publishing Company.
6. Transducers for Biomedical Measurements: Principles and Applications, Richard S. C. Cobbold, John Wiley & Sons.


**NPTEL/Swayam Course:**

*Course*: Industrial Instrumentation by Prof. Alok Barua - IIT Kharagpur

*https://nptel.ac.in/courses/108/105/108105064/*

## Assessment:

***Term Work:***

Term work shall consist of minimum 7 experiments.

The distribution of marks for term work shall be as follows:

Laboratory work (Experiments) : 10 Marks

Laboratory work (Journal) : 10 Marks

Attendance : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Oral examination will be based on suggested practical list and entire syllabus.**

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BML303 | Electronic Circuit Analysis and Design Lab (ECAD Lab) | -- | 02 | -- | -- | 01 | -- | 01 |

| Course Code | Course Name | Examination Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | |
| BML303 | Electronic Circuit Analysis and Design Lab (ECAD Lab) | -- | -- | -- | -- | 25 | -- | -- | 25 | 50 |

| Course Code | Course Name | Credits |
|---|---|---|
| BML303 | Electronic Circuit Analysis and Design Lab | 01 |
| Course Objective | • To practically verify characteristics of different electronic components like diodes, BJT, MOSFET etc<br>• To practically verify outputs of few applications of diodes, BJT, MOSFET.<br>• To design and implement small signal amplifier. | |
| Course Outcome | Learner will be able to:<br>• Explain the transfer characteristics of basic semiconductor devices.<br>• Design and verify the outputs of various electronic circuits such as clipper, clampers etc using bread boards and various lab equipments.<br>• Design amplifier circuits and plot its frequency response. | |

**Syllabus: Same as that of BMC304 Electronic Circuit Analysis and Design.**

**List of Laboratory Experiments: (Any Eight)**

1. To verify semiconductor diode and Zener diode characteristics.
2. To implement various clipper circuits and verify output.
3. To implement various clamper circuits and verify output.
4. To study line regulation and load regulation of voltage regulator using Zener diode.
5. To verify input and output characteristics of BJT.
6. To implement a switch using BJT.
7. To implementation different biasing circuit of BJT
8. To design and implement CE amplifier.
9. To study frequency response of CE amplifier.
10. To verify input and output characteristics of MOSFET.
11. To implementation different biasing circuit of MOSFET
12. To Study frequency response of an MOSFET amplifier.

Any other experiment based on syllabus can be included in the term work which will help learner to understand topic/concept.

**Assessment:**

***Term Work:***

Term work shall consist of minimum 8 experiments.
The distribution of marks for term work shall be as follows:
Laboratory work (Experiments) : 10 Marks
Laboratory work (Journal) : 10 Marks
Attendance : 5 Marks
The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Books Recommended:**

**Textbooks:**

1. Electronics Circuit. Analysis & Design, 2nd ed., Donald A. Neamen, McGraw Hill, 2001
2. Electronics Devices & Circuits Theory, by by Robert L. Boylestad and Louis Nashelsky, Pearson Education.
3. Semiconductor Data Manual, BPB Publications.

**Reference Books:**

1. Electronic Principles, by Albert Paul Malvino 6th edition, McGraw Hill
2. Electronic Devices and Circuits, by Jacob Milliman McGraw Hill.
3. Electronic Design, by Martin Roden, Gordon L.Carpenter, William Wieseman , Fourth edition, Shroff Publishers & Distributors Pvt. Ltd..
4. Electronic Circuits Discrete and Integrated, by Donald Schilling & Charles Belove, Third edition, McGraw Hill.

**NPTEL/Swayam Course:**

*Course*: Analog Electronic Circuits by Prof. Pradip Mandal - IIT Kharagpur
*https://nptel.ac.in/courses/108/105/108105158/*

**Practical exam consists of performance of any one practical from the conducted experiments within the semester and oral based on entire syllabus.**

| Course Code | Course Name | Teaching scheme | | | Credit assigned | | | |
|---|---|---|---|---|---|---|---|---|
| | | Theory | Pract. | Tut. | Theory | Pract. | Tut. | Total |
| BML304 | Electronics Lab (Skill Based Lab) | -- | 04 | -- | -- | 02 | -- | 02 |

| Course Code | Course Name | Examination Scheme | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | | | | Term work | Pract. | Oral | Pract. / Oral | Total |
| | | Internal Assessment | | | End sem | | | | | |
| | | Test 1 | Test 2 | Avg. | | | | | | |
| BML304 | Electronics Lab (Skill Based Lab) | -- | -- | -- | -- | 25 | -- | -- | 25 | 50 |

| Course Code | Course Name | Credits |
|---|---|---|
| BML304 | Electronics Lab (Skill Based Lab) | 02 |
| Course Objective | • To design and implement voltage regulator circuits.<br>• To design and implement digital circuits.<br>• To learn skills of soldering.<br>• To learn simulation of circuits using one of the simulation software. | |
| Course Outcome | Learner will be able to:<br>• Design and implement analog and digital electronic circuits on bread board and verify the outputs.<br>• Learn one of the tools for simulating different circuits.<br>• Know the limitations of ideal environment of simulations and also importance of simulation in designing the circuits.<br>• Learn soldering skills for implementing the circuits on PCB. | |

**List of experiments from Analog electronics:**

**Skill 1-Soldering the components on PCB (Any 4)**

1. Implement diode as full-wave rectifier using centre tap transformer.
2. Implement diode as full-wave rectifier using bridge circuit.
3. Use of Filter components with rectifier circuit.
4. Implement voltage regulators using IC 79XXand/or IC 78XX
5. Implement voltage regulators using IC 317/IC 723
6. Implement of logic gates using diodes.

**Skill 2-Simulations using simulation software like Multisim, Pspice etc (Any 4)**

1. Simulate CASCODE amplifier.
2. Simulate Darlington amplifier.
3. Simulate power Amplifier
4. Simulate DIAC for transfer characteristics.
5. Simulate TRIAC for transfer characteristics.
6. Simulate UJT for transfer characteristics.

**List of experiments from Digital Electronics (Perform using Breadboard or Logisim S/W etc):**

**(Any 8)**

1. A step in space vehicle checkout depends on FOUR sensors S1, S2, S3 and S4. Every circuit is working properly if sensor S1 and at least two of the other three sensors are at logic 1. Implement the system using NAND gates only, the output is connected to a red LED which must glow if the circuit is not working properly and the output is connected to a green LED which must glow if the circuit is working properly.
2. To design binary to gray code converter and gray to binary converter.

3. To design parity generator and parity checker circuits.
4. To design adder and subtractor circuits.
5. To design various circuits using multiplexers.
6. To design various circuits using de-multiplexer.
7. To design Asynchronous counter.
8. To design decade counter
9. To design Synchronous counter.
10. To implement shift register and ring counter using MSI shift register.
11. To implement Moore/ Mealy machine.
12. A given finite state machine has an input W and output Z. During four consecutive clock pulses a sequence of four values of W signal is applied. Design a machine that produces Z = 1 when it detects either of sequence W: 0010 or W: 1110 otherwise Z=0. After the fourth clock pulse the machine has to be again in the reset state ready for next sequence.

Any other experiment based on syllabus can be included in the term work which will help learner to understand topic/concept.

**Assessment:**

***Term Work:***

Term work shall consist of minimum 8 experiments from Analog electronics and 8 experiments from digital electronics.

The distribution of marks for term work shall be as follows:

Laboratory work (Lab work and journal):10 Marks
Soldering skills :05 Marks
Simulation skills :05 marks
Attendance :05 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

**Books Recommended:**

**Text Books:**

1. Op-Amps and linear integrated circuits – Ramakant Gayakwad, Prentice Hall
2. Electronics Devices & Circuits, by Boylestad Robert L., Louis Nashelsky, Pearson Education.
3. Modern Digital Electronics, by R.P.Jain, Tata McGraw Hill, 1984
4. Digital Design, M Morris Mono, Prentice Hall International-1984.

**Reference Books:**

1. Electronic Principles, by Albert Paul Malvino, 6/e, McGraw Hill
2. Semiconductor Data Manual, BPB Publications.
3. Electronic design, by Martin Roden, Gordon L. Carpenter, William Wieseman Fourth edition, Shroff Publishers &Distributors Pvt. Ltd.
4. Digital Design, by M Morris Mono Prentice Hall International 1984

**Practical exam consists of performance of any one practical from digital electronics experiments conducted within the semester and oral based on digital electronics syllabus.**

| Course code | Course Name | Credits |
|---|---|---|
| BMM301 | Mini Project - 1 A | 02 |

| Course Code | Course Name | Credits |
|---|---|---|
| BMM301 | Mini Project – 1 A | 02 |
| **Course Objective** | • To acquaint with the process of identifying the needs and converting it into the problem.<br>• To familiarize the process of solving the problem in a group.<br>• To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.<br>• To inculcate the process of self-learning and research. | |
| **Course Outcome** | Learner will be able to:<br>• Identify problems based on societal /research needs.<br>• Apply Knowledge and skill to solve societal problems in a group.<br>• Develop interpersonal skills to work as member of a group or leader.<br>• Draw the proper inferences from available results through theoretical/ experimental/simulations.<br>• Analyse the impact of solutions in societal and environmental context for sustainable development.<br>• Use standard norms of engineering practices<br>• Excel in written and oral communication.<br>• Demonstrate capabilities of self-learning in a group, which leads to life long learning.<br>• Demonstrate project management principles during project work. | |

## Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students hall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.

- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

## Guidelines for Assessment of Mini Project:

### Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
    - Marks awarded by guide/supervisor based on log book : 10
    - Marks awarded by review committee : 10
    - Quality of Project report : 05

**Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.**

### One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
    - First shall be for finalisation of problem
    - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
    - First review is based on readiness of building working prototype to be conducted.
    - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

### Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
    - Identification of need/problem
    - Proposed final solution
    - Procurement of components/systems

- Building prototype and testing
- Two reviews will be conducted for continuous assessment,
  - First shall be for finalisation of problem and proposed solution
  - Second shall be for implementation and testing of solution.

## Assessment criteria of Mini Project.

**Mini Project** shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
- In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

## Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

**Mini Project** shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communicate