VIT Vidyalankar Institute of Technology
Accredited A+ by NAAC

Vidyalankar Institute of Technology

An Autonomous Institute affiliated to University of Mumbai

Bachelor of Technology

in

Biomedical Engineering

with Multidisciplinary Minor

Second Year Scheme & Syllabus (R-2024)

(As per NEP 2020, with effect from Academic Year 2025-26)

Preamble

The National Education Policy (NEP) framework aims to break the mould from teacher centric to student centric educational practices. It empowers the students with flexibility in terms of choosing courses across different faculties and mode of learning.

This multidisciplinary approach will encourage learners to follow their passion and inherent interests. The learner is free to learn at a pace that he is comfortable with and this enables lifelong learning. It also enhances the scope for holistic personality development.

This premise is truly reflected in preamble of the NEP document, "The future of nation is decided in the classrooms of the schools and colleges today".

Details of implementation:

NEP curriculum framework enables us to accelerate change, redesign systems with equity in mind, respond to feedback, encourage collaboration, catch and pollinate ideas and create a culture of research and development. It will allow us to offer the required academic flexibility which will focus on improving competency level of students with diverse strengths.

The curriculum planned by VIT has vertical **Program Courses** consisting of core courses (PCC) of branch of engineering positioned and sequenced to achieve sequential and integral learning of the entire breadth of the specific branch. This vertical also includes programme elective courses (PEC) which offer flexibility and diversity to learners to choose specialization from a basket of recent developments in their field of technology. The selection of unique programme elective courses based on industrial requirements and organizing them into tracks is a special feature of this curricula ensuring employability.

The vertical **Multidisciplinary Courses** consists of Open Elective (OE) courses and multidisciplinary minor (MD M) courses. Special vocational and skill development courses are included as a part of **Skill courses** vertical that make student capable to work in industrial environment.

The student is expected to demonstrate their ability through course in **Experiential Learning Courses** vertical like internships/On Job Training, Community Engagement Project, Real Industry Project/ research problem. Our curriculum also introduces Social Service Internship and Internship with institutes abroad along with courses like Design Thinking. This will lead to creation of products and/ or patents through this program.

For holistic development of students, apart from technical courses, Ability Enhancement Courses, Entrepreneurship/Economics/Management Courses, Indian Knowledge System and Value Education courses from vertical **Humanities and Social Science and Management** develop the required soft-skills and attitude amongst learners.

In **Liberal Learning** vertical. courses like Various Dance Forms, Global citizenship Education, Facets of Astronomy etc. aims to create balance in brain hemispheres and hence improve learners' clarity in thoughts and responses.

In addition to core courses, professional and open electives; our framework offers honor degree in each programme of engineering. It includes specialized courses along with field/ domain study that make student capable of working on industry relevant problems.

Chairman, Board of Studies
Department of Biomedical Engineering
Vidyalankar Institute of Technology

Chairman, Academic Council
Vidyalankar Institute of Technology

Second Year B. Tech. Biomedical Engineering **Preferred Semester: III**
Course Structure and Assessment guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BESC_BSC	BSC06	Engineering Mathematics - III	Theory	3	20	30	50	100
BESC_ESC	ESC10T	Electronic Devices and Circuits	Theory	2	15	20	40	075
BESC_ESC	ESC10P	Electronic Devices and Circuits Lab	Practical	1	25	-	25	050
PC_PCC	PCBM03T	Human Anatomy & Physiology	Theory	2	15	20	40	075
PC_PCC	PCBM03P	Human Anatomy & Physiology Lab	Practical	1	25	-	25	050
PC_PCC	PCBM02T	Biomedical Transducers and Control Systems	Theory	2	15	20	40	075
PC_PCC	PCBM02P	Biomedical Transducers and Control Systems Lab	Practical	1	25	-	25	050
MDC_MDM	MDMXX	Multidisciplinary Minor Course-1	Theory	4	45	30	50	125
SC_VSEC	VSEC04T	Python Programming	Theory	2	15	20	40	075
SC_VSEC	VSEC04P	Python Programming Lab	Practical	1	25	-	25	050
HSSM_AEC	AEC02	Technical and Business Writing	Theory +Practical	2	75	-	-	075
CEP/FP	CEP01	Social Service Internship/ Project	Practical	2	-	-	75	075
Total				**23**				

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESA= End Semester Examination
*Selection based on the subset of courses made available by the Institute for the semester.
#**For CEP01- Social Service Internship/ Project:** 2 hours / week slot will be provided during the semester (in regular timetable). Additional work of 30 hours needs to be completed during the semester (besides regular timetable) or after the semester (during inter-semester break).
NOTE: As per Institute guidelines, the results of courses completed in inter-semester break will appear in the marksheet of the next semester.
The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be

approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Guidelines for Multidisciplinary Elective Courses and Minor Degree – Refer Appendix-B

Learners are required to go through the Appendix-B carefully before selecting the Multidisciplinary Elective courses. Detailed guidelines regarding Multidisciplinary Elective courses, Minor Degree Titles and courses relevant to each MDM Title are given in Appendix-B.

Multidisciplinary Elective Course-1 (MDMXX)

MDM Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI01	Introduction to Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE01	Foundations of Innovation and Entrepreneurship	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD01	Introduction to Business Development and Marketing Principles	Theory+ Tutorial	4	45	30	50	125
Computer Science	MDMCS01	Computational Logic and Data Structures	Theory+ Practical	4	45	30	50	125

Second Year B. Tech. Biomedical Engineering **Preferred Semester: IV**

Course Structure and Assessment guidelines

Vertical_ Subvertical	Course		Head of Learning	Credits	Assessment guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
BESC_BSC	BSC07	Engineering Mathematics-IV	Theory	3	20	30	50	100
PC_PCC	PCBM04T	Digital logic design and analysis	Theory	2	15	20	40	075
PC_PCC	PCBM04P	Digital logic design and analysis Lab	Practical	1	25	-	25	050
PC_PCC	PCBM05	Biomechanics Prosthetics and Orthotics	Theory + Tutorial	3	40	20	40	100
PC_PCC	PCBM06T	Analytical and Clinical Equipment	Theory	2	15	20	40	075
PC_PCC	PCBM06P	Analytical and Clinical Equipment Lab	Practical	1	25	-	25	050
PC_PCC	PCBM07T	Linear Integrated Circuits	Theory	2	15	20	40	075
PC_PCC	PCBM07P	Linear Integrated Circuits Lab	Practical	1	25	-	25	050
MDC_MDM	MDMXX	Multidisciplinary Minor Course-2	Theory	4	45	30	50	125
HSSM_AEC	AEC03	Presentation Skills	Practical	1	50	-	-	050
HSSM_EEMC	EEMC01	Design thinking	Theory+ Practical	3	50	-	50	100
Total				**23**				
Course credits completed during the previous inter-semester break will appear in this semester marksheet								
CEP/FP	CEP01	Social Service Internship/ Project	Practical	2	-	-	75	75

ISA=In Semester Assessment, MSE= Mid Semester Examination, ESE= End Semester Examination

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Multidisciplinary Elective Course-2 (MDMXX)

MDM Title	Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
	Code	Name			ISA	MSE	ESE	
Bioinformatics	MDMBI02	Algorithms and Data Structures in Bioinformatics	Theory+ Tutorial	4	45	30	50	125
Innovation, Entrepreneurial and Venture Development	MDMIE02	Startup Planning and Development	Theory+ Tutorial	4	45	30	50	125
Business Development, Marketing and Finance	MDMBD02	Financial Basics for Engineers and Technopreneurs	Theory+ Tutorial	4	45	30	50	125
Computer Science	MDMCS02	Operating Systems and Computer Networks	Theory+ Practical	4	45	30	50	125

Second Year B. Tech. Biomedical Engineering - Summer Break

Course		Head of Learning	Credits	Assessment Guidelines (Marks)			Total marks (Passing@40% of total marks)
Code	Name			ISA	MSE	ESE	
OEC01[$]	Collaborative Inter-Institute Studies	As per course	4	125	-	-	125

[$] **For Collaborative Inter-Institute Studies:** Collaboration with other reputed institutes equivalent to 4 credits is recommended to be done by learner during second year inter semester break (i.e. summer break between semester 4 and semester 5).
NOTE: As per Institute guidelines, the result of courses completed in inter-semester break will appear in the marksheet of the next semester.

Detailed Syllabus of Second Year Semester-III

Course Name: Engineering Mathematics-III

Course Code: BSC06

NEP Vertical _Basket: BESE_BSC

Category: Basic Science

Preamble:
The objective of the course is to impart the knowledge of Laplace Transform, Inverse Laplace Transform, Fourier Series, Fourier Transforms and Complex Variable. The course clarifies the concept of transforms and its applications. The course will enable students to learn different transforms of a function, Complex Variable and it will provide with a sound foundation in Mathematics to prepare them for graduate studies in Biomedical Engineering.

Pre-requisites:
Engineering Mathematics-I BSC02)
Engineering Mathematics-II BSC04)

Course Objectives:
- To understand and apply Laplace and inverse Laplace transform to solve differential equations.
- Understanding the fundamental of Fourier series, Fourier transform and Complex Variable to solve real world problems.
- To create a strong foundation by studying the basics of Engineering Mathematics and interfacing to various peripherals which will lead to a well-designed based System.
- To provide students with the sound foundation of Mathematics, Science, and Engineering fundamentals necessary to formulate, solve and analyze engineering problems and prepare them for Graduate studies.
- To impart knowledge of interfacing techniques and educate the student in the domain of Biomedical Engineering.

Course Outcomes:

Learner will be able to:
CO1: Compute Laplace Transform of a given function
CO2: Apply Inverse Laplace Transform to convert frequency domain into time domain.
CO3: Obtain Fourier series of a given periodic functions by decomposing it into sine and cosine series
CO4: Apply Fourier transforms to solve problems involving periodic and non-periodic functions.
CO5: Solve problems involving eigenvalues and eigenvectors to understand their applications in different contexts.
CO6: Analyze complex functions to determine if they are analytic and apply C-R equations to verify their analyticity.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Laplace Transform	Definition of Laplace transform Laplace Transform (L) of Standard Functions, 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 (All Properties are without proofs). Evaluation of integral using Laplace Transform.	8
2	Inverse Laplace Transform	Formulae of Inverse Laplace Transform, Laplace Inverse using partial fraction, Properties of Inverse Laplace Transform, convolution Theorem (without proof).	6
3	Fourier Series	Fourier series of a periodic function in the interval of period 2π, 2L. Half range Sine and Cosine Fourier series, Complex form of Fourier series.	8
4	Fourier Transform	Fourier Transform, Fourier Sine & Cosine Transform. Inverse Fourier transforms.	6
	Eigen Values and	Eigen values and Eigen vectors Properties, Cayley Hamilton theorem (without proof), examples based	

5	Eigen Vectors	on verification of Cayley Hamilton Theorem and by using it to find inverse and power of given matrix.	8
6	Complex variable	Analytic function, C-R equations in polar & cartesian form (without proof), Harmonic function. Finding analytic function if $u\ or\ v\ or\ (u+v)\ or\ (u-v)$ is given, Milne-Thompson method, Orthogonal trajectories.	9
Total			**45**

Text Books:

1. Dr. B. V. Ramana" Higher Engineering Mathematics", Tata McGraw Hill New Delhi, India 2006
2. P. N. Wartikar & J. N. Wartikar " A Test Book of Applied Mathematics, Vol I & II", Vidyarthi Ghriha Prakashan Pune 2005 9th Edition.
3. Kanti B Datta "Mathematical methods of Science and Engineering", Cengage Learning 2012 Edition
4. N. P. Bali and Manish Goyal" A Text Book of Engineering Mathematics", Laxmi Publications 2006 Edition

Reference Books:

1. Dr. B S Grewal, "Higher Engineering Mathematics", Khanna Publication, 44th Edition.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & sons, 10th Edition.
3. C. R. Wylie & L. C. Barrett, "Advanced Engineering Mathematics", Tata McGraw India, 6th Edition.
4. H K Das, "Advanced Engineering Mathematics", S Chand, 22nd Edition.
5. Murray R. Spiegel. "Schaum's Outline of Laplace Transform", Tata McGraw India, 1st Edition.
6. Murray R. Spiegel. "Schaum's Outline of Fourier analysis with applications", Tata McGraw India,1stEdition.
7. Dr. B S Tyagi, "Function of a Complex variable", Kedar Nath & Ram Nath publication, 2021.

Course Name: Electronic Devices and Circuits

Course Code: ESC10T

NEP Vertical_Basket: BESC_ESC

Category: Engineering Science

Preamble:

Electronics circuits are the nerves of all modern equipment that make our life sophisticated. Acquiring the basic knowledge about the principle of operation of semiconductor electronic devices like diodes, transistors and elementary circuits. In this course will enable the students to learn about the use of transistors in analog circuits like single and multistage amplifier and power amplifier. It also gives information about the biasing and analysis of Transistors, which are the essentials needed for Integrated Circuits and their applications in biomedical engineering.

Pre-requisites:

Basic Electrical & Electronics Engineering (ESC06T)
Physics for Biomedical Engineering (PCBM01T)
Engineering Mathematics-I (BSC02)

Course Objective:

- To understand transfer characteristics of semiconductor devices and to analyse basic application circuits.
- To make learners aware about the mathematical models of BJT and its use in analysing the circuits.
- To make the learners aware about different types of coupling and the concept of multistage amplifiers.
- Learners will be able to design power amplifier.
- To learn types and applications of MOSFET**.**

Course Outcomes:

Learner will be able to:
CO1: Recall the basic semiconductor components like P-N junction diodes, Zener diodes and their various applications.
CO2: Describe the working of BJT and its various configurations and DC operating conditions
CO3: Explain AC operating conditions and Design of single stage small Signal CE amplifiers.
CO4: Show the working of MOSFETs, its characteristics and its various applications.
CO5: Illustrate the concept of multistage amplifiers.
CO6: Analyse the power amplifier circuits.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Basics of Diodes & Basics of BJT	Construction, Working, Characteristics, and Current Equation & Equivalent circuits of P-N Junction Diode as well as Zener Diode. Applications of Diode: Clipper & Clamper. Construction, Working, Characteristics of 3 different configurations of BJT.	5
02	BJT as an Amplifier	Q-point, DC load line, BJT Biasing techniques (Fixed, Self, Voltage Divider, Collector to base, Collector to base self) and BJT as a switch.A.C. Equivalent Model: re model, h-parameter model (Exact and Approximate) and Hybrid-π model.A.C. Analysis (Using any one model): A.C. load line, A.C. analysis of CE, CB, CC amplifier configurations, Effects of RS & RL and Comparison of various amplifiers. Low frequency and High frequency analysis of Single stage amplifiers. Design of single stage amplifier using BJT.	8
03	Multistage Amplifier	Need of cascading, Types of coupling, cascode amplifier, Darlington amplifier	5
04	Power Amplifiers	Classes of Power amplifiers, Class-A Power Amplifiers (Direct coupled and Transformer coupled), Class-B Power Amplifiers, Crossover distortion, harmonic distortion, Class-AB Push Pull, Complementary Symmetry Power amplifier &	6

Module No.	Module Name	Module Contents	No. of Hours
		Class-C Power Amplifier. Power amplifier design, Heat Sinks and its design.	
05	MOSFET	Comparison of BJT & FET, Types, Characteristics, biasing of MOSFET, MOSFET as an amplifier & MOSFET as a switch	6
Total			**30**

Suggested Online Courses:

1. Introduction to Electronics- https://www.coursera.org/learn/electronics
2. Fundamentals of Audio and Music Engineering: Part 1 Musical Sound & Electronics- https://www.coursera.org/learn/audio-engineering
3. Introduction to Biomedical Engineering- https://www.coursera.org/learn/bioengineering
4. https://www.edx.org/learn/circuits
5. NOC:Analog Electronic Circuits, IIT Kharagpur, Prof. Pradip Mandal

a. https://nptel.ac.in/courses/108105158

Text Books:

1. Donald A Neamen, "Electronic Circuit Analysis and Design" Mc Graw Hill Education
2. Robert Boylestad. Louis Nashelsky "Electronic Devices and circuits".Pearson Education
3. "Semiconductor Data Handbook", BPB Publications.

Reference Books / Articles

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

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Course Name: Electronic Devices and Circuits Lab

Course Code: ESC10P

NEP Vertical_Basket: BESC_ESC

Category: Engineering Science

Preamble:

Electronics circuits are the nerves of all modern equipment that make our life sophisticated. Acquiring the basic knowledge about the principle of operation of semiconductor electronic devices like diodes, transistors and elementary circuits. In this course will enable the students to learn about the use of diodes and transistors in analog circuits like rectifiers, single & multistage amplifier and power amplifier. It also gives information about the biasing and analysis of Transistors, which are the essentials needed for Integrated Circuits and their applications in biomedical engineering.

Course Objectives:

- To practically verify characteristics of different electronic components like diodes, BJT, MOSFET etc
- To practically verify outputs of few applications of diodes, BJT, MOSFET.
- To design and implement small signal amplifier.

Pre-requisites:

Basic Electrical & Electronics Engineering (ESC06T)

Physics for Biomedical Engineering (PCBM01T)

Engineering Mathematics-I (BSC02)

Course Outcome:

Learner will be able to:
CO1: Explain the transfer characteristics of basic semiconductor devices
CO2: Design and verify the outputs of various electronic circuits such as clipper clampers etc using bread boards and various lab equipment.
CO3: Design amplifier circuits and plot its frequency response.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

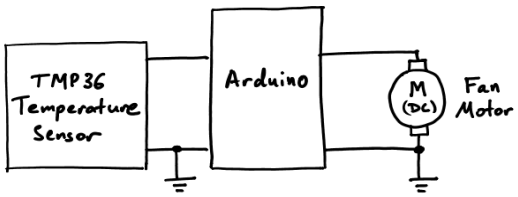
The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Experiments

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.
13. Implementing CMOS inverter using CMOS.

Suggested List of Mini Projects/PBL (to name few):

1. Frequency Counter Circuit
2. Appliances Security Controller Using Power Line
3. Automatic Sprinkler Control System
4. Half wave and Full wave precision rectifier.
5. Public addressing system
6. Adjustable Voltage Power Supply
7. Rain Alarm Circuit Using Two Transistors
8. Design a switch using BJT which turns on Green LED whenever it comes in close vicinity with a sound source.
9. Design a switch using BJT which turns on Red LED whenever it comes in close vicinity with a Hot object
10. Following system has two majot concerns firstly The TMP36 output voltage range does not match well with Arduino input voltage range and secondly The Arduino does not output enough current to start the motor



Suggest BJT based ciricuits to overcome over concerns.

11. Design an amplifier using BJT to amplify very small electrical signals consider following specifications:
    i. Gain of 150.
    ii. Filter setting: high pass filter of 300 Hz.
    iii. Stability factor to be maintained below 10.
12. Use cascode configuration along with a voltage ladder to form a high-voltage transistor.

Recommended Online Courses:

1. Introduction to Electronics- https://www.coursera.org/learn/electronics
2. Fundamentals of Audio and Music Engineering: Part 1 Musical Sound & Electronics- https://www.coursera.org/learn/audio-engineering
3. Introduction to Biomedical Engineering- https://www.coursera.org/learn/bioengineering
4. https://www.edx.org/learn/circuits
5. NOC:Analog Electronic Circuits, IIT Kharagpur, Prof. Pradip Mandal https://nptel.ac.in/courses/108105158

Reference Books / Articles

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

Course Name: Human Anatomy and Physiology

Course Code: PCBM03T

NEP Vertical _Basket: PC_PCC

Category: Program Core

Preamble:

This course introduces students to the anatomical structures of the human body and their relationship to each other. The course will also offer in-depth understanding of the different physiological processes taking place inside the human body.

Pre-requisites: NIL

Course Objective:

- To understand the anatomical structures of the human body and their relationship to each other.
- To understand the different physiological processes taking place inside the human body

Course Outcomes:

Learner will be able to:

CO1: Explain the organization of the human body, homeostasis and its maintenance, structure and functions of a cell and basic tissues.

CO2: Classify the components of blood and their functions.

CO3: Describe the anatomical parts and physiological processes of the cardiovascular system and respiratory system.

CO4: Elaborate the anatomical parts and physiological processes of the alimentary system & renal system.

CO5: Describe the structure and functions of nervous system, eye and skin along with the secretions and functions of all endocrine glands.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Cells and Tissues	Levels of structural organization; Homeostasis and its maintenance. Structure and functions of a cell; membrane potentials; Tissues: epithelial, connective, muscle and nervous.	02
02	Blood	Blood: Composition of Blood, blood cells and their functions, haemoglobin; Blood Grouping; Haemostasis.	02
03	Cardiovascular System & Respiratory system	Cardiovascular System: Anatomy of the heart; Heart valves, systemic and pulmonary circulation; Conduction system of the heart; Cardiac action potential, Cardiac cycle; Cardiac output; Blood pressure. Respiratory System: Anatomy of respiratory system; Pulmonary ventilation, lung volumes and capacities; external respiration, internal respiration.	07
04	Alimentary System & Renal System	Alimentary System: Anatomy of the alimentary system; Secretions of different organs of the alimentary system and their main functions. Renal System: Anatomy of the renal system; Functions of kidney (urine formation, electrolyte balance and pH balance); composition of urine; Micturition.	07
05	Nervous System	Divisions of the nervous system (central and peripheral nervous system); Structure and functions of the brain and spinal cord; Reflex actions and reflex arc; Functions of sympathetic and parasympathetic nervous system; Nerve action potential and nerve conduction	07
06	Special Senses and Endocrine System	Structure of the eye; Physiology of vision; Structure and functions of the skin. Endocrine System: All Glands of the endocrine system, their secretions, and functions.	05
Total			**30**

Suggested Online Courses:

1. Course: Animal Physiology by Prof. Mainak Das - IIT Kanpur
   https://nptel.ac.in/courses/102/104/102104058/
2. Human Anatomy courses on edx: https://www.edx.org/learn/human-anatomy

3. Coursera: Anatomy Specialization University of Michigan
   https://www.coursera.org/specializations/anatomy

Textbooks:

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

Reference Books / Articles

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

Course Name: Human Anatomy and Physiology Lab

Course Code: PCBM03P

NEP Vertical _Basket: PC_PCC

Category: Program Core

Preamble:

This course introduces students to the anatomical structures of the human body and their relationship to each other. The course will also offer in-depth understanding of the different physiological processes taking place inside the human body.

Course Objectives:

- To understand the anatomical structures of the human body and their relationship to each other.
- To gain the knowledge of measurement of various physiological parameters of the human body.

Pre-requisites: NIL

Course Outcome:

Learner will be able to:
CO1: Demonstrate measurement of blood pressure using occlusive cuff method.
CO2: Apply blood cell counting principles for measuring blood composition.
CO3: Demonstrate the measurement of electrical activity of heart and the related parameters.
CO4: Demonstrate the measurement of various lung volumes and capacities.
CO5: Appropriately utilize laboratory equipment, such as microscopes, general lab ware, and virtual simulations.
CO6: Locate and identify anatomical structures.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	**ISA**	**MSE**	**ESE**	**Total**
Practical	25	-	25	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Experiments

1. To measure blood pressure using a 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 specimens (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.

Suggested List of Mini Projects/PBL (to name few):

1. To measure heartbeats using PQRST Waveform of ECG.
2. Case a study on a given disease/abnormality which requires medical instruments for diagnosis/treatment.

Recommended Online Courses:

1.Course: Animal Physiology by Prof. Mainak Das - IIT Kanpur
https://nptel.ac.in/courses/102/104/102104058/
Human Anatomy courses on edx: https://www.edx.org/learn/human-anatomy
2. Coursera: Anatomy Specialization University of Michigan
https://www.coursera.org/specializations/anatomy

Reference Books / Articles

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

Course Name: Biomedical Transducers and Control Systems

Course Code: PCBM02T

NEP Vertical _Basket: PC_PCC

Category: Program Core

Preamble:
The primary aim of the biomedical engineering is to measure the physiological parameters with a great level of accuracy. This depends on the selection of an appropriate transducer for application. The measurement of physical quantity and processing of measured signal, utilized for control purpose.

This course introduces students to working principles, construction of basic transducers and development of medical instrumentation. It also covers the applications of transducers and sensors in biomedical engineering.

Pre-requisites:
Physics for Biomedical Engineers (PCBM01T)
Engineering Chemistry (BSC11T)

Course Objectives:

- To enable learners to understand the different properties of measuring instruments.
- To enable learners to understand the working principles of transducers.
- To enable learners to understand the different blocks of instrumentation.
- To enable learners to understand the fundamental of control system.

Course Outcomes:

Learner will be able to:
CO1: Describe the different properties of measuring instruments.
CO2: Explain the working principles of displacement transducers and application in diagnosis.
CO3: Understand the working principles different types of temperature transducers and their applications.
CO4: Understand the working biopotential electrodes and mechanism of ionic conduction.
CO5: Explain the working principles of chemical transducers and application in diagnosis.
CO6: Understand the control system components, time and frequency domain analysis techniques.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Instrumentation & Measurement	Generalized Instrumentation System, General Properties of Transducer. Static Characteristics: Accuracy, Precision, Resolution, Reproducibility, Sensitivity, Drift, Hysteresis, Linearity, Input Impedance and Output Impedance. Dynamic Characteristics.	6
2	Displacement Transducers	Displacement, motion and Pressure Measurement: (with applications) Resistive: Potentiometers, Strain Gauges and Bridge Circuits. Inductive: Variable Inductance and LVDT Capacitive type, Piezoelectric Transducers. Types of Diaphragms, Bellows, Bourdon Tubes.	6
3	Temperature Transducers	Temperature measurement: Thermistor, thermocouple, resistive temperature detector; IC-based temperature measurement; Radiation sensors.	4
4	Bio potential electrodes	Electrode-electrolyte interface, half-cell potential, polarization, polarizable and non-polarizable electrodes, calomel electrode; Electrode circuit model, electrode-skin interface and motion artefacts, and basic classification of biopotential electrodes	4
5	Chemical Sensors	Blood gas and Acid- Base Physiology, Potentiometric Sensors (pH, pCO_2 Electrodes, Amperometric Sensors (pO_2), ISFETS, Transcutaneous Arterial O_2 and CO_2 Tension Monitoring.	4
6	Basics of Control Systems	Control system components, Time response characteristics of control systems. Transfer function concept, pole and zero of transfer function, Stability analysis of control systems, Frequency Response, Bode diagram, Polar Plot and Nyquist Plot, Stability analysis using Nyquist Stability Criterion,	6
Total			**30**

Suggested list of Assignments:

1. Characteristics of measuring instruments.
2. Classification of transducers.
3. Static and dynamic characteristics of measuring systems.
4. Presentation on advanced transducers for displacement, temperature, chemical changes measurement.
5. Poster presentation on analyzing instrumentation system.

Suggested List of Value-Added Home Assignments:

1. Effect of loading effect on measurement of current & voltage.
2. Different types of biopotential electrodes available in the market.
3. Development of basic medical instrumentation system.

Suggested Online Courses:

1. Control engineering
   https://onlinecourses.nptel.ac.in/noc23_ee16/preview
2. Transducers For Instrumentation
   https://onlinecourses.nptel.ac.in/noc23_ee105/preview

Reference Books:

1. A.K. Sawhney, "Electrical Measurements and measuring Instruments", Dhanpat Rai and Sons, 1998
2. T Togawa, T Tamura, P. Ake Oberg, "Biomedical Transducers and Instruments", CRC press, 2011
3. K. Ogata, "Modern Control Engineering", Pearson Education, 2015.
4. I .J. Nagrath & M. Gopal, "Control System Engineering", New Age International Publication, 2009.
5. S. Norman Nishe, "Control system Engineering", John Wiely and Sons, 2000.

Course Name: Biomedical Transducers and Control Systems Lab

Course Code: PCBM02P

NEP Vertical _Basket: PC_PCC

Category: Program Core

Preamble:
The primary aim of the biomedical engineering is to measure the physiological parameters with a great level of accuracy. This depends on the selection of an appropriate transducer for application. The measurement of physical quantity and processing of measured signal, utilized for control purpose.
This course introduces students to working principles, construction of basic transducers and development of medical instrumentation. It also covers the applications of transducers and sensors in biomedical engineering.

Pre-requisites:
Physics for Biomedical Engineers (PCBM01T)
Engineering Chemistry (BSC11T)

Course Objectives:
- This course enables students to relate the instrumentation system with real-life automated systems.
- This course will develop the analytical reasoning for static characteristics of measuring instruments.
- This course will make students competent in understanding basic control systems components.
- This course enables learners to understand the usage of different methods in analyzing systems.

Course Outcomes:

Learner will be able to:
CO1: Understand and analyze the static and dynamic properties of measuring instruments.
CO2: Build the basic blocks of medical instrumentation system.
CO3: Classify the different transducers used in biomedical engineering.
CO4: Apply the fundamental knowledge of transducers for selection an appropriate transducer.
CO5: Explain the significance of different techniques used to analyze systems.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Suggested list of Practicals:

1. Measurement of the voltage & current for minimal error to relate the loading effect.
2. Estimation and calculation of errors during measurement.
3. Study the working of Linear Displacement Transducer- Potentiometer
4. To study principle and working of L.V.D.T.
5. To study principle and working of a capacitive sensor.
6. To study the resistance versus temperature characteristics of a thermistor.
7. Simulate the performance of a chemical sensor.
8. To study the transient response of dynamic system
9. Determination of Step response for first order and second order system with unity feedback on CRO and calculation of control system specification: Time constant, percentage peak overshoot, settling time from the response.
10. Determination of Step response and Impulse response for type-0, type-1 and type-2 system with unity feedback using MATLAB/PSPICE.

Suggested Online Courses:

1. Sensors and Transducers https://www.udemy.com/course/sensors-and-transducers/
2. Sensors and Sensor Circuit Design https://www.coursera.org/learn/sensors-circuit-interface

Reference Books:

1. A. K. Sawhney, “Electrical Measurements and measuring Instruments”, Dhanpat Rai and Sons, 1998
2. T Togawa, T Tamura, P. Ake Oberg, “Biomedical Transducers and Instruments”, CRC press, 2011
3. K. Ogata, “Modern Control Engineering”, Pearson Education, 2015.
4. I J. Nagrath & M. Gopal, “Control System Engineering”, New Age International Publication, 2009.
5. S. Norman Nishe, “Control system Engineering”, John Wiely and Sons, 2000.

Course Name: Introduction to Bioinformatics

Course Code: MDMBI01

NEP Vertical_Basket: MDC_MDM

Category: Multidisciplinary Elective

Preamble:

This course is designed with the objective of equipping students with a robust understanding of the integration between biology and computational science, key bioinformatics concepts, methodologies, and applications. Through a combination of theoretical knowledge and practical applications, students will develop a holistic understanding of how computational methods can enhance the comprehension of biological processes. It also emphasizes on real-world biological questions and research challenges, empowering them to make meaningful contributions to the rapidly evolving field of bioinformatics

Course Objectives:

- To enable learners to understand the basic principles of bioinformatics.
- Build foundational understanding of biology, types of biological data, and the role of computing in biology.

Course Outcomes:

Learner will be able to:
CO1: Explain foundational molecular biology concepts and their relevance to bioinformatics, including DNA, RNA, proteins, and gene functions.
CO2: Access, compare, and utilize various biological databases and sequence file formats to retrieve and analyze genomic and proteomic data effectively.
CO3: Apply key sequence alignment algorithms and computational techniques to analyze biological sequences and construct phylogenetic relationships.
CO4: Implement bioinformatics algorithms and data structures to solve problems in genomics, proteomics, and systems biology, including gene prediction and motif discovery.
CO5: Evaluate current applications and emerging trends in bioinformatics, including personalized medicine, big data analytics, ethical issues, and the integration of AI/ML technologies in biological research.

Course Scheme:

Course Code	Contact Hours		Credits Assigned	
	Theory	Tutorial	Theory	Practical
MDMBI01	3	1	3	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory (MDMBI01)	45	30	50	125

The assessment/evaluation guidelines for the courses of different credits are mentioned. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Basics of Molecular Biology	Structure and function of DNA, RNA, and proteins Central Dogma of Molecular Biology (Replication, Transcription, Translation) Codons and genetic code Types of genes (structural, regulatory) Mutations and their biological effects.	8
2	Biological Databases	Types: Primary, Secondary, Specialized databases, GenBank, EMBL, DDBJ – comparative study, UniProt, PDB, RefSeq, Ensembl, Sequence file formats (FASTA, GenBank, GFF, SAM/BAM), Querying biological databases (using NCBI Entrez, EBI search tools)	8
3	Sequence Analysis	Types of biological sequences: DNA, RNA, Protein,Pairwise and Multiple Sequence Alignment (MSA),Scoring matrices (PAM, BLOSUM),Tools: BLAST, FASTA, ClustalW, Applications: gene finding, phylogeny, structure prediction	8
4	Genomics & Human Genome Project	Genome organization and structure, Sequencing techniques: Sanger, Next Generation Sequencing (NGS), Nanopore, Applications: disease gene identification, forensic genomics, Human Genome Project: goals, achievements, ethical issues, Comparative genomics	12
5	Applications of Bioinformatics	Bioinformatics in personalized medicine, Drug discovery and vaccine design, Agriculture and animal genomics Role of AI/ML in bioinformatics	9
Total			**45**

Books and Resources:

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Course Title: Foundations of Innovation and Entrepreneurship

Course Code: MDMIE01

NEP Vertical_Basket: MDC_MDM

Category: Multidisciplinary Elective

Preamble:

Pre-requisites: NIL

Course Objectives:

- To introduce the foundational concepts of innovation and entrepreneurship.
- To build awareness of opportunity recognition, creativity, and idea validation.
- To expose students to business modelling and startup ecosystems.

Course Outcomes:

Learner will be able to:
CO1: Understand key entrepreneurial traits and innovation drivers
CO2: Apply ideation tools to identify entrepreneurial opportunities.
CO3: Create basic business models using Business Model Canvas.
CO4: Evaluate entrepreneurial case studies and pitch early-stage ideas.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	1(Tutorial)	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Entrepreneurship	• Definition, importance, and scope • Types of entrepreneurs • Entrepreneurial mindset and characteristics	8
2	Innovation Basics	• Types of innovation (product, process, business model) • Disruptive vs. incremental innovation Design Thinking fundamentals	8
3	Opportunity Identification & Evaluation	• Creativity and ideation tools (brainstorming, SCAMPER, mind-mapping) • Problem-solving frameworks • Validating ideas	10
4	Business Model Design	• Business Model Canvas • Value Proposition Design • Customer Segments and Customer Discovery	6
5	Entrepreneurial Ecosystem	• Role of incubators, accelerators, and funding bodies • Startup India, Atal Innovation Mission, etc	7
		Total	**45**

Tutorials (1 Credit):

- Case studies on startups
- Group exercises on ideation
- Hands-on practice with the Business Model Canvas
- Ideation workshops
- Business Model Canvas exercises
- Case studies and short group presentations

Textbooks:

1. Steve Blank, The Startup Owner's Manual, K&S Ranch Publishing Inc
2. Alexander Osterwalder, Business Model Generation, John Wiley and Sons
3. Peter F. Drucker, Innovation and Entrepreneurship, HarperCollins Publishers Inc

Course Name: Introduction to Business Development and Marketing Principles

Course Code: MDMBD01

NEP Vertical_Basket: MDC_MDM

Category: Multidisciplinary Elective

Preamble:
The objective of this course is to introduce engineering students to the fundamentals of business development and marketing using a customer centric lens. Students will learn how to conceptualize a basic business idea, understand market needs, and align engineering innovations with customer demand.

Pre-requisites:
None

Course Objectives:

- Understand basic business structures and concepts.
- Identify customer needs and conduct basic market research.
- Learn fundamentals of marketing strategy in a technology-driven world.
- Appreciate the role of engineering in business innovation.

Course Outcomes:

Learner will be able to:
CO1: Explain key concepts in business development and marketing relevant to engineers.
CO2: Conduct simple market research and competitor analysis for a tech-based idea.
CO3: Draft a basic value proposition and elevator pitch.
CO4: Identify business opportunities through innovation in telecom and electronics domains.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	1(Tutorial)	3	1(Tutorial)

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Foundations of Business	Types of businesses, vision-mission-goals, legal forms of business, introduction to entrepreneurship.	8
2	Marketing Essentials	Needs vs wants, Segmentation, targeting, positioning, Marketing mix (4Ps), digital vs traditional marketing.	8
3	Customer Focus	Basics of customer journey, personas	7
4	Technology Product Planning	Basics of product lifecycle, innovation funnel, idea screening.	10
5	Market Research Basics	Research Types, Research steps, Sampling,, Surveys, interviews, SWOT, competitor analysis.	6
6	Business Idea Pitch	Business idea pitch, value proposition canvas, storytelling.	6
		Total	**45**

Textbooks:

1. Marketing Management by Kotler

Reference Books:

1. Marketing Basics PDF by MIT OpenCourseWare

Course Name: Computational Logic and Data Structures

Course Code: MDMCS01

NEP Vertical_Basket: MDC_MDM

Category: Multidisciplinary Elective

Preamble:

The course introduces students to key concepts in discrete structures and data structures, providing a foundational understanding essential for many areas in computer science. Students will explore topics related to the organization, management, and manipulation of data, as well as learn about basic data structures, their associated algorithms, and principles of design and analysis. Emphasis will be placed on both theoretical understanding and practical application, enabling students to effectively use these concepts to solve complex computational problems.

Pre-requisites:

1. ES04T (Structured Programming).
2. ES05T (Object Oriented Programming)

Course Objectives:

- To establish foundational knowledge of discrete mathematical structures and their properties, enabling students to recall and apply these concepts in computational problem-solving.
- To develop conceptual understanding of linear/non-linear data structures (stacks, queues, trees, graphs), their memory representations, and operational principles for efficient data organization.
- To build practical skills in implementing, analyzing, and optimizing data structure operations while evaluating time/space complexity using asymptotic notations.
- To apply integrated knowledge of discrete mathematics and data structures to design solutions for real-world engineering challenges.

Course Outcomes:

Learner will be able to:

CO1: Recall fundamental concepts of set theory, logic, relations, and algebraic structures, including definitions, properties, and notations.

CO2: Explain the working principles of linear and non-linear data structures (stacks, queues, trees, graphs) and their representations in memory.

CO3: Explain the principles of linear and non-linear data structures (stacks, queues, trees, graphs) and their memory representations.

CO4: Implement basic operations (insert/delete/search) on linear data structures (arrays, stacks, queues, linked lists) using appropriate programming constructs.

CO5: Analyze and compare time/space complexity of different data structure implementations using asymptotic notations (Big-O, Omega, Theta).

CO6: Evaluate the application of discrete mathematical concepts (graph theory, algebraic structures) in solving engineering problems like network design or cryptography.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	2	3	1

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No	Module name	Content	No of Hours
1	Set Theory and Logic	Definition and representation of Sets, Types of sets, operations on sets, Laws of set, Principle of Inclusion & Exclusion (3 sets), Partition of set. Counting principle, Pigeonhole Principle, Mathematical Induction.	6
2	Relations and Functions	Relation: Definition, Representation of relation, Properties of relation, Closure properties of relation (Reflexive, Symmetric and Transitive), partial order and equivalence relation. Function: Definition, Types of function, Inverse function, composite functions.	8
3	Algebraic Structures	Algebraic structures with one binary operation: Groupoid, Semigroup, Monoid and Group, Abelian group, Cyclic groups, order and subgroup, Group Homomorphism, Isomorphism and Automorphism.	7
4	Introduction to Data Structures and Complexity	Introduction to Data Structures, Types of Data Structures- Linear and Nonlinear, Operations on Data Structures. Time Complexity of Algorithm. Space Complexity of Algorithm. Notations (Big O, Omega and Theta).	4

Module No	Module name	Content	No of Hours
5	Stack, Queue and Linked List	Introduction of Stack, Operations on Stack, Array Implementation of Stack. Introduction of Queue, Operations on Queue, Array Implementation of Queue, Types of Queue-Circular Queue, Priority Queue, Double Ended Queue. Introduction to Linked List, Representation of Linked List, Linked List v/s Array, Singly Linked List.	10
6	Graph and Trees	Introduction to Graph , Graph Terminologies, Representation of Graph, Graph Traversals-Depth First Search (DFS) and Breadth First Search (BFS). Introduction to Tree, Tree Terminologies, Binary Tree, Types of Binary Tree, Binary Tree Traversals. Binary Search Tree, Operations on Binary Search Tree. Applications of Binary Tree-Expression Tree, Huffman Encoding	10
Total			**45**

Text Books:

1. C. L. Liu, "Elements of Discrete Mathematics", TMH, ISBN 10:0-07-066913-9.
2. N. Biggs, "Discrete Mathematics", 3rd Ed, Oxford University Press, ISBN 0 –19-850717–8.
3. Kenneth H. Rosen, "Discrete Mathematics and its Applications", Tata McGraw-Hill, ISBN 978- 0-07-288008-3
4. Cryptograph and Network Security by B. A. Forouzan & D. Mukhopadhyay, 11th edition, McGraw Hill Publication.
5. Network Security and Cryptograph by Bernard Menezes, Cengage Learning Publication.
6. Reema Thereja," Data Structures using C", 2nd edition, Oxford Press, 2014
7. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", First Edition, Pearson Publication, 2019

Reference Books:

1. Bernard Kolman, Robert C. Busby and Sharon Ross, "Discrete Mathematical Structures",Prentice-Hall of India /Pearson, ISBN: 0132078457, 9780132078450.
2. Narsingh Deo, "Graph with application to Engineering and Computer Science", Prentice Hall of India, 1990, 0 – 87692 – 145 – 4.
3. Eric Gossett, "Discrete Mathematical Structures with Proofs", Wiley India Ltd, ISBN:978-81-265-2758-8.
4. Sriram P. and Steven S., "Computational Discrete Mathematics", Cambridge University Press, ISBN 13: 978-0-521-73311-3.
5. Elementary Number Theory and its applications by Kenneth H. Rosen, 5th edition, Addison Wesley Publication.
6. Richard F. Gilberg and Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C",

2ndEdition, CENGAGE Learning, 2004.
7. P.S. Deshpande, O.G. Kakde, "C and Data Structures", First Edition, Dreamtech Press, 2003
8. E. Balagurusamy, "Data Structure Using C", First Edition, Tata McGraw-Hill Education India, 2013

Course Name: Python Programming

Course Code: VSEC04T

NEP Vertical_Basket: SC_VSEC

Category: Vocational and skill Enhancement

Preamble:

Python is a versatile programming language that finds applications in various engineering fields. As an engineering student, you will find that Python can be a valuable tool in your arsenal for data analysis, simulation, modeling, and automation. This course is designed to equip you with the necessary skills and knowledge to use Python effectively in your engineering projects.

In this course, we will start with the basics of Python programming, including data types, control structures, functions, and modules. We will then progress to more advanced topics such as object-oriented programming, data visualization, and web development using Python frameworks. Additionally, we will introduce you to some of the most popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib, and show you how to apply them to solve engineering problems. By the end of this course, you will have a solid understanding of Python programming and the ability to apply it to your engineering projects, making you a more competent and effective engineer.

Pre-requisites:

Structured Programming (VSEC01T).

Structured Programming (VSEC01P).

Course Objective:

- To understand the fundamental concepts of Python programming,
- To understand the basic data types, control structures, functions, and modules.
- To understand the utilization of various libraries in Python by working with popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib.
- To use Python to solve a range of programming problems and tasks, including data analysis, visualization, and web development.

Course Outcome:

Learner will be able to:
CO1: Describe Numbers, Strings, Lists, Tuples, Dictionaries, Array and Math functions in Python.
CO2: Express different Decision-Making statements and Functions
CO3: Illustrate different file handling operations.
CO4: Interpret object-oriented programming in Python.

CO5: Work with popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib, to analyze and visualize data.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Python	Installation and resources; Introduction of the Python object types: Numbers, Strings, Lists, Tuples, Dictionaries, Arrays; Numeric types; Assignments; Expressions; Print statements and formats	5
02	Decision Control Statements and Functions	if and else statement, if-elif-else statement, Loop Statement: While loops, for loops, Break, Continue, and Pass, Functions: Defining and calling functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions.	5
03	Files Handling	Types of Files in Python, Opening a File, Closing a File. Writing Text Files, Knowing Whether a File Exists or Not, Working with Binary Files, Appending Text to a File, Reading Text Files, File Exceptions	5
04	Object Oriented Programming	Introduction, Creating classes and objects., Constructors, Inheritance, and interface	5
05	Numpy, Matplotlib	Introduction to Numpy: Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy. Introduction to Matplotlib library: Line properties, Plots and subplots, Types of Plots.	5
06	Pandas, Seaborn	Introduction to Pandas: Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and	5

Module No.	Module Name	Module Contents	No. of Hours
		write operation. Introduction to Seaborn	
Total			**30**

Suggested Online Courses:

1. Python Data Science Handbook (GitHub) - https://jakevdp.github.io/PythonDataScienceHandbook/
2. Google's Python Class - https://developers.google.com/edu/python/
3. DataCamp - Introduction to Python - https://www.datacamp.com/courses/intro-to-python-for-data-science
4. Python Programming: A Concise Introduction (Wesleyan University) - https://www.coursera.org/learn/python-programming-introduction
5. Introduction to Python Programming (edX) - https://www.edx.org/course/introduction-to-python-programming

Textbooks:

1. E Balagurusamy, “Introduction to computing and problem-solving using python”, McGraw Hill Education.
2. Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press.
3. John Grayson, “Python and Tkinter Programming”, Manning Publications.
4. Dusty Phillips, “Python 3 object-oriented Programming”, Second Edition PACKT Publisher August
5. 2015.
6. Yashavant Kanetkar, “Let us Python: Python is Future, Embrace it fast”, BPB Publications; 1
7. edition
8. James Payne, “Beginning Python: Using Python 2.6 and Python 3.1”, Wrox publication.

Reference Books / Articles

1. David Beazley, “Python Cookbook: Recipes for Mastering Python 3, Brian K. Jones O'Reilly Media.
2. Zed “Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code”,A. Shaw Addison Wesley.
3. Andreas C. Mueller O’Reilly,” Introduction to Machine Learning with Python”, Third edition
4. Eric Matthes” Python Crash Course A hands-on, Project Based Introduction to programming, second edition.

Course Name: Python Programming Lab

Course Code: VSEC04P

NEP Vertical_Basket: SC_VSEC

Category: Vocational and skill Enhancement

Preamble:

Python is a versatile programming language that finds applications in various engineering fields. As an engineering student, you will find that Python can be a valuable tool in your arsenal for data analysis, simulation, modeling, and automation. This course is designed to equip you with the necessary skills and knowledge to use Python effectively in your engineering projects.

In this course, we will start with the basics of Python programming, including data types, control structures, functions, and modules. We will then progress to more advanced topics such as object-oriented programming, data visualization, and web development using Python frameworks. Additionally, we will introduce you to some of the most popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib, and show you how to apply them to solve engineering problems. By the end of this course, you will have a solid understanding of Python programming and the ability to apply it to your engineering projects, making you a more competent and effective engineer.

Pre-requisites:

Structured Programming (VSEC01T).

Structured Programming (VSEC01P).

Course Objectives:

- To demonstrate the fundamental concepts of Python programming.
- To give examples of the basic data types, control structures, functions, and modules.
- To perform experiments by utilization of various libraries in Python by working with popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib.
- To solve a range of programming problems and tasks, including data analysis, visualization, and web development.

Course Outcome:

Learner will be able to:

CO1: Demonstrate Numbers, Strings, Lists, Tuples, Dictionaries, Array and Math functions in Python.

CO2: Give examples of different Decision-Making statements and Functions.

CO3: Interpret different file handling operations.

CO4: Relate object-oriented programming in Python.

CO5: Work with and demonstrate popular Python libraries and tools for scientific computing, such as NumPy, SciPy, and Matplotlib, to analyze and visualize data.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Experiments

1. Write python programs to understand expressions, variables, quotes, basic math operation.
2. Write a Python program to remove elements from the list.
3. Write a Python program to understand the concept of tuple and dictionary. (Creating, accessing elements, and deleting elements)
4. Write a Python program to demonstrate if-else, for loop and while loop.
5. Write a Python program to demonstrate continue, break and pass statement.
6. Write a Python program to read, write and copy from a file.
7. Write a Python program to demonstrate the working of classes and objects and members.
8. Write a Python program to demonstrate constructors.
9. Write a Python program to demonstrate inheritance.
10. Write a Python program to demonstrate sorting in NumPy.
11. Write a Python program to perform merging, joining and concatenating using Panda.
12. Write a Python program to plot the data using matplotlib

Suggested List of Mini Projects/PBL (to name few):

1. **Weather App:** Build a weather app that displays the current weather conditions for a given location using an API like OpenWeatherMap.
2. **Password Manager:** Develop a password manager that generates and stores secure passwords for different accounts and allows users to retrieve them when needed.
3. **Text Editor:** Create a simple text editor that allows users to create, edit, and save text files.
4. **Sudoku Solver:** Develop a program that solves Sudoku puzzles automatically using backtracking and recursion.
5. **Image Resizer:** Create a program that resizes images and saves them in a different format.

6. **Sentiment Analysis:** Develop a program that performs sentiment analysis on text data using Natural Language Processing techniques and outputs the sentiment score for the text.

Suggested List of Mini Projects/PBL in healthcare (to name few):

1. **Medical Image Analysis:** Develop a program that can analyze medical images such as X-rays, MRIs, and CT scans using Python libraries like scikit-image and OpenCV.
2. **Health Monitoring System:** Build a system that can monitor and track a patient's health using wearable devices and sensors, and alert healthcare providers in case of any abnormalities.
3. **Electronic Health Record (EHR) System**: Create a simple EHR system that can store and retrieve patient medical records, such as lab results, prescription information, and medical history.
4. **Medical Chatbot:** Develop a chatbot that can answer common medical questions, provide basic health advice, and refer patients to relevant healthcare providers or services.
5. **Medical Data Analysis:** Analyze medical data using Python libraries like pandas and NumPy to identify trends and patterns in disease incidence, mortality rates, and healthcare utilization.
6. **Telemedicine Platform:** Build a telemedicine platform that allows healthcare providers to conduct virtual consultations with patients, using video conferencing and messaging features.
7. **Medical Image Segmentation:** Develop a program that can segment medical images to identify specific structures and regions of interest, such as tumors or blood vessels.
8. **Disease Prediction:** Use machine learning algorithms and healthcare datasets to predict the likelihood of certain diseases in patients based on their demographics, medical history, and lifestyle factors.
9. **Automated Diagnosis:** Develop a program that can automatically diagnose certain medical conditions, such as skin diseases, based on images and symptoms.

Recommended Online Courses:

1. Python for Everybody (University of Michigan) on Coursera: https://www.coursera.org/specializations/python
2. Complete Python Bootcamp: Go from zero to hero in Python 3 on Udemy: https://www.udemy.com/course/complete-python-bootcamp/
3. Python Crash Course: A Hands-On, Project-Based Introduction to Programming by Eric Matthes: https://ehmatthes.github.io/pcc/
4. Learn Python (Codecademy) - https://www.codecademy.com/learn/learn-python
5. Python Data Science Handbook (GitHub) - https://jakevdp.github.io/PythonDataScienceHandbook/
6. Google's Python Class - https://developers.google.com/edu/python/
7. DataCamp - Introduction to Python - https://www.datacamp.com/courses/intro-to-python-for-data-science
8. Python Programming: A Concise Introduction (Wesleyan University) - https://www.coursera.org/learn/python-programming-introduction

Reference Books / Articles

1. David Beazley, "Python Cookbook: Recipes for Mastering Python 3, Brian K. Jones O'Reilly Media.
2. Zed "Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code", Shaw Addison Wesley.

3. Andreas C. Mueller O'Reilly," Introduction to Machine Learning with Python", Third edition
4. Eric Matthes" Python Crash Course A hands-on, Project Based Introduction to programming, second edition.

Course Name: Technical and Business Writing

Course Code: AEC02

NEP Vertical _Basket: HSSM_AEC

Category: Ability Enhancement

Preamble:

The course, Technical and Business Writing, introduces students to the basics of effective writing. Writing, being one of the core pillars of Communication Skills, is a significant aspect of the engineering curriculum. Engineers will encounter a plethora of technical writing tasks in their careers, and their writing needs to be professional. Technical and Business Writing will enable students to draft effective emails and letters, technical proposals and reports, maintain meeting documentation, while actively using contemporary digital writing tools.

Pre-requisites:

NIL

Course Objectives:

- To enable learners to gain understanding of writing effective letters, proposals and reports.
- To facilitate learners in developing the skills of participating in meetings.
- To create awareness of strengthening research orientation by reading and paraphrasing technical papers.
- To introduce strategies for drafting documentation required for higher studies.

Course Outcome:

Learner will be able to:
CO1: Draft effective letters and emails for various professional and business requirements.
CO2: Collect and compile data in the form of a technical report, and present findings in front of an audience.
CO3: Write technical reviews and instructions and differentiate between various hazard notations.
CO4: Draft persuasive proposals to achieve the desired outcomes.
CO5: Participate in meetings and draft meeting-related documentation like notice, agenda and minutes.
CO6: Write a Statement of Purpose and understand the requirements of a Letter of Recommendation.

Course Scheme:

Contact Hours		**Credits Assigned**
Theory	Practical	Theory + Practical
1	2	2

*****2 hours practical session will be conducted for the entire class together (to discuss the necessary concepts so that students can participate in practical activities in the class and lab).

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	-	075
Practical	50	-	-	

The assessment/evaluation guidelines for the courses of different credits are mentioned. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Business Correspondence	Principles of Correspondence (7 Cs) Parts of a letter and Formats Request for information/permission Enquiry, Reply to Enquiry Letters Complaints, Claims, Adjustment Letters Email writing and etiquette	4
2	Report Writing	Significance, Objectives of Report Writing Types of Reports Language and Style of Reports Formats of Reports Synopsis writing	3
3	Technical Writing	Introduction to Technical Writing Writing Definitions, Instructions, Safety Notations, Descriptions Technical Reviews of gadgets, software and technologies Principles of Scientific Vocabulary Technical Reports & Technical Presentation Paraphrasing Technical Paper (IEEE Format)	3
4	Proposal Writing	Parts of a Proposal and Formats Drafting persuasive proposals	2

Module No.	Module Name	Content	No. of Hours
5	Meetings and Documentation	Strategies for conducting effective meetings (in person/virtual) Note Taking Notice, Agenda, and Minutes of Meeting Business Meeting Etiquettes	2
6	Documentation for Higher Studies	Statement of Purpose Letter of Recommendation	1
Total			**15**

Suggested List of Assignments:

- Draft an email and a reply to that on any one type of letter (Individual)
- Draft a synopsis of the mini-project report (Group)
- Paraphrase a published IEEE Technical Paper (Individual)
- Draft a technical proposal (Group)
- Participate in a mock meeting and prepare notice, agenda, and minutes (Group)
- Draft a Statement of Purpose (for admission to Higher Studies) (Individual)

Suggested List of Practical:

1. Ice Breakers/Elevator Pitch
2. Letter Writing & Email Writing
3. Synopsis Writing
4. Paraphrase a published IEEE Technical Paper
5. Technical Proposal – Discussion and drafting with relevance to domain (application-based)
6. Mock Meeting (Oral + Documentation)
7. Technical Blogs
8. Technical Reviews
9. Drafting Statement of Purpose & LOR
10. Mini Project Presentation

Suggested Online Courses:

1. Courses on Communication offered by Udemy, Coursera, EdX, NPTEL Swayam, TCS iON
2. Writing Skills for Engineering Leaders https://www.coursera.org/programs/vidyalankar-institute-of-technology-coursera-response-program-tysb7/browse?productId=6sk543Q6EeaRqAobOpNSMQ&productType=course&query=technical+and+business+writing&showMiniModal=true
3. Technical Writing https://www.coursera.org/programs/vidyalankar-institute-of-technology-coursera-response-program-tysb7/browse?productId=4ESRQQpFEea5dwol2CF9Kw&productType=course&query=technical+writing&showMiniModal=true

Reference Books:

1. Raman Meenakshi and Sangeeta Raman, "Communication Skills", OUP, 2016.
2. Murphy Herta, "Effective Business Communication", McGraw Hill, 2017.
3. Locker Kitty, "Business Communication-Building Critical Skills", McGraw Hill, 2013.
4. Lehman Dufrene, Sinha, "BCOM", Cengage Learning, 2020.
5. Stanton Nicky, "Mastering Communication", Palgrave Master Series, 2009.
6. A. Kaul, "Effective Business Communication", Prentice Hall of India, 2015.
7. Monipally, "Business Communication Strategies", Tata McGraw Hill, 2001.
8. Monipally, "The Craft of Business Letter Writing", Tata McGraw Hill, 1997.
9. Lesiker and Petit, "Report Writing for Business", Mc Graw Hill, 1997.

Course Name: Social Service Internship/ Project

Course Code: CEP01

NEP Vertical _Basket: CEP/FP

Category: Community Engagement Project/Field Project

Preamble:
The Social Service Internship encourages students to identify real-world social problems, formulate clear problem statements, and propose feasible technical or non-technical solutions. Through active community engagement, students enhance empathy, problem-solving, and innovation skills while contributing meaningfully to society and preparing for responsible professional roles.

Pre-requisites:
NIL

Course Objectives:

- To develop empathy and social awareness through community engagement.
- To enable students to identify and analyze real-world social problems.
- To guide students in formulating clear, structured problem statements.
- To encourage innovative thinking for proposing appropriate technical or practical solutions.
- To enhance communication, teamwork, and project documentation skills through fieldwork.

Course Outcomes:

Learner will be able to:
CO1: Identify and analyze real-world social problems through community interaction.
CO2: Formulate clear and structured problem statements reflecting societal needs.
CO3: Propose practical or technical solutions that are feasible, ethical, and sustainable.
CO4: Demonstrate ethical behavior and sensitivity to community values and responsibilities.
CO5: Communicate internship activities and outcomes effectively through reports and presentations, and work effectively in teams.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	6	0	3

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	-	-	100	100

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus of Second Year Semester-IV

Course Name: Engineering Mathematics-IV

Course Code: BSC07

NEP Vertical _Basket: BESC_BSC

Category: Basic Science

Preamble:
This course introduces students to Engineering Mathematics-IV, with detailed Mathematical introduction to Complex Integration, Vector Spaces and Statistical Techniques like Probability Distribution, Correlation and Regression which are widely applicable in Biomedical Engineering. This Course will also offer in-depth understanding of fundamental and theoretical underpinnings, applications, best practices, and research activities.

Pre-requisites:
Engineering Mathematics-I (BSC02)
Engineering Mathematics-II (BSC04)
Engineering Mathematics-III (BSC06)

Course Objectives:
- To understand complex Integration concept and apply to evaluate integrations.
- Understanding the fundamental of linear algebra with advanced matrices and Vector Space, Statistical Techniques like Probability Distribution and Correlation and Regression to solve real world problems.
- To create a strong foundation by studying the basics of Engineering Mathematics and interfacing to various peripherals which will lead to a well-designed based System.
- To provide students with the sound foundation of Mathematics, Science, and Engineering fundamentals necessary to formulate, solve and analyse engineering problems and prepare them for Graduate studies.
- To impart knowledge of interfacing techniques and educate the student in the domain of Biomedical Engineering.

Course Outcomes:

Learner will be able to:
CO1: Develop the ability to understand the basics of Complex Integration and Residues.
CO2: Calculate probabilities and other measures using probability distributions.
CO3: Understand the concept of 2-dimensional random variable to find the joint moments.
CO4: Apply the basic statistical techniques Correlation and Regression lines for the field of Data analysis.
CO5: Understand the basics of Vector Spaces used in the field of Machine learning, AI and Data Science.
CO6: Apply the knowledge of vector integration to solve engineering problems.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	20	30	50	100

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Complex Integration	Line Integral, Cauchy's Integral Theorem, Cauchy's Integral formula. Taylor's and Laurent's Series, Zeros, singularity, poles of (z), residues, Cauchy's Residue theorem.	8
2	Probability Distribution	Random Variable: Probability distribution for discrete and continuous random variable, Bayes Theorem (without proof) Expectation, Variance, Moment generating function, Probability distributions (for detailed study): Binomial, Poisson and Normal distributions.	8
3	2D Random Variables	Random Variable: Probability distribution for discrete and continuous random variable, Probability Density Functions, Expected Values and Moments, Conditional Probability, Joint Moments	8
4	Statistical Techniques	Correlation: Covariance, Karl Pearson's Correlation Coefficient. Spearman's rank correlation coefficient, Regression lines, fitting of curves.	6
5	Vector Spaces	n-dimensional vector space, Norms, Inner product, Cauchy-Schwarz Inequality (with proof). Vector spaces over a real field, Subspaces, Orthonormal basis, Gram-Schmidt process for vectors.	7
6	Vector Integration	Gradient, Divergence, and Curl, Line Integral, Green's Theorem in a plane	8
		Total	**45**

Text Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & sons, 10th Edition.
2. Dr. B V Ramana "Higher Engineering Mathematics", Tata McGraw Hill New Delhi, India 2006
3. P N Wartikar and J N Wartikar "*Textbook of Applied Mathematics Volume I & II, Vidyarthi* Ghriha Prakashan Pune 2005 9th Edition.
4. N P Bali and Manish Goyal, "A textbook of Engineering Mathematics", Laxmi Publication 2006.

Reference Books:

1. Dr. B S Grewal, "Higher Engineering Mathematics", Khanna Publication, 44th Edition.
2. C. R. Wylie & L. C. Barrett, "Advanced Engineering Mathematics", Tata McGraw India, 6th Edition.
3. H K Das, "Advanced Engineering Mathematics", S Chand, 22nd Edition.
4. Kenneth Hoffman. "Linear Algebra", Pearson 2018.
5. Seymour Lipschutz, "Schaum's Outline of Linear Algebra", Tata McGraw India, 6th Edition.
6. Seymour Lipschutz,"Schaum's Outline of Probability and Statistics", Tata McGraw India ,1st Edition.
7. T. Veerarajan, "Probability, Statistics and Random processes", Tata McGraw India, 2nd Edition.
8. Robert Weinstock, "Calculus of variation with application to physics and Engineering", Dover
9. Publications, New York, 1st Edition.

Course Name: Digital Logic Design and Analysis

Course Code: PCBM04T

NEP Vertical_Basket: PC_PCC

Category: Program Core

Preamble:

Most of the Medical Electronic devices are using digital technology and basic understanding of digital logic design is essential for Biomedical Engineering students

This course introduces students to digital Logic Design, with detailed technical introduction to two widely methods of digital design-Combinational and Sequential design. Course will also offer in-depth understanding of theoretical concepts, hands on trainings and applications

Pre-requisites:

1. Basic Electrical Engineering (ESC06T)
2. Electronic Devices and Circuits (ESC10T)

Course Objective:

- To make learner aware of basics of Digital circuits, logic design, various Logic Families and Flip-flops.
- Learner should be able to design of various counters, registers and their applications.
- Learner should be able to design sequential circuits as a state machine.

Course Outcomes:

Learner will be able to:
CO1: Describe various number systems, logic gates and logic families.
CO2: Apply Boolean algebra, K-maps for Logic reduction and implementations in SOP and POS form.
CO3: Develop combinational circuits using logic gates, multiplexers, de-multiplexers, and decoders.
CO4: Design synchronous and asynchronous counters using flip flops.
CO5: Design of synchronous sequential circuit as state machine

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Fundamentals of Digital Design:	Introduction, Number system, Binary, Octal, Hexadecimal and other. Conversion from One system to another. Binary Codes: Weighted, Reflective, Sequential, Gray, Error detecting codes, Odd, Even parity, Hamming Codes etc	4
02	Logic Families	TTL,CMOS logic Families and Comparison	2
03	Combinational Logic Design:	Boolean Algebra: Laws of Boolean algebra, De- Morgan's theorems, Relating a Truth Table to a Boolean Expression, Multilevel circuits. Logic Reduction Techniques: K-MAPS and their use in specifying Boolean Expressions, Prime implicant, Minterm, Maxterm, SOP and POS Implementation. Implementation of logic function using universal gates. Application of gray code, Hazards in combinational circuits	6
04	MSI Combinational Circuits:	Elementary designs: Designing code converter circuits Binary Arithmetic circuits: Adder, Subtractor, Magnitude Comparators, Arithmetic Logic Units.Use of Multiplexers in Logic Design: Multiplexer (ULM) Shannon's theorem. De- Multiplexers, Line decoders.	8
05	Fundamentals of Sequential Logic Circuits	Flip-Flops: Comparison of Combinational & Sequential Circuits, Flip-Flops,Converting one Flip-Flop to another Counters: Modulus of a counter, designing synchronous and asynchronous counter using flip flop. Minimum cost and minimum risk approach in design. Designs: Design of sequential circuits as a Mealy and Moore model, basic design of sequence detector. Registers: Working and applications of shift registers	10
Total			**30**

Suggested Online Courses:

- Digital Systems: From Logic Gates to processors offered by University of Barcelona https://www.coursera.org/learn/digital-systems
- Hardware Security-University of Maryland https://www.coursera.org/lecture/hardware-security/introduction-sqYzy

Suggested List of Value-Added Home Assignments:

1. Design of automatic Springler system
2. Hospital Patient flow automation
3. Patient data collection
4. Problem Based Assignment

Text Books:

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

Course Name: Digital Logic Design and Analysis Lab

Course Code: PCBM04P

NEP Vertical _Basket: PC_PCC

Category: Program Core

Preamble:

Most of the Medical Electronic devices are using digital technology and basic understanding of digital logic design is essential for Biomedical Engineering students
This course introduces students to digital Logic Design, with detailed technical introduction to two widely methods of digital design-Combinational and Sequential design. Course will also offer in-depth understanding of theoretical concepts, hands on trainings and applications

Pre-requisites:

1. Basic Electrical Engineering (ESC06T)
2. Electronic Devices and Circuits (ESC10T)

Course Objective:

- To make learner design basics Digital circuits, using logic gates
- Learner should be able to implements circuits like various counters, registers and their applications.
- Learner should be able to implement sequential circuits as a state machine.

Course Outcomes:

Learner will be able to:
CO1: Design and implement digital circuits using logic gates.
CO2:. Implement combinational circuits using logic gates, multiplexers, de-multiplexers, and decoders.
CO3: Implement synchronous and asynchronous counters using flip flops.
CO4: Design and implement synchronous sequential circuit as state machine.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	25	-	25	050

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Suggested list of practicals:

1. To design binary to gray code converter and gray to binary converter.
2. To design parity generator and parity checker circuits.
3. To design adder and subtractor circuits.
4. To design various circuits using multiplexers.
5. To design various circuits using de-multiplexer.
6. To design Asynchronous counter.
7. To design decade counter
8. To design Synchronous counter.
9. To implement shift register and ring counter using MSI shift register.
10. To implement Moore/ Mealy machine.

Suggested list of Miniprojects:

Implementation of digital circuits as state machines

Suggested Online Courses:

1. Digital Systems: From Logic Gates to processors offered by University of Barcelona https://www.coursera.org/learn/digital-systems
2. Hardware Security-University of Maryland https://www.coursera.org/lecture/hardware-security/introduction-sqYzy

Suggested List of Value-Added Home Assignments:

1. Design of automatic Springler system
2. Hospital Patient flow automation
3. Patient data collection
4. Problem Based Assignment

Text Books:

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

Course Name: Biomechanics, Prosthetics & Orthotics

Course Code: PCBM05

NEP Vertical _Basket: PC-PCC

Category: Program Core

Preamble:

The course will help students to understand the basic definitions, classification and general applications of biomechanics. Students will understand the basics of gait cycle, different types of prosthetics and orthotics devices.

Course Objectives:

- To understand the basics of human gait cycle.
- To gain the knowledge of various types of orthotic and prosthetic devices.

Pre-requisites:

1. Engineering Mechanics (ESC02T)
2. Physics for Biomedical Engineers (PCBM01T)
3. Human Anatomy and Physiology (PCBM03T)

Course Outcome:

Learner will be able to:
CO1: Understand the definition of biomechanics, prostheses orthoses and its classification and design principles.
CO2: Develop a better understanding of how mechanical principles influence human motion during everyday life.
CO3: Student will be able to differentiate different types of artificial limbs.
CO4: Understand the definition of prostheses and orthoses and its design principles.

Course Scheme:

Contact Hours		Credits Assigned
Theory	Tutorial	Theory + Tutorial
02	02	03

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Tutorial	40	20	40	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Force system	Classification of force system. Equilibrium of force system.	2
02	Tissue Biomechanics	Direct shear, bending and torque actions and the corresponding stresses and strains in biological tissues. Stress relaxation and creep. Bone structure & composition, Mechanical properties of bone, Soft connective (skin, tendon, ligaments, etc.) covering structure function, and physiological factors.	8
03	Movement Biomechanics	Study of joints and movements. Anatomical levers, Gait Analysis.	5
04	Joint analysis	Instrumentation for gait analysis: Measurement devices-footswitches, instrumented	5
05	Principles in designing orthoses and prostheses	Principles of three-point pressure, total contact, partial weight bearing.	5
06	Classification in prosthetics and orthotics	Lower Extremity orthoses and prostheses, Upper Extremity orthoses and prostheses. Spinal orthoses.	5
Total			**30**

Suggested List of Tutorials

1. To study the concurrent coplanar force system.
2. To study the stress-strain relation of mild steel.
3. To study the classification of human bones.
4. To study different types of joints in human body and joint movements.
5. To study the classification of muscles.
6. To study the human gait cycle.
7. To study the gait cycle parameters.
8. Fabrication of PTB/socket of prosthesis.
9. Fabrication of PTB/socket of orthosis.
10. Prosthetic Rehabilitation
11. Advancements in materials used for Prosthetic Devices

Recommended Online Courses:

1. Mechanics of Human Movement By Prof. Sujatha Srinivasan, IIT Madras
   https://onlinecourses.nptel.ac.in/noc21_me52/preview
2. Assistive Devices,Prosthesis and Orthosis, by Dr Sujatha Srinivasan, IIT Madras.
   http://www.digimat.in/nptel/courses/video/112106248/L47.html

Reference Books / Articles

1. Susan J. Hall “Basic Biomechanics”, MC Graw Hill.
2. Dr. Ajay Bahl and others “Basics of Biomechanics" Jaypee Brothers Medical
3. M. Nordin, V.Frankel “Basic Biomechanics of the Musculoskeletal System” Wolters Kluwer
4. Atlas, C. V. Mosby “Human Limbs and their substitutes”
5. C. V. Mosby, “American Atlas of Orthopedics: Prosthetics”
6. C. V. Mosby, “American Atlas of Orthopedics: Orthotics”
7. Prof Ghista “Biomechanics” Private Publication UAE
8. White and Puyator “Biomechanics” Private Publication UAE

Course Name: Analytical and Clinical Equipment

Course Code: PCBM06T

NEP Vertical _Basket: PC-PCC

Category: Program Core

Preamble:

This course introduces students to understanding basic principles and the working of analytical and clinical equipment. The skills developed will help students to design and develop health care systems. Studying this course will help students to serve in industry and health care institutions.

Pre-requisites:

Human Anatomy & Physiology (PCBM03T)
Electronic Devices and Circuits (ESC10T)

Course Objective:

- To understand the principles and working of analytical instruments.
- To gain knowledge about the principles and working of blood analysis equipment.
- To learn about different types of infusion pumps and components of drug infusion systems.
- To acquire knowledge about different techniques for measuring lung function and capacity.

Course Outcomes:

Learner will be able to:
CO1: Understand principles of various analytical instruments used in hospital and laboratories.
CO2: Demonstrate the knowledge about various blood cell counting systems and blood gas analyzers.
CO3: Demonstrate the knowledge about various infusion pumps used for drug delivery.
CO4: Understand the basic mechanism of ventilation and analysis of pulmonary functions.
CO5: Understand the basic principles and applications of audiometry techniques.
CO6: Understand the basic principle and working of neonatal monitoring systems.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2+1 (O)	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	75

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Analytical Instruments	Colorimeter, Spectrophotometer, Auto Analyzer, Electrophoresis Principles, Chromatography Equipment, ELISA Technique (Reader and Washer).	8
02	Blood cell Counter and Blood Gas Analyzer	Blood cell counter (Coulter and Pico-scale) Blood gas Analyzer principle and working,	6
03	Drug Delivery Systems	Infusion pumps, components of drug infusion systems, syringe and peristaltic pumps, Implantable infusion system (insulin pumps).	4
04	Pulmonary Function Analyzer	Respiration measurement technique: Lung volume and capacities, Spirometry, Pulmonary function measurement, Nitrogen Washout & Helium Dilution Techniques.	4
05	Audiometry Equipment	Basic audiometer, Pure tone and Speech audiometer, evoked response Audiometry, Hearing Aids.	4
06	Foetal and Neonatal monitoring instruments	Cardiotocograph, Methods of monitoring of Foetal Heart rate, Monitoring of labor.	4
Total			**30**

Suggested Online Courses:

1. Infusion Pump Testing (https://www.flukebiomedical.com)

2. INCU II Incubator/Radiant Warmer Analyzer (https://www.flukebiomedical.com)
3. Phototherapy Radiometer/Irradiance Meter (https://www.flukebiomedical.com)

Textbooks:

1. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Prentice Hall of India.
2. J.G. Webster, "Medical Instrumentation: Application and Design", John Wiley.
3. Leislie Cromwell, Fred J. Weibell, Enrich A. Pfeiffer, "Biomedical Instrumentation and measurements", Prentice Hall of India.

Reference Books / Articles

1. Carr-Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall of India.
2. J.G. Webster, "Encyclopedia of Medical Devices and Instrumentation", Prentice Hall of India.
3. Various instruments manuals.
4. Various internet resources.

Course Name: Analytical and Clinical Equipment Lab

Course Code: PCBM06P

NEP Vertical _Basket: PC-PCC

Category: Program Core

Preamble:

This course introduces students to understanding basic principles and the working of analytical and clinical equipment. The skills developed will help students to design and develop health care systems. Studying this course will help students to serve in industry and health care institutions.

Pre-requisites:

Human Anatomy & Physiology (PCBM03T)
Electronic Devices and Circuits (ESC10T)

Course Outcome:

Learner will be able to:
CO1: Apply the concepts and principles learned in the course to design and conduct an analytical experiment and interpret the results to draw conclusions.
CO2: Design and implement a regulated power supply using appropriate components and test its performance.
CO3: Design and implement circuits for clinical equipment's like temperature control circuit, respiratory rate monitoring circuit etc. and evaluate its accuracy and precision.
CO4: Apply the principles of colorimetry and spectrophotometry to determine the concentration of unknown samples and interpret the results.
CO5: Gain exposure to industry/hospital environments through a visit and understand the role of analytical and clinical equipment in different settings.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Experiments

1. Selection of wavelength for colorimeter and spectrophotometer.
2. Find out the concentration of unknown sample using colorimeter and spectrophotometer.
3. Design and implementation of 6V, 1 Amp regulated power supply.
4. Design and Implementation of temperature controller circuit for Infant Warmer machine.
5. Design and Implementation of respiratory rate monitoring circuit for pulmonary function measurement.
6. Demonstration of foetal heart rate monitor.
7. Study of Testing of hearing ability using Audiometer.
8. Industry or Hospital visit.
9. Any other experiment based on syllabus which will help learner to understand topic/concept.

Suggested List of Mini Projects/PBL (to name few):

1. Design and optimize an ELISA assay to detect a specific protein biomarker in blood or urine samples and analyze the results using a spectrophotometer.
2. Investigate the effects of different drug infusion rates on the blood glucose levels of diabetic patients, using a continuous glucose monitoring system and infusion pumps.
3. Develop a portable spirometry device that can measure lung volumes and capacities in real-time and compare its performance with a clinical spirometer.
4. Evaluate the accuracy and precision of a blood cell counter using Coulter and Pico-scale technologies and determine its applicability in clinical settings.
5. Compare the efficiency and sensitivity of different chromatography techniques, such as high-performance liquid chromatography (HPLC) and gas chromatography (GC), for separating and quantifying complex mixtures of organic compounds.
6. Investigate the role of hearing aids in improving the hearing ability of individuals with hearing loss and design an experiment to measure their performance using a pure-tone audiometer.
7. Develop a fetal monitoring system using cardiotocograph and analyze the variations in fetal heart rate and uterine contractions during labor.
8. Design an experiment to measure the respiratory rate and lung function of healthy individuals during exercise, using nitrogen washout and helium dilution techniques.

Recommended Online Courses:

Virtual Labs: https://vlab.amrita.edu/index.php?sub=2&brch=190
Virtual Labs: https://ccnsb06-iiith.vlabs.ac.in/

Virtual Labs: https://mas-iiith.vlabs.ac.in/

Reference Books / Articles

1. R.S. Khandpur, "Handbook of Biomedical Instrumentation", Prentice Hall of India.
2. J.G. Webster, "Medical Instrumentation: Application and Design", John Wiley.
3. Leislie Cromwell, Fred J. Weibell, Enrich A. Pfeiffer, "Biomedical Instrumentation and measurements", Prentice Hall of India.
4. Carr-Brown, "Introduction to Biomedical Equipment Technology", Prentice Hall of India.
5. J.G. Webster, "Encyclopedia of Medical Devices and Instrumentation", Prentice Hall of India.

Course Name: Linear Integrated Circuits

Course Code: PCBM07T

NEP Vertical _Basket: PC-PCC

Category: Program Core

Preamble:

The term integrated circuit reflects the capabilities of semiconductor industry to fabricate complex electronic circuit consisting of a large number of components on a single substrate. The operational amplifier is the most versatile active element amongst the linear ICs. The course covers the basic principles of Linear Integrated Circuit and Operational Amplifiers in particular their analysis, design and applications.

Pre-requisites:
Basic Electrical & Electronics Engineering (ESC06T)
Physics for Biomedical Engineering (PCBM01T)
Electronic Devices and Circuits (ESC10T)

Course Objective:

- To provide concepts of operational amplifier (Op-Amp) with their applications and design methodology.
- To cover analysis of circuits using various ICs.
- To design and develop various circuits for biomedical applications and to develop analytical thinking of students.

Course Outcomes:

Learner will be able to:
CO1: Demonstrate basics of operational amplifiers.
CO2: Analyse different types of Op-Amp based circuits.
CO3: Analyse and design operational amplifier to perform mathematical operations.
CO4: Design operational amplifier-based oscillators.
CO5: Describe various waveform generation IC's and their applications and use it in projects.
CO6: Apply the knowledge of various special function IC's and special purpose diodes for designing of practical applications.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
2	-	2	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	15	20	40	075

The assessment guidelines for the courses of different credits are mentioned above. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Introduction to Operational Amplifier (Op-Amp):	Introduction to Differential Amplifier. Introduction to an Ideal Operational Amplifier, Block Diagram, DC & AC Characteristics and Equivalent circuit of Op-amp. Op-amp IC 741 characteristics, frequency response and concept of virtual ground.	5
02	Linear Application of Op-Amp	Adder, Subtractor /differential Amplifier, Voltage follower, Integrator (Ideal and practical), Differentiator (Ideal and practical), Instrumentation amplifier and Instrumentation amplifier IC (AD620).Voltage to Current and Current to Voltage converters.	5
03	Non-Linear Applications of operational Amplifier	Voltage comparators, zero crossing detector and Schmitt Trigger (Regenerative comparator).Active Half wave rectifiers, Active Full wave rectifier, Clipper, Clampers, Log and Antilog amplifiers, Sample & hold circuits, Peak detector, Peak to Peak detector and Generalized Impedance Convertor. Introduction to additional Op-Amp ICs and their features: CA3140E, TL081CN, TL061CP, TL071CP, MC33171N, TL0xx, MCP601 and OPA602.	8
04	Oscillators using Operational Amplifier	Concepts of feedback, types of feedback and various topologies of negative feedback.Concepts of Oscillation and Barkhausen's criteria for an oscillator.Types of oscillators: RC Phase shift Oscillator, Wien Bridge oscillator, Colpitt's Oscillator, Hartley Oscillator, Crystal Oscillator and Clapp Oscillator (For all the above oscillators; working, Frequency of oscillation, condition for sustained oscillation and design of each oscillator).	6
05	Special Function ICs	IC 555 Functional Block diagram and Circuit diagram. IC 555 in Astable Multivibrator(AMV) functional diagram, circuit diagram with applications. IC 555 in Monostable Multivibrator (MMV) functional diagram, circuit diagram with applications.	6

Module No.	Module Name	Module Contents	No. of Hours
		Function Generator (IC 8038 or equivalent) Circuit diagram and its applications. VCO (IC 566) Circuit diagram and applications. F-V convertors and V-F convertors Circuit diagram and its applications.	
Total			**30**

Suggested Online Courses:

1. Introduction to Electronics- https://www.coursera.org/learn/electronics
2. Fundamentals of Audio and Music Engineering: Part 1 Musical Sound & Electronics- https://www.coursera.org/learn/audio-engineering
3. Introduction to Biomedical Engineering- https://www.coursera.org/learn/bioengineering

Text Books:

1. Donald A Neamen, "Electronic Circuit Analysis and Design"
2. R Bolystead "Electronic Devices and circuits ".
3. R. Gayakwad "Op-Amps and linear integrated circuits"–
4. D.Roy Chaudhary "Linear Integrated Circuits"

Reference Books / Articles

1. Millman & Halkias "Integrated Electronics"
2. James Fiore "Op-amps and linear integrated circuits, Theory and Applications"
3. https://circuitdigest.com/electronic-circuits/555-timer-monostable-circuit-diagram.

Course Name: Linear Integrated Circuits Lab

Course Code: PCBM07P

NEP Vertical _Basket: PC-PCC

Category: Program Core

Preamble:

The term integrated circuit reflects the capabilities of semiconductor industry to fabricate complex electronic circuit consisting of a large number of components on a single substrate. The operational amplifier is the most versatile active element amongst the linear ICs. The course covers the basic principles of Linear Integrated Circuit and Operational Amplifiers in particular their analysis, design and applications.

Pre-requisites:
Basic Electrical & Electronics Engineering (ESC06T)
Physics for Biomedical Engineering (PCBM01T)
Electronic Devices and Circuits (ESC10T)

Course Objectives:

- To study op-amp parameters and understand the data sheet
- To provide designing methodologies for basic circuits like amplifiers, filters, and oscillators etc. using operational amplifiers.
- To implement the circuits on bread boards for verifying the outputs and obtain frequency response.

Course Outcome:

Learner will be able to:
CO1: Read the data sheet of different ICs; compare the parameters to select appropriate IC
CO2: To design and implement various building blocks of different biomedical instruments.
CO3: Understand various waveform generation IC's and their applications and use it in projects.
CO4: Apply the knowledge of various special function IC's and special purpose diodes for designing of practical applications.

Course Scheme:

Contact Hours		**Credits Assigned**	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	25	-	25	050

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Suggested List of Experiments

1. To study op-amp parameters.
2. To design and verify outputs of inverting amplifier, noninverting amplifier and voltage follower.
3. Design and verify the outputs of adder and subtractor.
4. To design and verify output of instrumentation amplifier.
5. To study frequency response of an integrator
6. To study frequency response of differentiator.
7. To study peak detector circuit.
8. To study half wave rectifier and full wave rectifier.
9. To study RC-phase shift oscillator.
10. To study Wein bridge oscillator.
11. To study comparators and zero crossing detector.
12. To design and study band pass filter using op-amp
13. To design and study notch filter.
14. To study monostable multivibrator using IC 555
15. To study astable multivibrator using IC555
16. To verify outputs of IC 8038

Suggested List of Mini Projects/PBL (to name few):

1. Electronics Thermometer Using Op-amp 741 IC
2. Sound detector circuit using op-amp 741
3. Tone Control for Guitar Amplifier Using 741
4. Half wave and Full wave precision rectifier.
5. Adjustable Ripple-Regulated Power Supply Using 741
6. Motion Detector Using NE555 Timer
7. Sound Operated Timer
8. 555 Timer PWM Audio Amplifier
9. Touch-Free Timer Switch
10. Infrared Remote Control Timer
11. Signal Generator and Inverter Using NE555 Timers
12. AC Lamp Blinker Using Timer 555

13. RGB Bulb Using NE555 Timer
14. False Triggering Eliminator for Timer 555

Recommended Online Courses:

Course: Integrated Circuits, MOSFETs, Op-Amps and their Applications by Prof. Hardik Jeetendra Pandya – IISc Bangalore https://nptel.ac.in/courses/108/108/108108111/

Reference Books / Articles

1. Tony Chan Carusone, David Johns, Kenneth William Martin "Analog Integrated Circuit Design", Wiley, 2012
2. James Fiore Delmar "Op-amps and linear integrated circuits, Theory and Applications", Thomson Learning, 2001

Course Name: Algorithms and Data Structures in Bioinformatics

Course Code: MDMBI02

NEP Vertical _Basket: MDM

Category: Multidisciplinary Minor(Bioinformatics)

Preamble:

This course is designed with the objective of equipping students with a robust understanding of the integration between biology and computational science, key bioinformatics concepts, methodologies, and applications. Through a combination of theoretical knowledge and practical applications, students will develop a holistic understanding of how various data structures and algorithms can enhance the comprehension of biological processes. It also emphasizes on real-world biological questions and research challenges, empowering them to make meaningful contributions to the rapidly evolving field of bioinformatics

Course Objectives:

- To enable learners to understand the basic data structures for Bioinformatics.
- Build foundational understanding of various algorithms

Pre-requisites:

Introduction to Bioinformatics (MDMBI01)

Course Outcome:

Learner will be able to:
CO1: Apply fundamental data structures and algorithms (arrays, trees, graphs, hashing, etc.) to solve computational problems in bioinformatics.
CO2: Analyze and implement sequence alignment algorithms for comparing DNA, RNA, and protein sequences, including global, local, and heuristic approaches.
CO3: Construct and interpret phylogenetic trees using distance-based and character-based algorithms for evolutionary analysis.
CO4: Use algorithmic and statistical models, such as HMMs and motif-finding tools, to predict genes and regulatory elements in genomic sequences.
CO5: Design and evaluate scalable bioinformatics workflows and pipelines using big data technologies and cloud platforms for handling large-scale genomic datasets.

Course Scheme:

Contact Hours		Credits Assigned
Theory	Practical	Total
3	1	4

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory+ Tutorial	45	30	50	125

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose a revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Module Contents	No. of Hours
01	Review of Data Structures and Algorithms	Arrays, strings, stacks, queues, Graphs and trees: DFS/BFS with examples from biological data, Suffix trees, suffix arrays, tries, Hashing techniques for genome indexing	8
02	Sequence Alignment Algorithms	Needleman-Wunsch algorithm (global alignment) Smith-Waterman algorithm (local alignment) Space optimization (Hirschberg's algorithm) Heuristic alignment methods (BLAST internals) Complexity analysis of sequence alignment algorithms Self-Learning Topics: Recent advances in sequence alignment techniques	10
03	Phylogenetic Tree Construction	Multiple Sequence Alignment (MSA) pre-processing Distance-based methods: UPGMA, Neighbor-Joining Character-based methods: Maximum Parsimony, Maximum Likelihood,Tree visualization tools: MEGA, iTOL Self-Learning Topics: Bayesian approaches in phylogenetics	10
04	Gene Prediction and Motif Finding	Regulatory elements in genomes Basics of Hidden Markov Models (HMMs) Motif discovery tools (MEME, FIMO)	10

Module No.	Module Name	Module Contents	No. of Hours
		Promoter and enhancer identification Use of regular expressions in motif searches Self-Learning Topics: Deep learning methods for gene prediction	
05	Big Data in Bioinformatics	Challenges of large-scale genomic and multi-omics data, Hadoop and Spark frameworks for bioinformatics, Bioinformatics pipelines: Snakemake, Nextflow,Cloud platforms for genomics: AWS, Google Genomics, Case studies: 1000 Genomes Project, Cancer Genome Atlas Self-Learning Topics: Emerging big data technologies in bioinformatics	07
Total			**45**

Reference Books / Articles

1. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
2. Bioinformatics- a Practical Guide to the Analysis of Genes and Proteins by Baxevanis, A.D. and Francis Ouellellette, B.F., Wiley India Pvt Ltd. 2009
3. Introduction to bioinformatics by Teresa K. Attwood, David J. Parry-Smith. Pearson Education. 1999

Course Name: Startup Planning and Development

Course Code: MDMIE02

NEP Vertical_Basket: MDC_MDM

Category: Multidisciplinary Minor(Innovation, Entrepreneurial and Venture Development)

Preamble:

Pre-requisites: NIL

Course Objectives:

- To develop skills for building, validating, and planning a new venture.
- To understand basic startup finance, legalities, and market strategy.
- To enable students to create business plans and investor pitches.

Course Outcomes:

Learner will be able to:
CO1: Design MVPs and apply lean startup methods
CO2: Conduct market and competitor analysis.
CO3: Prepare financial models and pitch decks.
CO4: Understand legal frameworks and intellectual property.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	1(Tutorial)	3	1

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Lean Startup Methodology	• MVP (Minimum Viable Product) • Pivoting and iteration • Build-Measure-Learn loop	8
2	Market Research and Strategy	• TAM-SAM-SOM analysis • Competitive analysis • Go-to-market strategy	8
3	Startup Finance	• Basics of financial modelling • Unit economics, pricing, and revenue models • Funding sources: bootstrapping, angels, VCs, crowdfunding	10
4	Legal & Regulatory Aspects	• Company formation: types and registration • IPR basics: patents, trademarks, copyrights • Compliance and taxation	6
5	Business Plan Development	• Writing an effective business plan • Pitch deck essentials	7
		Total	**45**

Tutorials (1 Credit):

- Building a mock startup pitch deck
- Simulated investor pitch
- Budgeting and forecasting exercises

Textbooks:

1. Peter Thiel ,Zero to One: Notes on startups, or how to build the future, Crown Business 2014
2. E,ric Ries The Lean Startup, Crown Business 2011
3. Brad Feld ,Venture Deals, Wiley Publications

Course Name: Financial Basics for Engineers and Technopreneurs

Course Code: MDMBD02

NEP Vertical _Basket: MDM

Category: Multidisciplinary Minor(Business Development, Marketing and Finance)

Preamble:
The objective of this course is to equip students with basic financial skills needed to evaluate and manage technical projects or business ventures. It covers the principles of cost analysis, budgeting, financial statements, and introduction to funding models.

Pre-requisites:
Introduction to Business Development and Marketing Principles

Course Objectives:

- Learn basic financial terminology and concepts.
- Understand components of a budget and perform break-even analysis.
- Analyse financial viability of a project or startup.
- Gain exposure to funding options.

Course Outcomes:

Learner will be able to:

CO1: Interpret and analyze basic financial statements (P&L, balance sheet).
CO2: Prepare a project cost sheet and conduct break-even analysis.
CO3: Explain sources of capital and funding stages for startups.
CO4: Apply budgeting techniques to engineering project proposals

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	1(T)	3	1(T)

Assessment Guidelines:

Head of learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall

be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Introduction to Finance	Financial definitions, roles in business, overview of income, expenses, assets, liabilities, cash flows.	8
2	Costing and Budgeting	Types of costs (fixed/variable), project budgeting, break-even analysis, basic forecasting.	8
3	Financial Statements	Structure and interpretation of P&L, balance sheet, cash flow statements.	10
4	Time Value of Money	Simple vs compound interest, Net Present Value (NPV), Internal Rate of Return (IRR) concepts.	6
5	Funding Sources	Equity, debt, bootstrapping, angel investment, venture capital, crowdfunding.	7
6	Financial Decision Making	Financial ratios (ROI, ROE), pricing basics, cost-benefit analysis, breakeven models.	6
Total			**45**

Textbooks:

1. Finance for Non-Finance Managers, by: V.G. Narayanan, Publisher: Cengage India, ISBN: 9789353501786
2. Finance for Non-Financial Managers by Gene Siciliano, McGraw Hill, Second Edition, (pdf available online)

Reference Books:

1. Introduction to Finance - Yale Online Course
2. Investopedia - Financial Statements Guide

Course Name: Operating Systems and Computer Networks

Course Code: MDMCS02

NEP Vertical _Basket: MDM

Category: Multidisciplinary Minor(Computer Science)

Preamble:

This course introduces the basics of Operating Systems and intermediate concepts in Computer Networks, focusing on how systems manage processes and enable communication. Students will learn key OS functions, networking protocols, and explore their integration through hands-on tasks like scheduling, subnetting, and socket programming. The course emphasizes real-world relevance in areas like virtualization, cloud computing, and secure communications.

Pre-requisites:

3. ES04T (Structured Programming)
4. ES04T (Object Oriented Programming)

Course Objectives:

- To establish foundational understanding of operating system principles, including process management, memory management, and system-level functionalities, enabling students to recall and apply these concepts in computing tasks.
- To develop conceptual clarity of computer networking fundamentals such as layered architectures, addressing schemes, protocols, and network models to support effective communication between systems.
- To build practical skills in configuring networks, analysing traffic using tools, and simulating OS-level tasks like scheduling and memory allocation for system efficiency.
- To apply integrated knowledge of operating systems and computer networks in designing and implementing basic client-server applications and exploring modern environments like cloud and containerized systems.

Course Outcomes:

Learner will be able to:

CO1: Recall fundamental concepts of operating systems such as process states, memory management techniques, and system calls.
CO2: Explain core principles of computer networks including OSI and TCP/IP models, IP addressing, and transport layer protocols.
CO3: Describe the interaction between operating systems and network components for enabling process communication and data transfer.
CO4: Implement basic OS-level algorithms such as process scheduling and memory allocation and simulate network operations using tools.
CO5: Analyse the performance of OS and network mechanisms with respect to efficiency, scalability, and resource utilization.

CO6: Evaluate the role of OS and networking integration in solving real-world problems such as secure communication, client-server architecture, and containerized deployment.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
3	2	3	1

Assessment Guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory	45	30	50	125

The assessment guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to propose her/his assessment methodology based on the nature of the course. However, the proposed assessment methodology shall be approved by a panel constituted at Institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No	Module name	Content	No of Hours
1	Introduction to Operating Systems	Overview of Operating Systems, types of OS (batch, multitasking, real-time), components (kernel, shell), system calls, functions and services of OS, booting process.	6
2	Process and Memory Management	Process concepts, process states, scheduling algorithms (FCFS, SJF, Round Robin), memory management basics, paging and segmentation (conceptual).	6
3	Network Fundamentals	OSI and TCP/IP models, data encapsulation, IP addressing (IPv4 basics), subnetting, MAC address, ARP, DHCP, DNS, routing and switching fundamentals.	12
4	Transport and Application Layer Protocols	TCP vs UDP, 3-way handshake, flow and congestion control, protocols: HTTP, FTP, SMTP, HTTPS. Use of port numbers, socket basics.	8

Module No	Module name	Content	No of Hours
5	Wireless Networking and Security	Wireless networks (WLAN, Bluetooth, 5G basics), VPN, firewalls, basics of encryption (symmetric vs. asymmetric), SSL/TLS, secure browsing practices.	7
6	OS-Network Integration & Application	Role of OS in networking: sockets, inter-process communication, threads with network programming, introduction to container networking (Docker), client-server applications.	6
Total			**45**

Text Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, *Operating System Concepts*, 10th Edition, Wiley, ISBN: 978-1119456339
2. Andrew S. Tanenbaum, Herbert Bos, *Modern Operating Systems*, 4th Edition, Pearson, ISBN: 978-0133591620
3. Behrouz A. Forouzan, *Data Communications and Networking*, 5th Edition, McGraw-Hill, ISBN: 978-0073376226
4. James F. Kurose, Keith W. Ross, *Computer Networking: A Top-Down Approach*, 7th Edition, Pearson, ISBN: 978-0136681557
5. William Stallings, *Operating Systems: Internals and Design Principles*, 9th Edition, Pearson, ISBN: 978-0134670959

Reference Books:

1. William Stallings, *Data and Computer Communications*, 10th Edition, Pearson, ISBN: 978-0133506488
2. Daniel P. Bovet, Marco Cesati, *Understanding the Linux Kernel*, 3rd Edition, O'Reilly Media, ISBN: 978-0596005658
3. Douglas E. Comer, *Computer Networks and Internets*, 6th Edition, Pearson, ISBN: 978-0133587937
4. Tanenbaum and Steen, *Distributed Systems: Principles and Paradigms*, 2nd Edition, Pearson, ISBN: 978-8131734031
5. Thomas L. Floyd, *Network Fundamentals*, Pearson Education, ISBN: 978-0131973831

Course Name: Presentation Skills

Course Code: AEC03

Category: HSSM_AEC

Category: Ability Enhancement

Preamble:

The course, Presentation Skills, is intended to equip students with the necessary skill-set to help them bridge the gap from the campus to the corporate world. It will help them to be industry ready in sync with the requirements of the program they are pursuing.

Pre-requisites:

Nil

Course Objectives:

- To familiarize students about constructing a personal brand effectively.
- To create engaging and deliver effective business presentation skills by utilizing digital tools.
- To apply communication and strategic planning in business plan pitches and presentations.
- To develop an appreciation for cultural diversity and enhance intercultural communication skills.
- To understand the nuances of storyboarding and storytelling
- To present oneself professionally in interviews, group discussions and various corporate situations.

Course Outcomes:

Learner will be able to:

CO1: Understand the significance of brand-building and apply strategies to construct an effective personal brand.

CO2: Demonstrate proficiency in delivering impactful presentations by utilizing digital tools and applying structured communication principles.

CO3: Proficient in crafting comprehensive business plans by employing persuasive marketing and financial strategies and implementation plans.

CO4: Craft engaging visual stories through storyboarding and storytelling, create compelling video presentations.

CO5: Demonstrate readiness for placements by gaining practice in aptitude tests, HR interviews and GDs, and crafting professional resumes.

CO6: Understand intercultural communication, global citizenship, and respect cultural diversity.

Course Scheme:

Contact Hours		Credits Assigned	
Theory	Practical	Theory	Practical
-	2	-	1

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Practical	50	-	-	50

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content	No. of Hours
1	Personal Branding	Introduction to Personal Branding –Purpose, Significance, Benefits and Techniques to build a personal brand. Corporate/Organisational Branding. Online identity of Brand on social media. Maintenance and Improvement of your Brand Factors affecting your Brand	6
2	Corporate Presentations	Business Presentation Tips Digital Presentations PAIBOC Model and Minto Pyramid Principles	4
3	Business Plan Presentations	Introduction to Business Plans Company Overview & Industry Analysis Persuasive Communication in Marketing Strategy Operations Strategy in Financial Management Implementation Plan	6
4	Storyboarding and Storytelling	Visual Story Telling Video Presentations Story Structure with images Film and Animation	4

Module No.	Module Name	Content	No. of Hours
5	Placement Readiness	Mock HR Interviews Mock GDs Aptitude Tests Placement ready resume	6
6	Global Communication	An introduction to inter-cultural communication Introduction to languages and cultures Global media in mass communication Tips to become a global citizen Respecting cultural diversity	4
Total			**30**

Guidelines to conduct practical sessions:

1. Personal Branding
2. Personal Branding
3. Personal Branding
4. Corporate Presentations
5. Corporate Presentations
6. Business Plan Presentations
7. Business Plan Presentations
8. Business Plan Presentations
9. Storyboarding and Storytelling
10. Storyboarding and Storytelling
11. Placement Readiness
12. Placement Readiness
13. Placement Readiness
14. Global Communication
15. Global Communication

List of Assignments:

1. Personal Branding (Individual)
2. Corporate Presentations (Group)
3. Business Plan Presentations (Group)
4. Storyboarding and Storytelling (Group)
5. Global Communication (Individual)

Recommended Online Courses:

1. Introduction to Personal Branding

   https://www.coursera.org/learn/personal-branding
2. Strategic Self-Marketing and Personal Branding

https://www.coursera.org/learn/self-marketing

3. Learn to Storyboard for Film or Animation
4. https://www.udemy.com/course/storyboard-for-film-or- animation/
5. Powerful Tools for Teaching and Learning: Digital Storytelling - https://www.coursera.org/learn/digital- storytelling
6. Presentation Skills: Speechwriting, Slides and Delivery Specialization - https://www.coursera.org/specializations/presentation-skills
7. Business English for Cross-Cultural Communication - https://www.coursera.org/learn/cross-cultural-communication-business

Reference Books:

1. Personal Development for Life and Work, Wallace and Masters, Thomson Learning
2. Organizational Behaviour, Robbins Stephens, Pearson Education
3. Me 2.0: 4 Steps to Building Your Future, Dan Schawbel, Diversion Books
4. Branding Pays: The Five-Step System to Reinvent Your Personal Brand, Karen Kang, Branding Pays Media
5. The Presentation Secrets of Steve Jobs: How to Be Insanely Great in Front of Any Audience, Carmine Gallo, McGraw Hill Education
6. Talk Like TED: The 9 Public-Speaking Secrets of the World's Top Minds, Carmine Gallo, St. Martin's Press
7. The Storytelling Animal: How Stories Make Us Human, Jonathan Gottschall, Mariner Books
8. Made to Stick: Why Some Ideas Survive and Others Die, Chip Heath and Dan Heath, Random House
9. The Culture Map: Decoding How People Think, Lead, and Get Things Done Across Cultures, Erin Meyer, Public Affairs
10. Kiss, Bow, or Shake Hands: The Bestselling Guide to Doing Business in More Than 60 Countries, Terri

Morrison and Wayne A. Conaway, Adams Media

11. Brand Thinking and Other Noble Pursuits, Debbie Millman, Allworth

Building a Brand Story: Clarify Your Message So Customers Will Listen, Donald Miller, HarperCollins

Course Name: Design Thinking

Course Code: EEMC01

NEP Vertical _Basket: HSSM_EEMC

Category: Entrepreneurship/Economics/Management

Preamble:

Design thinking is a powerful tool for rethinking and revitalizing strategy—and for driving organizational performance. By placing customers' needs at the center of a product, service, process, or business model, you can reframe strategic challenges and develop more effective solutions. Drawing on right-brained creativity and left-brained analytics, the course on design thinking enables you to broaden your strategic perspective, find novel opportunities for innovation, and keep your business moving forward.

Course Objectives:

- To impart knowledge on the concepts of Design Thinking
- To impart knowledge on the phases of Design Thinking
- To apply Design Thinking concepts

Course Outcomes:

Learner will be able to:
CO1: Understand the concepts of design thinking approaches.
CO2: Create design thinking teams and conduct design thinking sessions.
CO3: Apply both critical thinking and design thinking in parallel to solve problems.
CO4: Apply design concept to their daily work.

Course Scheme:

Contact Hours		Credits Assigned	
Theory+ Practical		Theory + Practical	
3	-	3	-

Assessment guidelines:

Head of Learning	ISA	MSE	ESE	Total
Theory & Tutorial	50	-	50	100

The assessment/evaluation guidelines for the courses of different credits are mentioned in the above table. Notwithstanding the above, each course faculty shall have the choice to decide her/his assessment methodology based on the nature of the course. Faculty may propose the revised

assessment methodology for his/her course. However, the revised assessment methodology shall be approved by a panel constituted at institute level and published to the learners before the commencement of the semester.

Detailed Syllabus:

Module No.	Module Name	Content
1	Design Thinking Overview	What is different about design thinking, Design thinking skills, Design thinking mindset, Principles of Design thinking
2	General Approaches to Design Thinking	The basics of Design thinking, Design thinking frameworks, Design thinking team, Design thinking workshops and meeting – Characteristics and types
3	Design Thinking approach in stages	Apply design thinking framework, empathize with customers/users, Define the problem, Ideate, Prototype, Test solution.
4	Design Thinking Techniques	Listening and emphasizing techniques – Engagement, Observation, showing empathy, Define and ideation techniques – Unpacking, Personas, Pattern recognition and connecting the dots, Prototype, and testing techniques – Types of prototypes, forms of testing in design thinking,
5	General Design Thinking Practices	Use of diagrams and maps in design thinking – empathy map, affinity diagram, mind map, journey map. Story telling techniques – Improvisation, scenarios, K-scripts
6	Adopt and Adapt Design thinking	Cautions and pitfalls – assumptions, pitfalls and cautions in design thinking workgroups, Best practices
		Total Hours=30

Suggested list of Practical

1. Creating an Empathy Map Canvas by interviewing the users (10M)
2. To create User Personas and user pain points to understand users on an individual basis (10M)
3. Customer Journey Mapping to understand Customer Experience (5M)
4. Framing of Problem Statement and analysis (5M)
5. Brainstorming of ideas through post-it notes (10M)
6. Creating low fidelity prototypes/ paper prototypes/drawings (10M)

Reference Books:

1. Tim Brown, "Change by Design - How Design Thinking Transforms Organizations and Inspires Innovations"
2. Larry J.Leifer, Michael Lewerick, and Patrick, "The Design Thinking Toolbox: A Guide to Mastering the Most Popular and Valuable Innovation Methods"