UNIVERSITY OF MYSORE

(Re-accredited by NAAC with 'A' Grade)

(NIRF-2022: Ranked 33rd in University Category and 54th in Overall Category)

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

SCHEME AND SYLLABUS OF

B.E IN BIOMEDICAL & ROBOTIC ENGINEERING

Outcome Based Education (OBE)

and

Choice Based Credit System (CBCS)

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DIRECTOR
Mysore University
School of Engineering
Manasagangotri, Mysuru - 06

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

I-SEMESTER BE (Physics Cycle)

Sl No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT11	Engineering Mathematic-I	MAT	MAT	3	2	-	03	50	50	100	4
2	BSC	21PHY12	Engineering Physics	PHY	PHY	3	-	-	03	50	50	100	3
3	ESC	21ELN13	Basic Electronics Engineering	BM & RE	BM & RE	3	-	-	03	50	50	100	3
4	ESC	21CIV14	Elements of Civil Engineering	CEE	CEE	3	-	-	03	50	50	100	3
5	BSC	21BIE15	Biology for Engineers	CHE	CHE	3	-	-	03	50	50	100	3
6	BSC	21PHYL16	Engineering Physics Laboratory	PHY	PHY	-	-	2	03	50	50	100	1
7	ESC	21EEL17	Basic Electrical & Electronics Laboratory	BM & RE	BM & RE	-	-	2	03	50	50	100	1
8	ESC	21IDT18	Innovation & Design Thinking	Respective Dept.	Respective Dept.	-	2	-	-	50	-	50	1
9	HSMC	21EGH19	Technical English	HSMC	HSMC	-	-	2	-	50	-	50	1
Total						**15**	**04**	**06**	**21**	**450**	**350**	**800**	**20**

Note: BSC: Basic Science Courses, ESC: Engineering Science Courses, MAT: Mathematics, PHY: Physics, BM & RE: Bio-medical and Robotics Engineering, CEE: Civil Environmental Engineering, CHE: Chemistry, HSMC: Humanity, Social Science and Management Courses.

Credit Definition:

- 1-hour lecture**(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process

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

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

The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression.

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

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme of Teaching and Examination 2021-2022(As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2021–2022)

II-SEMESTER BE (Chemistry Cycle)

Sl No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory lectures	Tutorial	Practical/ Drawing	Examination in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT21	Engineering Mathematic-II	MAT	MAT	3	2	-	03	50	50	100	4
2	BSC	21CHE22	Engineering Chemistry	CHE	CHE	3	-	-	03	50	50	100	3
3	ESC	21ELE23	Basic Electrical Engineering	BM & RE	BM & RE	3	-	-	03	50	50	100	3
4	ESC	21CPS24	C Programming for Problem Solving	CS & E	CS & E	3	-	-	03	50	50	100	3
5	BSC	21EME25	Elements of Mechanical Engineering	BM & RE	BM & RE	3	-	-	03	50	50	100	3
6	BSC	21CHEL26	Engineering Chemistry Laboratory	CHE	CHE	-	-	2	03	50	50	100	1
7	ESC	21CPL27	C Programming Laboratory	CS & E	CS & E	-	-	2	03	50	50	100	1
8	ESC	21AEC28	Ability Enhancement Course	Respective Dept.	Respective Dept..	-	2	-	-	50	-	50	1
9	HSMC	21KAN29	Technical Kannada	HSMC	HSMC	-	2	-	-	50	-	50	1
Total						**15**	**06**	**04**	**21**	**450**	**350**	**800**	**20**

Note: BSC: Basic Science Courses, ESC: Engineering Science Courses, MAT: Mathematics, CHE: Chemistry, BM & RE: Bio-medical and Robotics Engineering, CS & E: Computer Science and Engineering, HSMC: Humanity, Social Science and Management Courses

Credit Definition:

- 1-hour lecture **(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** course are to be designed for **15** hours of Teaching-Learning process

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

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

The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression.

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

Physics Cycle

Engineering Mathematics-I (21MAT11)

Semester I (Common for both Physics and Chemistry Cycle)			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T :P	3:2:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Differential Calculus:** **Partial Differentiation**: Basics; Euler's theorem of first kind (only problems); Total derivatives; Jacobian; Maclaurin's series of one and two variable; Differentiation under Integral sign. **Applications:** Problems on evaluation of non-elementary integrals using Maclaurin's series	**10 Hours**
Module 2	**Ordinary Differential Equations** **Linear Equations**: Bernoulli's equation; Exact Equations; Reducible to Exact (If of the form); Orthogonal Trajectory (Cartesian only); and Newton's law of cooling. **Non- Linear Equations:** Solve for p, Clairaut's form(singular, general solution). **Applications:** Problems on LR circuits leading to linear differential equations.	**10 Hours**
Module 3	**Integral Calculus:** **Multiple Integrals:** Double integrals, changing the order of integration, changing Cartesian form to polar form. Special Functions- Beta and Gamma Functions, relation between beta and gamma function, properties, and its problems (related to reduction formula of definite integral). **Applications:** Problems on centre of gravity and moment of inertia which involve evaluation of multiple integrals.	**10 Hours**
Module 4	**Numerical methods and Infinite Series** **Numerical methods:** Types of errors in numerical methods, Solution of Algebraic and Transcendental Equation: Newton-Raphson. Finite Differences: Forward and Backward, Interpolation, Lagrange's Interpolation. Numerical Integration- Simpson's $1/3^{rd}$rule. **Infinite Series: C**onvergence of infinite series: D-Alembert's Ratio Test, Raabe's Test, Leibniz test, absolute and conditional convergent. **Applications:** Problems on application of Newton-Raphson method to some physical contexts	**10 Hours**

Module 5	**Linear Algebra** Vectors, linearly dependent and independent vectors, Solution to systems of Linear Equation: Rank, Consistency, Gauss Elimination, LU decomposition. Eigen values- Eigen vectors, Diagonalization, Gauss–Seidel Method, Rayleigh Power method. **Applications:** Problems on Kirchhoff's law leading to solving system of linear equations. Problems on computation of inverse matrix using LU decomposition.	**10 Hours**

Course outcomes:
At the end of the course the students will be able to:

- Explain the basic concepts of calculus for a single and multivariable function, ordinary.
  differential equations, infinite series, numerical methods and linear algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyze the solutions of engineering problems using these concepts.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation (CIE): The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each fullquestion carries 20 marks.

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

Text and Reference Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering,* 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. Gilbert Strang, Linear Algebra and its Applications, Wellesley Publishers.
5. Peter V. O'Neil, *Engineering Mathematics*, CENGAGE Learning India Pvt Ltd.
6. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.
7. Thomas and Finney, *Calculus and Analytic Geometry,* 9th Edition, Pearson Education.

Engineering Physics (21PHY12/22)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Electrostatics, Magnetostatics and Elastic properties of materials:** **Electrostatics:** Electrostatic field and potential of a dipole, dielectric constant, Bound charges due to electric polarization, electric displacement, dielectric slab in uniform electric field, relation between dielectric susceptibility (χ), dielectric constant and polarization density (P). Numerical problems. **Magnetostatics:** Biot Savart's law, divergence and curl of static magnetic field, Gauss divergence theorem sand stokes' theorem, Faraday's law in terms of EMF produced by changing magnetic flux. **Elastic properties of materials:** concept of elasticity, stress, strain, tensile stress, shear stress, compressive stress. Hooke's law, different elastic moduli: Poisson's ratio, Expression for Young's modulus (Y), Bulk modulus and Rigidity modulus (n) in terms of α and β. Relation between Y, n and K. Derivation of expression for bending moment of a beam with circular and rectangular cross section. Numerical problems.	**08 Hours**
Module 2	**Crystal physics:** Space lattice, Basis vectors, Unit cell, lattice parameters. Bravais lattice and crystal systems, Estimation of directions and planes in a crystal lattice, Miller indices and expression for interplanar spacing in terms of Miller indices. Expression for lattice constant for a cubic lattice, Co-ordination number, Atomic packing factor-Atomic packing factor for sc, bcc and fcc structures. Crystal structures of NaCl and diamond, Diffraction of X-rays –derivation of Bragg's law, X-ray spectrometer, –problems on Bragg's law.	**08 Hours**
Module 3	**Introduction to solids**: Review of classical free electron theory, Quantum free electron theory, Fermi energy and Fermi factor in metals, Variation of Fermi factor with energy and temperature, Fermi-Dirac statistics, Derivation of density of states, Band theory of solids (qualitative approach) Intrinsic semiconductors, concept of effective mass (qualitative) Intrinsic carrier density, Fermi level in intrinsic semiconductors, Extrinsic semiconductors- types, variation of carrier concentration with temperature, variation of Fermi	**08 Hours**

	level with temperature, numerical problems.	
Module 4	**Modern Physics** **Dual nature of matter**: Wave particle dualism, de-Broglie hypothesis, Davisson and Germer experiment, Matter waves and their characteristic properties. Phase velocity and group velocity, Relation between phase velocity and group velocity. Relation between group velocity and particle velocity. Problems on de-Broglie's wavelength. **Wave mechanics**; Heisenberg's uncertainty principle, significance and its applications: non-existence of electron inside the nucleus. Properties of wave function and physical significance. Probability density and Normalization of wave function, Schrodinger time independent wave equation in one-dimension, Eigen values and Eigen functions. Particle in one dimensional infinite potential well. Numerical problems.	**08 Hours**
Module 5	**Lasers, optical fibers and nanomaterials**: **Lasers:** Laser Characteristics, Spatial and Temporal Coherence, Einstein Coefficient and its significance, Population inversion, Two, three and four level systems, Pumping schemes, Threshold gain coefficient, Components of laser, Nd-YAG, He-Ne, and Dye laser and their engineering applications. Numerical problems. **Optical fibers**- Construction and light propagation mechanism in optical fibers (total internal reflection and its importance), Propagation mechanism in optical fibers. Angle of acceptance. Numerical aperture. Types of optical fibers and modes of propagation. Attenuation, Pulse dispersion (qualitative only). **Nanomaterials**- Effect of nano-scale dimension, Classification of nano materials, Properties and applications of nano systems, Carbon nanotubes (CNTs).	**08 Hours**

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

- Recall and relate the knowledge of quantum physics to the properties of advanced materials such as conductors, semiconductors, dielectrics, lasers, optical fibers and nanomaterials.
- Interpret the physical laws to study the materials properties.
- Apply the problem-solving ability to identify and construct the applications of the advanced materials in new technologies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module. The students will have to answer five full questions, selecting one full question from each module.

Text and Reference books:

1. Fundamentals of Physics - Halliday and Resnick, 10th Edition, 2012, Wiley, UK
2. Introduction to Mechanics - MK Verma, 2008, CRC Press, Taylor and Francis.
3. Quantum Mechanics - D.J Griffiths, 2013, Pearson Pentice Hall, New Jercy.
4. Lasers and Nonlinear Optics - B.B Laud, 2011, New Age International, New Delhi.
5. Solid State Electronics Devices - B.G. Streetman, 7th Edition, 2014, Pearson Pentice Hall, New Jersy.
6. Concept of Modern Physics - Arthur Beiser, 2009, MacGraw Hill, New Delhi.

Basic Electronics Engineering (21ELN13/23)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Semiconductor Diode and its Applications**: Construction, working, and characteristics of PN-junction Diode, Diode approximations, Shockley's Equation, Half-wave, Full-wave, and Bridge Rectifiers, Mention of expression for average, RMS, and Peak Inverse Voltage, and Ripple Factor to each configuration, Zener Diode and its Characteristics, **Transistor:** Construction and working of Bipolar Junction Transistor, Transistor voltages and currents, mention of CB, CE and CC configurations, Input and Output characteristics of CE configuration, Circuit diagram and working of Transistor as Switch and Amplifier. **Amplifiers:** Need for transistor biasing, Voltage-Divider Bias Circuit, Classification of amplifiers.	**08 Hours**
Module 2	**Field Effect Transistors:** Construction and working of JFET, Common Drain and Transfer Characteristics of JFET. **MOSFET:** Construction, working and Characteristics of Depletion and Enhancement mode MOSFETs. **CMOS:** Construction, Working and Characteristics of CMOS transistors.	**08 Hours**
Module 3	**Basics of Digital Electronics:** Analog verses Digital Signals, Decimal, Binary, Octal and Hexadecimal Numbers and interconversion among them, 2's complement Arithmetic, Addition and Subtraction of Binary Numbers, Basic and Universal Gates. **Combinational Logic Circuits:** Boolean Algebra and Theorems, Simplification of Logic Circuits, SoP and PoS forms, 2 and 3 variable K-Maps. **Sequential Logic Circuits:** Basics of Flip-flops, SR and JK Flip-flops.	**08 Hours**
Module 4	**Operational Amplifiers and its Applications:** Basics of Differential Ampler, Block diagram of Op-amp and its modes, Ideal verses Practical Op-amps, Open and Closed Loop Op-amp configurations. **Op-amp Parameters**: Definition and expression for Voltage gain, CMRR, Input Offset Voltage and Current, Input Bias Current, Virtual Ground, Input and Output impedance, Slew	**08 Hours**

	Rate.	
Module 5	**Basics of Electronic Communication:** Definition of Modulation and Demodulation, Need for Modulation, Electromagnetic Frequency Spectrum. **Analog Communication:** Block Diagram of Analog Communication System, Principles of AM and FMModulation Schemes and their Comparison. **Digital Communication:** Block Diagram of Digital Modulation System, Advantages of Digital Communication over Analog Communication.	**08 Hours**

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

- Analyze the characteristics of Basic Electronic Devices
- Realize the importance of Electronic Devices in everyday life
- Apply the principles of working of Electronic Devices to design the Electronic circuits
- Analyze the importance of Electronic Communication System
- Gain the fundamental knowledge on the operation of Mobile Telephones

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each fullquestion carries 20 marks.

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

Text Books:

1. David A. Bell, "Electronic Devices and Circuits," 5th Edition, Oxford University Press, 2015.
2. Ramakanth A Gayakwad, "Op-Amps and Linear ICs," Pearson Education, 4th Edition, 2015.
3. D. P. Leach, A.P. Malvino, Goutham S, "Digital Principles and Applications," 8th Edition, MGH, 2014.
4. Wayne Tomasi, "Electronic Communications Systems," 5th Edition, Pearson Education, 2009.

Reference Books:

1. Robert L Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory," 11th Edition, Pearson Education India, 2018.
2. David A. Bell, "Operational Amplifiers and Linear ICs," 3rd Edition, Oxford University Press, 2011.
3. Morris Mano, "Digital Logic and Computer Design," Pearson Education, 2004
4. Kennedy and Davis, "Electronic Communication System," 5th Edition, MGH, 2011.
5. R. S. Sedha, "A Text book of Applied Electronics," 7th Edition, S. Chand and Company Ltd., 2011.

E-Resources:

1. https://www.elsevier.com/books/basic-electronics/holbrook/978-0-08-006865-7
2. http://nptel.ac.in/courses/117103063/
3. https://nptel.ac.in/courses/117/105/117105143/
4. https://swayam.gov.in/
5. https://www.mooc-list.com/course/introduction-electronics-coursera

Elements of Civil Engineering (21CIV14/24)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Definition of Civil Engineering, Scope of different fields of Civil Engineering; Building Materials, Surveying, Geotechnical Engineering, Structural Engineering, Construction Technology, Hydraulics, Water Resources & Irrigation Engineering, Transportation Engineering and Environmental Engineering. Role of Civil Engineers in the Infrastructural development, effect of infrastructural facilities on social- economic development of a country. Bridges: Types of Bridges and Culverts, RCC, Steel and Composite Bridges Dams: Different types of Dams based on Material, Structural behaviour and functionality with simple sketches.	**08 Hours**
Module 2	Virtual Work and Energy Method-Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	**08 Hours**
Module 3	Review of particle dynamics-Rectilinear motion; Plane curvilinear motion(rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular).	**08 Hours**
Module 4	Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in planemotion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation.	**08 Hours**
Module 5	Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple,	**08 Hours**

	compound and torsion pendulums.	

Course outcomes:
At the end of the course the students will be able to:

- Mention the application of the various fields of civil Engineering.
- Determining the basic knowledge of mathematics and physics to solve real-world problem.
- Use scalar and vector analytical techniques for analysing forces in statically determinate structures
- Understand basic kinematics concepts – displacement, velocity and acceleration.
- Understand basic dynamics concepts – force, momentum, work and energy.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text/Reference Books:

1. Reddy Vijaykumar K. and K. Suresh Kumar Singer's "Engineering Mechanics", 2010.
2. Tayal A.K.," Engineering Mechanics", Umesh Publications, 2010.
3. F. P. Beer and E. R. Johnston, "Vector Mechanics for Engineers", Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill,2011.
4. Andy Ruina and Rudra Pratap, "Introduction to Statics and Dynamics", Oxford University Press,2011.

Biology for Engineers (21BIE15/25)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	Need to study Biology: – Life Science Studies Significance - Bio Inspired Inventions - Role of Biology in Next Generation Technology Development – Cell Structure – Cell Potential - Action Potential – ECG and other common signals – Sodium	**08 Hours**
Module 2	Potassium channels – Neuron function – Central Nervous Systems – Discussion Topics: Evolution of Artificial Neural Networks, Machine Learning techniques.	**08 Hours**
Module 3	Genetics: Basic Principles of Mendel, molecular genetics, Structure and function of genes and chromosomes, Transcription and Translation, Gene expression and regulation	**08 Hours**
Module 4	Sensing Techniques: - Understanding of Sense organs working – Sensing mechanisms - Sensor Development issues – Discussion Topics: Digital Camera – Eye Comparison, electronic nose, electronic tongue, electronic skin.	**08 Hours**
Module 5	Physiological Assist Device: Artificial Organ Development: Kidney, Liver, Pancreas, heart valves – Design Challenges and Technological Developments	**08 Hours**

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

- Understand the biological concepts from an engineering perspective.
- Understand the concepts of biological sensing and its challenges.
- explain the fundamentals of genetic and transfer of genetic information.
- Understand development of artificial systems mimicking human action.
- Integrate biological principles for developing next generation technologies.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. "Biology for Engineers: As per Latest AICTE Curriculum" Wiley Editorial ISBN:9788126576340.
2. Biology for Engineers (ISBN: 9781121439931), TMH
3. Leslie Cromwell, Biomedical Instrumentation, Prentice Hall 2011.
4. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Biology for Engineers, Tata McGraw-Hill, New Delhi, 2012.
5. Medicine Dentistry Electronic Nose
6. Electronic Tongue

Reference Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers

Engineering Physics Laboratory (21PHYL16/26)

Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	-	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	01

Sl No.	List of experiments
1	**Resonance in LCR circuits-** Study frequency response of series and parallel resonance circuits
2	**Dielectric constant**- Determination of dielectric constant of the given dielectric material by charging and discharging
3	**Zener diode-** I-V characteristics of Zener diode
4	**B-H curve**- Determination of energy loss, remnant flux density and coercive field of the given ferromagnetic material
5	**Planck's constant**- Determination of the Planck's constant using light emitting diodes
6	**Stefan's law**- Verification of Stefan's law
7	**Fermi Energy-** Determination of Fermi energy of given material
8	**Band gap**- Determination of energy gap of a given semiconductor
9	**Laser diffraction-** Determination of wavelength of given laser
10	**Torsional Pendulum-** Determination of moment of inertia of the given irregular body

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

- Understand the Measuring Techniques
- Understand the characteristics of devices and materials.
- Use different techniques of measuring instruments

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Practical Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation (CIE): The 75% (35 marks) CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the

conduction of every experiment and 25% (15 marks) marks for one practical test. The total CIE marks shall be the sum of marks secured by students in the above events.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-12 per batch.

1. All laboratory experiments are to be included for practical examination.
2. The instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Break up of marks are 15% marks for procedure, 70% marks for conduction and calculation and 15% of marks for viva voce.
4. Students can pick one experiment from the questions lot prepared by the examiners.
5. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Basic Electrical and Electronics Laboratory (21EEL17/27)

Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	-	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	01

Sl No.	List of experiments
1	Verification of KVL and KCL for DC circuits
2	Measurement of resistance and inductance of a choke coil using three voltmeter method
3	Two-Way and Three-Way control of lamp.
4	Measurement of Current, Power and Power Factor of Incandescent Lamp, Fluorescent Lamp and LED Lamp.
5	Determination of Electrical Characteristic of Photovoltaic cells.
6	Obtain the V-I Characteristics of a Diode.
7	Zener diode as a Voltage Regulator with variable load.
8	Design and Verify the truth table of logic gates
9	Calculate the efficiency of Half Wave and Full Wave diode rectifier.
10	Obtain the characteristic of MOSFET.

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

- To conduct experiment to verify KVL and KCL.
- To conduct experiment to measure impedance of a choke coil & power factor of different lamps.
- To understand the working of two-way and three-way control of lamp.
- To obtain the characteristic of Diode, Zener diode, MOSFET & PV Cell.
- To verify the truth table of Logic gates
- To compute the efficiency of half wave and full wave diode rectifier

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE

and SEE to pass. Practical Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation (CIE): The 75% (35 marks) CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and 25% (15 marks) marks for one practical test. The total CIE marks shall be the sum of marks secured by students in the above events.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-12 per batch.

1. All laboratory experiments are to be included for practical examination.
2. The instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Break up of marks are 15% marks for procedure, 70% marks for conduction and calculation and 15% of marks for viva voce.
4. Students can pick one experiment from the questions lot prepared by the examiners.
5. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Innovation and Design Thinking (21IDT18/28)

Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	02	**SEE Marks**	-
Total No. of Lecture hours	-	**Exam Hours**	-
L: T:P	0:2:0	**Credits**	01

Module 1	
PROCESS OF DESIGN: Understanding Design thinking Shared model in team-based design – Theory and practice in Design thinking – Exploring work of Designers across globe – MVP or Prototyping.	
Pedagogy	*Introduction about the design thinking: Chalk and Talk method* *Theory and practice through presentation* *MVP and Prototyping through live examples and videos.*
Module 2	
Tools for Design Thinking Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design.	
Pedagogy	*Case studies on design thinking for real-time interaction and analysis,* *Simulation exercises for collaborated enabled design thinking,* *Live examples on the success of collaborated design thinking.*
Module 3	
Design Thinking in IT Design Thinking to Business Process modeling – Agile in Virtual collaboration environment – Scenario based Prototyping.	
Pedagogy	*Case studies on design thinking and business acceptance of the design,* *Simulation on the role of virtual eco-system for collaborated prototyping.*
Module 4	
DT For strategic innovations Growth – Story telling - Predictability – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.	
Pedagogy	*Business model examples of successful designs* *Presentation by the students on the success of design* *Live project on design thinking in a group of 4 students.*
Module 5	
Design thinking workshop Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.	
Pedagogy	*8 hours design thinking workshop from the expect and then presentation by the students on the learning from the workshop.*

Course Outcome:

At the end of the course the student will be able to:

- Explain various design process.

- Generate and develop ideas through different techniques.
- Identify the significance of reverse engineering
- Draw technical drawings for design ideas.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50%. The student has to obtain minimum of 40% marks in CIE to pass.

Continuous Internal Evaluation:

1. Methods suggested: Test, Open Book test, Written Quiz, Seminar, report writing micro project etc.
2. The class teacher has to decide the topic for closed book test, open book test, Written Quiz and Seminar. In the beginning only teacher has to announce the methods of CIE for the subject.

Text Books:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.

Reference Books:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
2. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).

Technical English (21EGH19)

Semester I (Common for both Physics and Chemistry Cycle)			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	-	**Exam Hours**	-
L: T:P	0:0:2	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	1.1 Word Formation 1.2 Etymology, origin of foreign words and their use in English Language 1.3 Familiarizing with prefixes and suffixes from foreign languages in English to form derivatives. 1.4 Synonyms, Antonyms and Standard Abbreviations. Basic Writing Skills	**05 Hours**
Module 2	2.1 Structure of Sentences 2.2 Use of Idioms and phrases in sentences 2.3 Punctuation of Sentences 2.4 Syntax and Creating coherence 2.5 Organizing principles of paragraphs in documents	**05 Hours**
Module 3	Identifying Common Errors in Writing 3.1 Subject-verb agreement 3.2 Noun-pronoun agreement 3.3 Misplaced modifiers 3.4 Articles 3.5 Prepositions 3.6 Redundancies 3.7 Clichés	**05 Hours**
Module 4	Nature and Style of Proper Writing 4.1 Defining 4.2 Describing and Classifying 4.3 Illustrations with suitable examples 4.4 Formulating Introduction and Conclusion Honing Writing Skills	**05 Hours**
Module 5	5.1 Report Writing/Comprehension 5.2 Précis Writing 5.3 Essay Writing 5.4 Critical analysis of unknown Prose Pieces/Poems Oral Communication (This unit involves interactive practice sessions in Language Lab) Listening Comprehension- Active Listening, Feedback and Response, Pronunciation, Intonation and Accent, Common	**05 Hours**

	Everyday Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal and PPT Presentations	

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

- Comprehend and Perceive things/issues to be Creative and Innovative.
- To voice the opinions with precision.
- Communicate and Converse with exuberance with the Global Audience.

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 50%. The student has to obtain a minimum of 40% marks in CIE to pass.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Text Books

1. Balasubramanian, P. Phonetics for Indian Students. (Second Edition) Macmillan, Mumbai, 2013
2. CIEFL, Hyderabad , Exercises in Spoken English. Parts. I-III. Oxford University Press.
3. Liz Hamp-Lyons and Ben Heasly Study Writing. Cambridge University Press. 2006.
4. Raman, M & Sharma. S. Technical Communication: Principles and Practice. OUP, New
5. Delhi, 2014
6. Sanjay Kumar and PushpLata Communication Skills. Oxford University Press. 2011.
7. Swan, Michael. Practical English Usage. (Fourth Edition) OUP. 2017.
8. Wood. F.T. Remedial English Grammar. Macmillan.2007
9. Zinsser William. On Writing Well. Harper Resource Book. 2001

Chemistry Cycle

Engineering Mathematics-I (21MAT11)

Semester I (Common for both Physics and Chemistry Cycle)			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:2:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Differential Calculus:** **Partial Differentiation**: Basics; Euler's theorem of first kind (only problems); Total derivatives; Jacobian; Maclaurin's series of one and two variable; Differentiation under Integral sign. **Applications:** Problems on evaluation of non-elementary integrals using Maclaurin's series.	**10 Hours**
Module 2	**Ordinary Differential Equations** **Linear Equations**: Bernoulli's equation; Exact Equations; Reducible to Exact (If of the form); Orthogonal Trajectory (Cartesian only); and Newton's law of cooling. **Non- Linear Equations:** Solve for p, Clairaut's form(singular, general solution). **Applications:** Problems on LR circuits leading to linear differential equations.	**10 Hours**
Module 3	**Integral Calculus:** **Multiple Integrals:** Double integrals, changing the order of integration, changing Cartesian form to polar form. Special Functions- Beta and Gamma Functions, relation between beta and gamma function, properties, and its problems (related to reduction formula of definite integral). **Applications:** Problems on centre of gravity and moment of inertia which involve evaluation of multiple integrals.	**10 Hours**
Module 4	**Numerical methods and Infinite Series** **Numerical methods:** Types of errors in numerical methods, Solution of Algebraic and Transcendental Equation: Newton-Raphson. Finite Differences: Forward and Backward, Interpolation, Lagrange's Interpolation. Numerical Integration- Simpson's $1/3^{rd}$rule. **Infinite Series: C**onvergence of infinite series: D-Alembert's Ratio Test, Raabe's Test, Leibniz test, absolute and conditional convergent. **Applications:** Problems on application of Newton-Raphson method to some physical contexts	**10 Hours**

Module 5	**Linear Algebra** Vectors, linearly dependent and independent vectors, Solution to systems of Linear Equation: Rank, Consistency, Gauss Elimination, LU decomposition. Eigen values- Eigen vectors, Diagonalization, Gauss–Seidel Method, Rayleigh Power method. **Applications:** Problems on Kirchhoff's law leading to solving system of linear equations. Problems on computation of inverse matrix using LU decomposition.	**10 Hours**

Course outcomes:
At the end of the course the students will be able to:

- Explain the basic concepts of calculus for a single and multivariable function, ordinary differential equations, infinite series, numerical methods and linear algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyze the solutions of engineering problems using these concepts.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

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1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.
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3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

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

Text and Reference Books

1. S C Chapra and R P Canale, *Numerical Methods for Engineering*, 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. Gilbert Strang, Linear Algebra and its Applications, Wellesley Publishers.
5. Peter V. O'Neil, *Engineering Mathematics*, CENGAGE Learning India Pvt Ltd.
6. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.
7. Thomas and Finney, *Calculus and Analytic Geometry*, 9th Edition, Pearson Education.

Engineering Mathematics-II (21MAT21)

Semester II (Common for both Physics and Chemistry Cycle)			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	50	**Exam Hours**	03
L: T:P	3:2:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Higher Order Differential Equations** Inverse Differential Operator: Particular integral of the form e^{ax}, Sinax, polynomials and $e^{ax}V(x)$ (up to third order) and Variation of Parameters. Differential Equation with variable coefficient: Cauchy's and Legendre differential equations. **Applications:** Problems on LRC circuit leading to higher order differential equation. Problems on forced oscillation leading to homogeneous linear ODE	**10 Hours**
Module 2	**Power Series Solutions:** Frobenius method of Power Series (only second order), Bessel's Differential Equation leading to $J_n(x)$, $J_{1/2}(x)$, $J_{-1/2}(x)$, Legendre's Differential Equations, Rodrigues formula (without proof)-Legendre's Polynomial.	**10 Hours**
Module 3	**Vector Calculus**: VPDO- Gradient of a scalar field (angle between two surfaces & Directional Derivatives), Divergence and Curl of Vector field and its properties (Solenoidal and Irrotational). Line integrals, Green's theorem, Stroke's theorem, and Gauss Divergence theorem. **Applications:** Problems on calculating work done using line integrals. Problems on finding the outward flux of a filedusing Green's theorem	**10 Hours**
Module 4	**Laplace Transform** Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions and unit-step function (problems only). Inverse Laplace Transform: Inverse Laplace transforms by method of partial fractions, Convolution theorem to find the inverse Laplace transforms. Solution of linear differential equations using Laplace transforms. **Applications:** Problems on Laplace transforms related to electric circuits.	**10 Hours**
Module 5	**Advanced Linear Algebra:** Vector Space, basis and span, subspace, linear Transformation (LT), Matrix representation of LT, Change of basis, Rank nullity theorem, inverse LT.	**10 Hours**

Course outcomes:
At the end of the course the students will be able to:

- Explain the basic concepts of vector calculus, higher order differential equations,
- Laplace transforms and advanced linear algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyze the solutions of engineering problems using these concepts.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text and Reference Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering,* 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. Gilbert Strang, Linear Algebra and its Applications, Wellesley Publishers.

5. Peter V. O'Neil, *Engineering Mathematics*, CENGAGE Learning India Pvt Ltd.
6. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.
7. Thomas and Finney, *Calculus and Analytic Geometry,* 9th Edition, Pearson Education.

Engineering Chemistry (21CHE12/22)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Thermodynamics and Energy Balance** Introduction, Terminology of thermodynamics, Zeroth law; First law of thermodynamics- Heat and work, Enthalpy, Standard Enthalpies, Bond Enthalpy; The Second Law of Thermodynamics- Entropy the Carnot Cycle; The Third Law of Thermodynamics- Entropy and Temperature-Gibbs Free Energy, Standard Gibbs Free Energies and Chemical Equilibrium. **Electrochemical Energy Systems** Introduction, Single Electrode Potential-origin and terminology; Derivation of Nernst Equation and its applications; Standard Electrode Potential; Measurement of Single Electrode Potential and its applications- Definition, construction of a galvanic cell; Classification of galvanic cells-primary, secondary and concentration cells; EMF of a cell-Definition, notation and conventions; Types of electrodes; Reference electrodes- calomel electrode and Ag / AgCl electrode. **Battery Technology: A New Era Emerging:** **Batteries**-Basic concepts, battery characteristics, Classification of batteries-primary, secondary and reserve batteries; Classical batteries-construction, working and applications of Nickel-metal hydride, lithium-MnO_2 and Li-ion batteries.	**08 Hours**
	Self-Study Components: Concentration Cells- construction and working; Determination of pH using Glass Electrode; Ion Selective Electrode-Principle, construction and applications.	
Module 2	**Science of Corrosion and Electrolysis** **Corrosion**: Introduction, electrochemical theory of corrosion, galvanic series. **Factors affecting the rate of corrosion**: ratio of anodic to cathodic areas, nature of metal, nature of corrosion product, nature of medium – pH, conductivity, and temperature. **Types of corrosion**- Differential metal, differential aeration	**08 Hours**

	(Pitting and water line) and stress. **Corrosion control**: Inorganic coatings- Anodizing of Al and phosphating; Metal Coatings-Galvanization and Tinning. Cathodic protection (sacrificial anodic and impressed current methods). **Metal Finishing:** Introduction, Technological importance. **Electroplating:** Introduction, principles governing- Polarization, decomposition potential and overvoltage. Factors influencing the nature of electro deposit-current density, concentration of metal ion and electrolyte; pH, temperature and throwing power of plating bath; additives- brighteners, levellers, structure modifiers and wetting agents. Electroplating of Nickel (Watt's Bath) and Chromium (decorative and hard).	
	<u>Self-Study Components</u>: **Electroless plating:** Introduction, distinction between electroplating and electro less plating, electro less plating of copper and manufacture of double-sided Printed Circuit Board with copper.	
Module 3	**<u>Energy Sources</u>** **Chemical Fuels**: Introduction, classification, calorific value-gross and net calorific values, determination of calorific value of fuel using bomb calorimeter, numerical problems. **Cracking**: Introduction, fluidized catalytic cracking, synthesis of petrol by Fishcher-Tropsch process, reformation of petrol, octane and cetane numbers. Gasoline and diesel knocking and their mechanism, anti-knocking agents, power alcohol and biodiesel. **Solar Energy:** Introduction, utilization and conversion, photovoltaic cells (PV)- construction and working. **Design of PV cells**: modules, panels and arrays. Advantages and disadvantages of PV cells.	**08 Hours**
	<u>Self-Study Components</u>: **Production of solar grade silicon**: Union carbide process, purification of silicon (zone refining), doping of silicon-diffusion technique (n- and p-types). Construction and working of energy storage supercapacitors.	
Module 4	**Water Technology** Introduction**,** Boilers and Boiler Troubles, Determination of hardness, DO, BOD and COD, Determination of acidity, chlorides and alkalinity. **Sewage treatment**: Primary, secondary (activated sludge method) and tertiary methods. Softening of water by ion- exchange process. Desalination of sea water by reverse osmosis and electro dialysis (ion selective) **Silicate Technology** Introduction, Cement nomenclature, manufacture of Portland cement, setting of cement, Analysis of Cement, Plaster of Paris/Gypsum Plaster. **Refractories**: Characteristics of Good Refractory Materials,	**08 Hours**

	Classification of refractories, Properties of Refractories, Manufacture of High-Alumina Bricks, Magnesite Bricks and Zirconia Bricks.	
	Self-Study Components: Public Health Significance of heavy metal ions, fluoride, nitrate and detergents	
Module 5	**Functional Materials for Engineers** **Polymers:** Introduction, Classification of Polymers, Functionality, Mechanism of Polymerisation, Polymerisation Techniques, Molecular Weight of Polymers. Plastics, Individual Polymers, Rubbers (Elastomers), Fibres, Speciality Polymers, Properties of Polymers, Degradation of Polymer and Polymer Composites. **Nanomaterials** Introduction, Nanotechnology in the Twenty-First Century, Classification of Nanomaterials, Synthesis of Nanomaterials by Top-down and Bottom-up approaches, Properties of nanomaterials (Surface area, Magnetic, Optical, Electrical, catalytic and thermal).	**08 Hours**
	Self-Study Components: Carbon nanotubes and Graphene and their applications.	

Course Outcome:

At the end of the course the student will be able to:

- Explain the basic concept of thermodynamics, batteries and their applications.
- Develop the knowledge in corrosion science and also to control corrosion problems.
- Understand different energy sources and storage devisors
- Determine the contaminants in the water samples by suitable analytical procedures.
- Explain the properties and applications of functional materials in the different fields.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.

2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. Essentials of Engineering Chemistry, S. K. Bhasin and Vijay Sharma, Himalaya Publishing House (2010).
2. Engineering Chemistry: Fundamentals and Applications, Shikha Agarwal, Cambridge University Press (2015).
3. Engineering Chemistry, R. Mukhopadhyay and Sriparna Datta, New Age International Ltd (2007).
4. Engineering Chemistry, V. Srinivasan, S. Rekha and K. Sudhakar, Pearson Ltd (2017).
5. Engineering Chemistry, K N Jayaveera, G V Subba Reddy and C Ramachandraiah, McGraw Hill Education (India) Private Limited (2016).
6. Engineering Chemistry, K. SeshaMaheswaramma and MridulaChugh, Pearson India Education Services Pvt. Ltd (2017).
7. Nanomaterials and Nanocomposites: Synthesis, Properties, Characterization Techniques and Applications, Rajendra Kumar Goyal, CRC Press, Taylor and Francis (2018).

Reference Books

1. Fundamentals of Corrosion: Mechanisms, Causes and Preventive Methods, Philip A. Schweitzer, CRC Press (2010).
2. Applied Chemistry- A Textbook for Engineers and Technologists, 2nd Edition, O.V. Roussak and H.D. Gesser, Springer (2013).
3. Introduction to Polymer Chemistry, 3rd Edition, Charles E. Carraher, Jr. CRC Press (2013).
4. Fundamentals of Electrochemistry, Second Edition, V. S. Bagotsky, Wiley Inter science (2006).
5. Introduction to Corrosion Science, E. McCafferty, Springer (2010).

Basic Electrical Engineering (21ELE13/23)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**DC Circuits:** Ohm's Law and Kirchhoff's Laws, analysis of series, parallel and series-parallel circuits excited by independent voltage sources. Power and Energy. **AC Fundamentals:** Generation of sinusoidal voltage, frequency of generated voltage, definition and numerical values of average value, root mean square value, form factor and peak factor of sinusoidally varying voltage and current, phasor representation of alternating quantities.	**08 Hours**
Module 2	**Single Phase Circuits:** Analysis of circuits with R, L, C, R-L, RC, R-L-C for series and parallel configurations with phasor diagram, Real power, reactive power, apparent power and power factor. **Three Phase circuits:** Advantages of 3-phase power, Generation of 3-phase power, voltage and current relations in star and delta connections.	**08 Hours**
Module 3	**Electrical Machines:** Constructional features, Operation and applications: Single and three phase induction motors, universal motor, stepper motor, Single-phase transformers: Principle and emf equation.	**08 Hours**
Module 4	**Renewable and Non-Renewable Energy Resources:**Sources of energy-Power generation: thermal, hydel, nuclear, Advantages of renewable energy sources, power generation Solar, Wind, Tidal, biomass, geothermal, Electrical characteristic of PV Cell.	**08 Hours**
Module 5	**Tariff**: Tariff Schemes, Study of Electricity Bill, Calculation of electricity bill **Protection Devices:** Need of earthing, types of Earthing: Plate and Pipe Earthing, Fuse, MCB, Electrical Safety Issues, Two-way and Three-Way control of lamp. **Battery:** Types of Batteries: lead acid, Nickel-iron and lithium-ion, important characteristic of batteries: Voltage, Capacity and efficiency.	**08 Hours**

Course Outcome:

At the end of the course the students will be able to:

- To explain the fundamental laws of electric circuits and behaviour of single-phase circuit with circuit elements.
- To explain the generation and operation of three-phase power
- To understand the construction and operation of Electrical Machines.
- To Describe the working principle of both renewable and non-renewable power generating plant.
- To explain the tariff, electricity billing, protection devices and batteries.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30 marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. D.C. Kulshreshtha “Basic Electrical Engineering” Tata McGraw Hill Education, Revised first edition, 2019.
2. Edward Hughes “Electrical and Electronic Technology” Pearson, 12th edition, 2016.
3. Mittle V.N. and A. Mittal, “Basic Electrical Engineering” Tata McGraw Hill, 2nd Edition, 2005
4. Kothari D.P., L.J. Nagrath “Basic Electrical Engineering”, Tata McGraw Hill, 2009

C Programming for Problem Solving (21CPS14/24)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Introduction to computer Hardware and Software:** Computer Generations, Von Neumann Architecture, ports & its functions, Port Vs. Connector, Input and Output Devices, Types of Computer Network, basic concepts of software. **Overview of C:** Basic structure of C program, C program execution. Keywords, Constant & Variable, data types, Operators and expressions.	**08 Hours**
Module 2	**Managing Input and output operations in C:** Reading and writing a character, C-formatted I/O Functions, Control statements in C with Programming examples.	**08 Hours**
Module 3	**C Array:** 1-D & 2-D Arrays, return an Array in C, Passing Arrays to a function, Basic Searching & Sorting Algorithms: (Linear search, Binary search, Bubble sort and Selection sort). C Strings: string basics, String Functions.	**08 Hours**
Module 4	**C Functions:** What is function- Advantages, Function aspects, Types of functions, Different aspects of Function call,call by value and call by reference, Programming Examples. Introduction to Recursive function. C Pointers: Pointer basics, Simple programming examples. Dynamic Memory allocation in C.	**08 Hours**
Module 5	**Structure**: What is Structure? declaring structure variable, Accessing Members of the Structure, Programming examples. **File Handling in C:** Functions for file handling, Simple Programming examples.	**08 Hours**

Course Outcomes:

At the end of the course the student will be able to:

- Analyse the given problem and develop an algorithm to solve the problem.
- Optimize the solution given for an existing problem.
- Use ‘C’ language constructs in the right way.
- Develop and test programs written in ‘C’.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE

and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall be three tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
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3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books:

1. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw• Hill
2. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, PrenticeHall of lndia.

Reference Books:

1. Sumitabha Das, Computer Fundamentals & C Programming, Mc Graw Hill Education.
2. Gary JBronson, ANSI C Programming, 4th Edition, Ceneage Leam in g.
3. Dey and Ghosh, Programming in C, 3rd Edition, Oxford University Press.
4. Vikas Gupta: Computer Concepts and C Programming, Dreamtech Press 2013.
5. RS Bichkar, Programming with C, University Press, 2012.
6. V Rajaraman: Computer Programming in C, PHI, 2013.
7. Basavaraj S. Anami, Shanrnukhappa A Angadi, Sunilkumar S. Manvi, Computer Concepts and C Programming: A Holistic Approach to Leaming C, Seond edition, PHI India, 2010.

Elements of Mechanical Engineering (21EME15/25)

Semester I/II			
No. of Lecture hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Energy Sources:** Sources and Classification of Energy Resources. Non-renewable and renewable energy resources, Brief Description and Utilization of Solar Energy, Wind Energy, Ocean Thermal Energy Conversion (OTEC), Geothermal Energy, Tidal Energy and Nuclear Energy. Steam: Steam Formation, Steam Properties, Boilers-Classification, Lancashire boiler, Simple numerical.	**08 Hours**
Module 2	**Steam turbines** – Classification, Principle of Operation and Working of Impulse and Reaction. Type Steam Turbines. **Gas turbines** – Classification, Working Principles and Operations of Open Cycle and Closed Cycle Gas Turbines. **Water turbines** –Classification, Principles and Working of Pelton wheel and Francis turbine **Internal Combustion Engines:** Classification, Two and Four Stroke Petrol and Diesel Engines. P-V Diagramsof Otto and Diesel Cycles. Comparison of Petrol and Diesel Engines. Comparison of two and Four Stroke Engines.	**08 Hours**
Module 3	**Refrigeration Air conditioning:** Refrigeration - Definitions - Refrigerating effect, Ton of Refrigeration, Ice making capacity, COP, relative COP, Unit of Refrigeration. Refrigerants, Properties of refrigerants, List of commonly used refrigerants. Domestic refrigerator. Principles and applications of air conditioners. **Power Transmission:** Belt Drives – Open and Cross Belt drives, Definition-slip, creep, velocity ratio, Derivation of length of the belt in open and crossed belt drive, ratio of tension in belt drives. Gear Drives – Types of gears, velocity ratio, advantages and disadvantages over belt drives. Simple numerical problems.	**08 Hours**
Module 4	**Machine Tools:** Lathe: Working Principle of engine lathe, Main parts of lathe, Operations on lathe: Turning, facing, knurling, thread cutting, taper turning and drilling. **Drilling Machine:** Working Principle, Operations of drilling machines, Drilling, grinding machine: working principle of cylindrical and surface grinding machines.	**08 Hours**

	Metal Joining Processes: Definitions and methods of Soldering, Brazing and Welding	
Module 5	**Automation and Robotics:** Automation: CNC- Introduction, components of CNC, Advantages and disadvantages of CNC. Robotics: Introduction, Robot anatomy, Robots configuration- Polar, cylindrical, Cartesian coordinate and spherical. Applications, Advantages, and disadvantages. **Engineering Materials:** Properties, Composition and Industrial Applications of engineering materials Metals – Ferrous: cast iron, tool steels and stainless steels and Non-ferrous: aluminium, brass, bronze. **Polymers** - Thermoplastics and thermosetting polymers. **Ceramics** - Glass, optical fiber, glass, cermet's.**Composites** - Fiber reinforced composites, Metal Matrix Composites	**08 Hours**

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

- Identify different sources of energy and their conversion process
- Explain the working principle of hydraulic turbines, pumps, IC engines and refrigeration.
- Understand the properties of common engineering materials and their applications in engineering industry.
- Recognize power transmission elements.
- Discuss the working of conventional machine tools, machining processes, tools and accessories.
- Describe the advanced manufacturing systems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain a minimum of 40% marks individually both in CIE and SEE to pass. Theory Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration) and then it is reduced to 50. Based on this grading will be awarded.

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1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.

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Question Paper Pattern (SEE):

- The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
- The question paper will have ten full questions carrying equal marks. Each full question carries 20 marks.
- There will be two full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Text Books

1. Elements of Mechanical Engineering by K.P. Roy, S K Hajra Choudhury, A K Hajra Choudhury, Media Promoters, 2012
2. Elements of Mechanical Engineering b K R Gopalakrishna, Subhash Publishers, Bangalore
3. Elements of Mechanical Engineering - Kestoor Praveen, Ramesh M R: Interline Publishing House

Reference Books

1. Workshop Technology, Vol I & II, - by SK Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy, 11th edition 2001, Media Promotors and Publishers, Mumbai.
2. Elements of Mechanical Engineering by Sadhu Singh S. Chand Publication
3. S.Trymbaka Murthy, "A Text Book of Elements of Mechanical Engineering", 4th Edition2006, Universities Press (India) Pvt Ltd, Hyderabad.

Engineering Chemistry Laboratory (21CHEL16/26)

Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	-	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	01

Sl No.	List of experiments
	Part-A
1	Determination of total hardness in water by complexometric titration.
2	Determination of total alkalinity of soda ash.
3	Analysis of chromate-dichromate mixture by acid-base titration.
4	Determination of manganese dioxide in pyrolusite by permanganate method.
5	Determination of Iron in the Haematite ore by dichromate method.
6	Determination of Chemical Oxygen Demand (COD) of the given industrial waste water sample.
7	Determination of Calcium Oxide (CaO) in the given sample of cement by Rapid EDTA method.
	Part-B
9	Determination of Iron (II) by Potentiometric titration.
10	Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
11	Determination of dissociation constant of a weak acid using pH meter.
12	Colorimetric method for the determination of Iron (III) using thiocyanate.
13	Determination of chromium in industrial waste by colorimetric method using diphenyl carbazide reagent.
14	Electro gravimetric method for the determination of copper.

(Note: Any ten experiments may be conducted)

Course Outcome:

At the end of the course the student will be able to:

- Carryout quantitative determination of analytes accurately and handling of some minor equipment's.
- Validation of the data and interpret the experimental results.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Practical Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation (CIE): The 75% (35 marks) CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and 25% (15 marks) marks for one practical test. The total CIE marks shall be the sum of marks secured by students in the above events.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-12 per batch.

1. All laboratory experiments are to be included for practical examination.
2. The instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Break up of marks are 15% marks for procedure, 70% marks for conduction and calculation and 15% of marks for viva voce.
4. Students can pick one experiment from the questions lot prepared by the examiners.
5. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books

1. Vogels textbook of quantitative chemical analysis, 5th edition revised by G.H.Jeffery, J.Bassett, J. Mendham and R.C.Denny, Longman Scientific Technical (2005).
2. Analytical Chemistry, 6th Edition, G.D.Christian, John Wiley & Sons (2004).
3. Quantitative Chemical Analysis, 8th Edition, Daniel C. Harris, W. H. Freeman and Company (2010).

C Programming Laboratory (21CPL17/27)

Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	-	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	01

Sl No.	Title of the experiment
	Part-A
1	Develop a C program to compute the roots of a quadratic equation by accepting the coefficients. Print appropriate messages.
2	Write a C program to perform arithmetic operations using switch statement.
3	Develop a program to find the reverse of a positive integer and check for palindrome or not using while- loop and display appropriate messages wherever necessary.
4	Develop a C program to generate the first ‘n’ terms of the Fibonacci sequence using for- loop.
5	Develop a C Program to Sort the Array elements in an Ascending Order i. Bubble sort ii. Selection Sort
6	Develop a C Program to search for an element in an array using i. Linear Search ii. Binary Search Display appropriate messages for successful and unsuccessful attempts.
7	Implement a C program using function to check whether the given number is prime or not.
	Part-B
9	Develop a program to introduce 2D Array manipulation and implement Matrix multiplication and ensure the rules of multiplication are checked.
10	Develop a C program to find the square root of a given number N and execute for all possible inputs with appropriate messages. Note: Don’t use library function sqrt(n).
11	Develop a C Program using structure i. To read student information such as (Sname, RollNo, Marks in 3 subjects) ii. Compute average- marks and appropriate grades. (S:98% to 100%, A+: 95 to 97%, A: 94 to 90%, B- 85 to 89%, C- 84% to 80%, D- 79% to 65%, E- >35% to 64%, F: <35%) iii. Print student details along with computed grade for a class of ‘N‘students.
12	Develop a program using pointers to compute the sum, mean and standard deviation of all elements stored in an array of n real numbers.
13	Implement Recursive functions for Binary to Decimal Conversion.
14	Write a C program to copy the contents of one file (t1.txt) to another file (t2.txt).

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

- Analyses of a given problem and implement an algorithm to solve the problem.
- Improve upon a solution to a problem.
- Implement the 'C' language constructs in the right way.
- Develop and test programs written in 'C'.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The student has to obtain minimum of 40% marks individually both in CIE and SEE to pass. Practical Semester End Exam (SEE) is conducted for 100 marks (3 Hours duration). Based on this grading will be awarded.

Continuous Internal Evaluation (CIE): The 75% (35 marks) CIE marks awarded in case of Practical shall be based on the weekly evaluation of laboratory journals/ reports after the conduction of every experiment and 25% (15 marks) marks for one practical test. The total CIE marks shall be the sum of marks secured by students in the above events.

Semester End Evaluation (SEE): The practical examinations to be conducted as per the time table of University in a batch wise with strength of students not more than 10-12 per batch.

1. All laboratory experiments are to be included for practical examination.
2. The instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Break up of marks are 15% marks for procedure, 70% marks for conduction and calculation and 15% of marks for viva voce.
4. Students can pick one experiment from the questions lot prepared by the examiners.
5. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Ability Enhancement Course-I (21AEC18/28)

Personality Development and Soft Skills			
Semester I/II			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	02	**SEE Marks**	-
Total No. of Lecture hours	-	**Exam Hours**	-
L: T:P	0:2:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Personal Skills** Self-Assessment; Identifying Strength & Limitations; Habits, Will-Power and Drives; Developing Self-Esteem and Building Self-Confidence, Significance of Self-Discipline, Understanding Perceptions, Attitudes, and Personality Types Mind-Set: Growth and Fixed; Values and Beliefs, Motivation and Achieving Excellence; Self-Actualisation Need, Goal Setting, Life and Career Planning; Constructive Thinking	**05 Hours**
Module 2	**Professional Skills** Communicating Clearly: Understanding and Overcoming barriers; Cross gender/Cross Cultural communication, Strategic Communication. Active Listening, Persuasive Speaking, Conducting Meetings, Writing Minutes, Sending Memos and Notices, Netiquette: Effective E-mail Communication; Telephone Etiquette, Body Language in Group Discussion and Interview	**05 Hours**
Module 3	**Presentation Skills:** Overcoming fear, Presentation Skills: Becoming a professional, Presentation Skills: the role of body language, Presentation Skills: using visuals, Reading skills: Effective Reading.	**05 Hours**
Module 4	**Interpersonal Skills** Enhancing Empathy, Showing Sympathy and Dealing with Antipathy; Gaining Trust and Developing Emotional Bonding Ethics and Etiquettes (Social and Official Settings); Respecting Privacy; Civic Sense and Care for theEnvironment, Negotiating, Decision-Making, Conflict- Resolution, Five Styles, Emotional Literacy; Assertiveness versus Aggressiveness; Learning to Say "No."; Learning to Appreciate and Give Praise; Presenting Bad News, Humour, Jokes and Anecdotes in Effective Communication	**05 Hours**
Module 5	**Management Skills** Managing Time and Beating Procrastination Managing People: Leading and Working with Team (Co-	**05 Hours**

	ordination and Co-operation); Developing Accountability, Commitment and Responsibility; Behaving Conscientiously Managing Stress and Maintaining Positive Outlook, Managing Health, Boosting Memory, Enhancing Study Skills, Managing Money and Love; Balancing Personal and Professional Life	

Course Outcome:

At the end of the course the student will be able to:

- Understand the role of soft skills in professional and interpersonal communication.
- Develop an all-round development of personality.

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 50%. The student has to obtain a minimum of 40% marks in CIE to pass.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.
3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

Text and Reference Books:

1. Dorch, Patricia, "What Are Sift Skills?" New York: Execu Dress Publisher, 2013.
2. Kamin, Maxine, "Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams and Leaders", Washington, DC: Pfeiffer & Company, 2013.
3. Klaus, Peggy, Jane Rohman & Molly Hamaker," The Hard truth about Soft Skills", London: HarperCollins E- books, 2007.
4. Petes S. J., Francis, "Soft Skills and Professional Communication", New Delhi: Tata McGraw-Hill Education, 2011
5. Stein, Steven J. & Howard E. Book, "The EQ Edge: Emotional Intelligence and Your Success", Canada: Wiley & Sons, 2006.

Technical Kannada (21KAN29)

Semester II (Common for both Physics and Chemistry Cycle)			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	-
Total No. of Lecture hours	-	**Exam Hours**	-
L: T:P	0:2:0	**Credits**	01

Modules	Contents	Teaching Hours
Module 1	1) ಶ್ರಾವಣ (ಕವನ) ದ.ರಾ.ಬೇಂದ್ರೆ 2) ಡಾ. ವಿಶ್ವೇಶ್ವರಯ್ಯ ವ್ಯಕ್ತಿ ಮತ್ತು ಐತಿಹ್ಯ (ವ್ಯಕ್ತಿಚಿತ್ರ) ಎ.ಎನ್. ಮೂರ್ತಿರಾವ್ 3) ದೋಣಿ ಹರಿಗೋಲುಗಳಲ್ಲಿ (ಪ್ರವಾಸ ಕಥನ) ಶಿವರಾಮ ಕಾರಂತ	**06 Hours**
Module 2	4) ಅಣ್ಣಪ್ಪನ ರೇಷ್ಮೆ ಕಾಯಿಲೆ (ಪ್ರಬಂಧ) ಕುವೆಂಪು 5) ನಮ್ಮ ಎಮ್ಮೆಗೆ ಮಾತು ತಿಳಿಯುವುದೇ (ವಿನೋದ) ಗೋರೂರು ರಾಮಸ್ವಾಮಿ ಅಯ್ಯಂಗಾರ್ 6) ಆನೆಹಳ್ಳದಲ್ಲಿ ಹುಡುಗಿಯರು(ವಿಜ್ಞಾನ ಲೇಖನ) ಬಿ.ಜಿ.ಎಲ್ ಸ್ವಾಮಿ	**06 Hours**
Module 3	7) ಬೆಡ್ ನಂ. ಏಳು (ಕತೆ) ತ್ರಿವೇಣಿ 8) ರೊಟ್ಟಿ ಮತ್ತು ಕೋವಿ (ಕವನ) ಸು.ರಂ.ಎಕ್ಕುಂಡಿ 9) ಗುಬ್ಬಚ್ಚಿ ಗೂಡು (ಅಂಕಂ ಬರಹ) ಲಂಕೇಶ್	**06 Hours**
Module 4	10) ಚೀಂಕ್ರ ಮೇಸ್ತ್ರಿ ಮತ್ತು ಹಾವು ಗಿಮೀನು (ಪರಿಸರ ಲೇಖನ) ಕೆ.ಪೂರ್ಣಚಂದ್ರ ತೇಜಸ್ವಿ 11) ಗಾಂಧಿ (ಕತೆ) ಬೆಸಗರಹಳ್ಳಿ ರಾವುಣ್ಣ 12) ಬೆಲ್ಚಿಯ ಹಾಡು (ಕವನ) ಸಿದ್ಧಲಿಂಗಯ್ಯ 13) ಎಲ್ಲ ಹುಡುಗಿಯರ ಕನಸು (ಕವನ) ಸವಿತಾ ನಾಗಭೂಷಣ	**06 Hours**
Module 5	14) ನೀರು (ಕತೆ) ಬಸವರಾಜ ಕುಕ್ಕರಹಳ್ಳಿ 15) ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ ಸ್ವರೂಪ (ಪರಿಚಯ ಲೇಖನ) ರಹಮತ ತರೀಕೆರೆ 16) ತಂತ್ರಜ್ಞಾನ ಕಲಿಕೆಯಲ್ಲಿ ಭಾಷೆ (ತಂತ್ರಜ್ಞಾನ ಬರಹ) ಎಸ್.ಸುಂದರ್ 17) ಕೊಣವೇಗೌಡ (ಕಾವ್ಯ) ಜಾನಪದ	**06 Hours**

Assessment Details (CIE)

The weightage of Continuous Internal Evaluation (CIE) is 50%. The student has to obtain a minimum of 40% marks in CIE to pass.

Continuous Internal Evaluation: The CIE marks for theory part of I year courses shall be 50.

1. Thirty (30) marks shall be considered to evaluate students in tests. There shall bethree tests generally conducted at the end of fifth, tenth and fifteenth week of each semester. Each test shall be conducted for a maximum of 50 marks and the final test marks shall be the average of three tests, proportionately reduced to a maximum of 30marks.
2. Ten (10) marks shall be prescribed for assignments /written quizzes (one scheduled quiz and one surprize quiz). There shall be at least two assignments and two quizzes. The marks earned in these events shall be averaged to reduce to 10 marks.

3. Ten (10) marks shall be prescribed for open book tests, for self-study or to test problem solving skills. There shall be at least two events. The marks earned in these events shall be averaged to reduce to 10 marks.

ABILITY ENHANCEMENT COURSE II (21AEC48)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	CIE Marks	50
No. of Tutorial hours/week	0	SEE Marks	00
Total No. of Lecture hours	16	Exam Hours	00
L: T:P	1:0:0	Credits	01

Modules	Course Content	Teaching Hours
Module 1	**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.	03 Hours
Module 2	**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.	03 Hours
Module 3	**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (Samples of resumes)	03 Hours
Module 4	**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles. Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.	04 Hours
Module 5	**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.	03 Hours

Course Outcomes:

At the end of the course the students will be able to:

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Reference Books:

1. Sanjay Kumar and Pushpalata, „Communication Skills", Oxford University Press. 2018.
2. M. Ashraf Rizvi, „Effective Technical Communication", McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. „Technical Communication", Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.

DIRECTOR
Mysore University
School of Engineering
Manasagangotri, Mysuru - 06

UNIVERSITYOF MYSORE
(Re-accredited by NAAC with 'A' Grade)
(NIRF-2022: Ranked 33rd in University Category and 54th in Overall Category)

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Manasagangotri Campus, Mysuru

Prof. Mahadeva Prasad M
Chairman, Bio Medical and Robotic Engineering

Email:prasada9@gmail.com
Mobile No.8172 290156, 9448411435

No. MUSE/235/2022-23

Dated 13.09.2022

To

The Registrar,
University of Mysore
Crawford Hall
Mysuru.

Sir,

Sub: **Proceeding** of **BoS in Bio Medical and Robotic Engineering-reg**
Ref: No.UA2 /134/2021-22 dated 08.09.2022.

With reference to the above subject, I am herewith enclosing the **Proceeding of Board of Studies in BoS in Bio Medical and Robotic Engineering** held on **13.09.2022** at 10.00 AM along with (1) **Scheme, Syllabus and Regulations, (2) Panel of Examiners for 2022-23** both **hard and soft copies.**

Yours faithfully

(Prof. MahadevaPrasad M)
Chairman
BoS in Bio Medical and Robotic Engineering

Copy to:
The Dy. Registrar (Academic), University of Mysore, Mysuru.

Proceeding of the Board of Studies in Bio Medical and Robotic Engineeringof Mysore University School of Engineering held on 13th Sept. 2022 at at VijnanaBhavan, Manasagangotri, Mysuru – 570 006.

Members Present

1	Prof. Mahadeva Prasad M	Chairman
2	Prof. Ananthapadmanabha T	Member
3	Prof. Chandrashekar M Patil	Member
4	Prof. Bindu A. Thomas	Member
5	Prof. Mahesh Rao	Member
6	Prof. RavichandraKulkarani	Member
7	~~Prof. Ravikumar~~	~~Member~~
8	Prof. Mallikarjun S Holi	Member
9	Dr.M.S. MallikarjunaSwamy	Member

Members Absent : 1) Prof. Ravikumar
2) Prof. M.S. Mallikarjuna Swamy.

The Chairman welcomed the members present in the meeting. The following agenda was taken up for discussion.

Agenda 1: Scheme from III to VIII Semesters for B.E. in Bio Medical and Robotic Engineering.

The Chairman explained that the Scheme has been framed on the lines of guidelines of AICTE/VTU and within the framework of NEP – 2020 from III to VIII. The Scheme to include the Basic Science Courses (BSC), Engineering Science Courses (ESC), Professional Core Courses(PCC), Professional Elective Courses (PEC), Open Elective Courses (OEC), Integrated Professional Core Courses (IPCC), Project Work, Internship (INT), Non-Credit Mandatory Courses (NCMC), Ability Enhancement Course (AEC), Universal Human Value Courses (UHV) and Languages. The Members of the Board examined and approved the Scheme for B.E.Bio Medical and Robotic Engineering from III Semester to VIII Semester within the ambit of 160 credits for the entire B.E. course. The Scheme is enclosed in the **Annexure I.**

Agenda 2: Syllabus for III and IV semesters B.E. Bio Medical and Robotic Engineering

The Members of the Board has examined, discussed and approved the Syllabus for III and IV semester B.E. Bio Medical and Robotic EngineeringCourse. The Syllabus is enclosed in the **Annexure II.**

Agenda 3: Regulations Governing the B.E Courses of Mysore University School of Engineering.

The Board has examined and discussed the draft Regulations Governing the B.E Courses of Mysore University School of Engineering(MUSE). The members of the Board taken note of VTU's implementation of NEP 2020. The Board also examined AICTE's letter dated 06.07.2022 for implementation of Credit Framework for the Movement from Professional/Vocational Education to Engineering and Technology and approve to incorporate the credit framework. The Board approved Regulations which governs B.E. courses of MUSE, UoM and enclosed in the **Annexure III.**

Agenda 4: Panel of Examiners for 2022-23

The Board has prepared and approved Panel of Examiners for the year 2022-23 (**Annexure IV**)

Agenda 5: Any Other subject with the permission of Chair: Nil

The meeting ended with a word of thanks.

(Prof. Mahadeva Prasad M)
Chairman
BoS in Bio Medical and Robotic Engineering

Sl No.	Name	Chairman/ Member	Signature
1	Prof. Mahadeva Prasad M	Chairman	
2	Prof. Ananthapadmanabha T	Member	
3	Prof. Chandrashekar M Patil	Member	13/1/22
4	Prof. Bindu A. Thomas	Member	
5	Prof. Mahesh Rao	Member	
6	Prof. RavichandraKulkarani	Member	
7	Prof. Ravikumar	Member	Not Present.
8	Prof. Mallikarjun S Holi	Member	
9	Dr.M.S. MallikarjunaSwamy	Member	Not Present.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme ofTeachingandExamination2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effectivefromtheacademicyear2021–2022)

B.E. in Biomedical and Robotic Engineering [BR]

III SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT31	Engineering Mathematics-III	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR32	Analog Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR33	Digital Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
4	PCC	21BR34	Basics of Human Anatomy and Physiology	BM & RE	BM & RE	3	0	0	03	50	50	100	3
5	PCC	21BR35	Fundamentals of Robotics	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL36	Analog and Digital Circuit Design Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	CEE	21CIV37	Environmental Studies	CEE	CEE	1	0	0	NA	50	-	50	
8	UHV	21UHV38	Universal Human Values and Professional Ethics	Basic Science	Basic Science	1	0	0	NA	50	-	50	
Total						**16**	**08**	**03**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship

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

9	NCMC	21MATDIP31	Additional Mathematics-1	Basic Science	Basic Science	2	2	0	03	50	50	100	0
10	NCMC	21KANDIP32	Technical Kannada	Basic Science	Basic Science	0	2	0	-	50	-	50	0

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

Credit Definition:
- 1-hour lecture **(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points to be earned by students admitted to BE/B.Tech., day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry toUoM. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

DIRECTOR
Mysore University
School of Engineering
Manasagangotri, Mysuru - 06

MYSORE UNIVERSITYSCHOOLOFENGINEERING

Scheme ofTeachingandExamination2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effectivefromtheacademicyear2021–2022)

B.E. in Biomedical and Robotic Engineering[BR]

IV SEMESTER

Sl. No	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT41	Engineering Mathematics-IV	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR42	Signal Conditioning and Data Acquisition Circuits	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR43	Biomedical Transducers and Instrumentation	BM & RE	BM & RE	3	0	0	03	50	50	100	3
4	IPCC	21BR44	Microcontroller and Embedded Systems	BM & RE	BM & RE	3	0	2	03	50	50	100	4
5	PCC	21BR45	Control Systems	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL46	Signal Conditioning and Biomedical Transducers Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	HSMC	21CPH47	Constitution of India, Professional Ethics and Cyber Law	Basic Science	Basic Science	1	0	0	NA	50	-	50	1
8	HSMC	21AEC48	Ability Enhance Course-II	BM & RE	BM & RE	1	0	0	NA	50	-	50	1
9	INT	21INT49	Summer Internship-I	(To be carried out during the intervening vacations of IV and V semesters)					-	-	-	-	-
Total						**16**	**06**	**05**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship.

Summer Internship-I (21INT59): shall be carried out at industrial (State and Central Government /Non-government organizations (NGOs)/Micro, Small and Medium Enterprise (MSME)/Innovation centers/ Incubation centers. The internship can also be Rural internship. All the students admitted shall have to undergo a mandatory internship of 04 weeks during the intervening vacation of IV and V semesters. A University Viva-Voce examination (Presentation followed by Question & Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)
Summer Internship-I: SEE shall be through seminar and viva-voce.

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

10	NCMC	21MATDIP41	Additional Mathematics-II	Basic Science	Basic Science	02	02	-	03	50	50	100	0
11	NCMC	21ENGDIP42	Technical English	Basic Science	Basic Science	-	2	-	-	50	-	50	0

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

Credit Definition:
- 1-hour lecture**(L)** per week per semester = **1 Credit**
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- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

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

Engineering Mathematics-III [21MAT31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Fourier Series:** Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Application of Practical harmonic analysis.	**08 Hours**
Module 2	**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.	**08 Hours**
Module 3	**Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.	**08 Hours**
Module 4	**Partial Differential Equations (PDE's):** Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation. Solution of one-dimensional heat equation and wave equation by the method of separation of variables.	**08 Hours**
Module 5	**Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares-fitting the curves of the form- $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of Fourier Series, Fourier Transforms, Z-Transforms, Partial Differential Equations, Some concepts of statistical analysis and curve fitting.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2017.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.

Reference Books:

1. Srimanta Pal & Subobh C Bhunia: “Engineering Mathematics”, Oxford University Press, 3rd Reprint, 2016.
2. C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics", 6th Edition, 2. McGrawHill Book Co., New York, 1995.
3. S.S.Sastry: “Introductory Methods of Numerical Analysis”, 11th Edition, Tata McGraw-Hill, 2010
4. N.P.Bali and Manish Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications. Latest edition, 2014.
5. Chandrika Prasad and Reena Garg “Advanced Engineering Mathematics”, Latest edition, Khanna Publishing, 2018.

Additional Mathematics-I [21MATDIP31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Complex V a r i a b l e s :** Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). **Vector Algebra:** Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.	**08 Hours**
Module 2	**Differential Calculus**: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	**08 Hours**
Module 3	**Vector Differentiation**: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vectorfields-Problems.	**08 Hours**
Module 4	**Numerical Methods:** Finite differences. Interpolation/ extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)-Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.	**08 Hours**
Module 5	**Ordinary differential equations (ODE's)**. Introduction-solutions of first order and first-degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of complex trigonometry, differential calculus and vector differentiation, Numerical methods, Ordinary Differential Equations of first order.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering*, 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Analog Circuit Design [21BR32]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**BJT Biasing:** Introduction, operating point, Fixed-bias configuration, Emitter-bias configuration, Voltage-divider biasing, Collector feedback bias, Emitter follower configuration. Current mirror circuits, Bias stabilization.	**08 Hours**
Module 2	**AC Analysis of BJT:** Introduction, BJT modeling, r_e transistor model: Common Emitter and fixed bias configuration, Voltage-divider bias, CE Emitter-bias Configuration, Emitter follower configuration, Cascaded Systems, mention of Cascode & Darlington connection and its application. The Hybrid equivalent model, Approximate Hybrid equivalent circuit: Fixed bias configuration, Voltage-divider configuration, Hybrid π model.	**08 Hours**
Module 3	**FET Biasing:** Introduction, Fixed-bias configuration, Self-bias configuration, Voltage-divider biasing. **FET Amplifiers:** Introduction, JFET Small signal model, JFET AC equivalent circuit, Fixed- bias configuration, Self-bias configuration with by passed source resistance, Voltage-divider configuration, Source follower configuration.	**08 Hours**
Module 4	**BJT and JFET Frequency Response:** Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, High frequency response of BJT Amplifier, High frequency response of FET Amplifier.	**08 Hours**
Module 5	**Power Amplifiers:** Introduction, Series Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier operation. **Class B amplifier circuits:** Transformer-Coupled Push-Pull and Complementary–Symmetry circuits, Amplifier Distortion. **Feedback and Oscillator Circuits:** Feedback concepts, Feedback connection types, effects of negative feedback, Practical feedback circuits: BJT current series and FET voltage shunt feedback configurations. Oscillator operation, Barkhaunsen's criteria, RC phase oscillator using BJT.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Design and implement a biasing circuit for BJT and FET
- Model the BJT/FET amplifier for ac analysis
- Analyze Frequency response of BJT and FET amplifier
- Acquire the knowledge of classifications of Power amplifier and its operation
- Understand the feedback concepts and designing of oscillator circuits

Text and Reference Books:

Text Book:

Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Pearson Prentice Hall, 2009

Reference Books:

1. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008
2. Anil K Maini, VarshaAgarwal, Electronic Devices and Circuits, Wiley, 2012.
3. Jacob Millman, Christos C. Halkias,Integrated Electronics: Analog and Digital Circuits and Systems, McGraw-Hill, 2015

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108105158
3. http://elearning.vtu.ac.in/econtent/ECE.php#
4. http://elearning.vtu.ac.in/econtent/courses/video/ECE/06ES32.html
5. http://elearning.vtu.ac.in/econtent/courses/video/ECE/Analog_Electronics_Lab.html

Digital Circuit Design [21BR33]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial Hours/Week	2	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Principles and Design of Combinational Logic:** Theorems and Properties of Boolean algebra, Boolean Functions, Definition of combinational logic, Canonical forms, Generation of switching equations from Truth Tables, Relevant Problems	**08 Hours**
Module 2	**Karnaugh Maps:** Minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants. Related Problems.	**08 Hours**
Module 3	**Logic Circuit Design:** Arithmetic Operation, Combinational Circuit, Binary Adder, Binary Subtractor, Binary Parallel Adder, The Look-Ahead-Carry Binary Adders, Comparator. **Data Processing:** Introduction, Decoders: One-to-Two Line Decoder, Two-to-Four Line Decoder, Three-to-Eight Line Decoder, Encoders: Four-to-Two Line Encoder, Four-to-Two Line Priority Encoders, Multiplexers: Two-to-One Multiplexer, Four-to-One Multiplexer, Eight-to-One Multiplexer, Cascading of Multiplexer using Enable	**08 Hours**
Module 4	**Latches and Flip-Flops:** Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3, SR Flip Flop, J K Flip Flop, T Flip Flop, Relevant Problems.	**08 Hours**
Module 5	**Design of Sequential Circuits:** Introduction, Notations, Moore and Mealy Sequential Circuits, Analysis of Asynchronous Sequential Circuits. **Registers and Counters:** Introduction, Registers, Shift Registers, Ripple Counters, Synchronous counters, timing sequences, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.	**08 Hours**

Course outcome:

After Studying this course, students will be able to

- Ability to apply the knowledge of mathematics and science to understand the operation of logic circuits and performance parameters.
- Ability to apply the simplification techniques/methods to optimize and implement the digital functions/circuits.
- Ability to analyze the given logic circuit based on the knowledge of digital elements
- Ability to design a combinational and sequential logic circuit for the given requirements/specifications
- Ability to understand and design the State machines with state graphs for sequential design

Text and Reference Books:

Text Books:

1. Charles H. Roth. Jr, Larry L. Kenny, "**Fundamentals of Logic Design**", 7th edition, Cengage Learning, ISBN: 978-1133628477.
2. Morris Mano , "**Digital Logic and Computer Design**", Pearson, 2016, ISBN: 9789332542525.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009, Dremtech Press

Reference Books:

1. Tomas Lang, Jaime H Moreno, "**Introduction to Digital System**", Milos Ercegovac, John Wiley, 2005, ISBN:978-8126522514.
2. John M Yarbrough, "**Digital Logic Applications & Design**", Cengage Delmar Learning India Pvt, 2015, ISBN: 9788131500583.

Basics of Human Anatomy and Physiology [21BR34]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Homeostasis, Tissue, Cartilage:** Levels of structural complexity, The internal environment and homeostasis, Communication, Movement of substances within the body, Body fluids, Cell structure and functions. Tissues: Epithelial tissue (all types), Connective tissue (all types), Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage.	**08 Hours**
Module 2	**Cardiovascular System:** Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, Capillaries. Control of blood vessel diameter, Blood supply- internal respiration, cell nutrition. Heart- position, structure - pericardium, myocardium, endocardium, interior of the heart. Flow of blood through the heart, blood supply to heart. Conducting system of the heart, factors affecting heart rate, Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation-aorta (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, brief explanation with flow diagram only)	**08 Hours**
Module 3	**Nervous System:** Functional Components of nervous system, Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Nerve impulse (action potential). Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: Meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum, Brainstem, Cerebellum, Spinal cord- grey matter, white matter, Spinal nerves (in brief list & functions only), Cranial nerves (in brief list & functions only), Autonomic nervous system (in brief)- functions and effects.	**08 Hours**
Module 4	**Respiratory System:** Organs of respiration, Nose and Nasal cavity- position, structure and functions, Pharynx - position, structure, functions. Larynx - position, structure and functions. Trachea - position, structure, functions, Bronchi, bronchioles and alveoli – structure and functions, Lungs- position, associated structure, pleura and pleural cavity. Respiration - muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity. **Digestive System:** Introduction, Organs of the digestive system, Basic structure of the alimentary canal, Stomach - Structure, gastric juice and functions of stomach.	**08 Hours**
Module 5	**Urinary System:** Introduction, Kidneys – Gross structure of kidney, microscopic structure of kidney, Functions of kidney. **Skeletal System:** Bone - Types of bone, Bone structure, microscopic structure of bone, Functions of bone. Skull bones	**08 Hours**

	(name and position only), Sinuses, Fontanelles, Vertebral column - characteristics of typical vertebra, Different parts of vertebral column (name and position only), Features of vertebral column, Functions of vertebral column. Bones of Thoracic cage (name and position only), Bones of shoulder girdle and upper limb (name and position only), Bones of pelvic girdle and lower limb (name and position only). **Muscles and Joints:** Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue. Types of joint- Fibrous, Cartilaginous, Synovial, Characteristics of synovial joints, shoulder joint, Hip joint, Knee joint.	

Course outcomes:

After Studying this course, students will be able to

- Describe internal environment of human body and explain the fundamental concept of homeostasis.
- Explain the structure and functioning of various types of tissues.
- Describe the structure and explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.
- Demonstrate and analyze various physiological parameters in normal and abnormal conditions.

Text and Reference Books:

Text Books:

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

Reference Books:

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

Fundamentals of Robotics [21BR35]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Robotics:** Introduction to Robotics and Automation technologies, Brief history of robotics, Robot Anatomy, Four common configurations of Robot, Robot motions-Linear, Rotational, Revolving, twisting, Cylindrical, Spherical. **Degrees of Freedom of Robot,** Introduction to degrees of freedom, three degrees of freedom associated with arm and body polar Robot. Three degrees of freedom associated with robot wrist, Joint notation scheme. Work Volume, links and joints. Introduction to End Effectors-types-basic definitions and operations, Spatial Resolution, Accuracy, Repeatability, and Compliance.	**08 Hours**
Module 2	**Robot Control Systems:** Introduction to Mathematical model of spring mass damper system. The Four types of Robot controls: Limited sequence robots, Playback robots with point to point control, playback robots with continuous path control, intelligent control. Robot controllers-On-off, proportional, integral, proportional-plus-integral, proportional-plus-derivative, proportional-plus integral plus derivative.	**08 Hours**
Module 3	**Robot ARM Kinematics:** Introduction to manipulator kinematics, Robot position representation, Forward transformation of a 2-degree of freedom Arm, Reverse Transformation of the 2-Degree of freedom Arm. **Robot ARM Dynamics:** Introduction to robot arm dynamics, understanding of Dynamics using Euler-Lagrangian-formation method. Only Introduction to Denavit–Hartenberg parameters. Simple problems on transformations.	**08 Hours**
Module 4	**Robot Sensors and Actuators: Feedbackcomponents**: Internal state sensors, external state sensors position,velocitysensors, Resolvers, Encoders.Tactile sensor, Force sensors, Joint sensing, Tactile array sensors, Proximity and range sensors, Introduction to functions of Machine vision systems only.	**08 Hours**
Module 5	**Introduction to Robot Programming:**Methods of Robot Programming-Lead through methods, Textural robot languages, Powered lead through, manual lead through. Introduction to generations of Robot Programming Languages-First Generation Languages-Second generation languages. Robot language structure block diagram. Definitions of Robot Language Elements and its functions, Robot Applications in Engineering and Specific applications in healthcare/Biomedical.-Practical demo	**08 Hours**

Course outcomes:

After studying this course, students will able to:

1. Comprehend basic concepts of robot which includes Degrees of freedom, links, joints, robot performances.
2. Develop the control aspect of robotic systems.
3. Analyze the different transformations associated with robot kinematics and robot arm dynamics, motion equations.
4. Illustrate different attributes of robot sensors and actuators.
5. To comprehend the basics/ fundamentals of Robot programming and its structure, to understand the applications of robotics in engineering and healthcare sectors.

Text and Reference Books:

Text Books:

1. Mikell P Groover, Industrial Robotics-Technology, Programming and Applications 2nd edition, Tata McGraw Hill
2. Robert J Schilling, Fundamentals of Robotics,2003.
3. Richard D.Klafter, Robotics Engg. PHI, 2003.
4. R.K.Mittal and J.Nagarath, Robotics and Control,Tata McGraw Hill, Year 1995.

Reference Books:

1. K.S.Fu, R.C.Gonzales and Lee. Robotics, McGraw Hill International, 2008.
2. Ganesh S Hegde, Industrial Robotics –Second Edition.

Analog and Digital Circuit Design Lab [21BRL36]

Semester III			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

List of Experiments

Sl No.	Course Content
1.	Study and plot the input and output characterises of CE transistor
2.	Study and plot the drain and transfer characteristics of FET
3.	Find the Efficiency and ripple factor of full-wave bridge rectifier
4.	Study the frequency response of CE amplifier with and without bypass capacitor
5.	Study the frequency response of CC amplifier and find the input and output impedances.
6.	Study of BJT based RC-Phase Shift Oscillator
Circuit Analysis using PSpice/Multisim	
7.	Analysis of voltage-divider biasing of BJT and FET.
8.	Analysis of two-stage RC-Coupled CE amplifier
9.	AC analysis of BJT with Voltage divider and Darlington configurations
10.	Analysis of frequency response of voltage divider biased single stage BJT and FET.
11.	Study of FET based Colpits and Hartley and oscillator
12.	Analysis of Series-FED Class A and Complementary Push-Pull Amplifiers

Course Outcome

After Studying this course, students will be able to

- Design and Test rectifiers circuits
- Design and Test BJT/JFET biasing circuits.
- Plot the frequency response of amplifier circuits
- Analyze the limitation in bandwidth of single stage and multi stage amplifier.
- Simulate and analyze amplifier, oscillator and power amplifier circuits using PSpice.

Digital Circuit Design Lab

Sl. No.	Course Content
List of Experiments	
1	Simplification, realization of Boolean expressions using logic gates and Universal gates.
2	Realization of half and full adders, half and full subtractor using logic gates.
3	(a) Realization of parallel adder and parallel subtractor using 7483 chip (b) Demonstration of BCD to Excess–3 code conversion and vice versa.
4	Application of the IC's – MUX–74153 for half and full adders, DEMUX – 74139 for 3 – bit binary to Gray and BCD to Excess–3 code converters.
5	Realization of 2 – bit comparator using gates and basic operational study of Priority encoder using 74147
6	Operational verification of Flip–Flops: (i) T type (ii) D type and iii) J–K Master slave.
7	Realization of 3 bit binary, and modulo N counters and display the count on seven segment display.
8	Realization of Shift left, Shift right, SIPO, SISO, PISO, PIPO register operations using 7495
9	Design and implementation of Multiplexer and De-multiplexer using logic gates
10	Design and implementation of encoder and decoder using logic gates
11	Design and implementation of 3-bit synchronous up/down counter
12	Design the Ring counters and Johnson counter.

Open ended Experiments:

1. Design and implement a circuit to synthesize clock signal of given frequency.
2. Design and implement a circuit to count event and latch it.
3. Design and implement a circuit to control traffic signal (Simple function).

Course Outcome

After Studying this course, students will be able to

- Analyzeand optimize the logic circuit for given Booleanexpressions.
- Design and Implement combinational digital circuits
- Design and Implement Sequential digital circuits
- Design and Develop a logic circuit for given problem.

Environmental Studies (21CIV37)

Semester III (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Environment - Components of Environment **Ecosystem**: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. **Impacts**: Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development.	**03 Hours**
Module 2	**Natural Resources, Water resources –** Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **Energy** – Different types of energy, Conventional sources &Non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	**04 Hours**
Module 3	**Environmental Pollution** – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. **Global Environmental Issues:** Population Growth, Urbanization, Land Management, Water & Waste Water Management	**03 Hours**
Module 4	**Air Pollution & Automobile Pollution:** Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. **Solid Waste Management**, E –Source, Segregation, Transportation, and Waste Treatment and Management &**Biomedical Waste Management** - Sources, Characteristics & Disposal methods.	**03 Hours**
Module 5	Applications of GIS & Remote Sensing and Smart Technologies in Environmental Engineering Practices. **Environmental Legislations:** Acts, Rules& Regulations, Role of government, Legal aspects, Role of Nongovernmental Organizations (NGOs), Environmental Education & Women Education.	**03 Hours**

Course outcomes:

After Studying this course, students will be able to

- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- Demonstrate Solid Waste Management.
- Apply knowledge and technology in environmental practices
- Build inquisitiveness to protect environment through societal interventions

Text Books:

1. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2005.
2. R.J.Ranjit Daniels and JagadishKrishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, 2009.
3. R Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford University Press, 2005.
4. Aloka Debi, “Environmental Science and Engineering”, Universities Press (India) Pvt. Ltd. 2012.

Universal Human Value and Professional Ethics [21UHV39]

Semester III			
No. of Teaching hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	16	**Exam Hours**	-
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	**03 Hours**
Module 2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	**03 Hours**
Module 3	**Harmony in the Family and Society:** Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	**03 Hours**
Module 4	**Harmony in the Nature/Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	**03 Hours**
Module 5	**Implications of the Holistic Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	**04 Hours**

Course outcomes:

The course and further follow up is expected to positively impact common graduate attributes like:

- Holistic vision of life
- Socially responsible behaviour and Environmentally responsible work
- Ethical human conduct.

- Having Competence and Capabilities for Maintaining Health and Hygiene
- Appreciation and aspiration for excellence (merit) and gratitude for all

Textbook and Reference Books :

1. R R Gaur, R Asthana, G P Bagaria,The Textbook "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 447-1 b.
2. R R Gaur, R Asthana,The Teacher's Manual for "A Foundation Course in Human Values and Professional Ethics"

Engineering Mathematics-IV [21MAT41]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Calculus of complex functions:** Review of function of a complex variables, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. **Construction of analytic functions:** Milne-Thomson method-Problems.	**08 Hours**
Module 2	**Conformal transformations:** Introduction. Discussion of transformations:$w = z^2$, $w = e^z$, $w = z + {}^{1}_{z}(z \text{ G } 0)$. Bilinear transformations- Problems. **Complex integration:** Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.	**08 Hours**
Module 3	**Numerical Solutions of Ordinary Differential Equations (ODE's):** Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae)-Problems. Numerical Solution of Second Order ODE's - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).	**08 Hours**
Module 4	**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.	**08 Hours**
Module 5	**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance. **Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.	**08 Hours**

Course outcomes: At the end of the course the students will be able to:

- Explain the concepts of integral calculus, higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Additional Mathematics-II [21MATDIP41]

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Integral Calculus**: Review of elementary integral calculus. Reduction formulae for $sin^n x, cos^n x$ (with proof) and $sin^m x cos^n x$(without proof) and evaluation of these with standard limits-Examples. Double integrals-Simple examples. Beta and Gamma functions- Simple problems	**08 Hours**
Module 2	**Higher order ODE's:** Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. [Particular Integral restricted to$R(x) = e^{ax}, \sin ax / \cos axforf(D)y = R(x)$].	**08 Hours**
Module 3	**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only)-problems. Inverse Laplace Transform: Inverse Laplace transforms by method of partial fractions, Convolution theorem to find the inverse Laplace transforms. Solution of linear differential equations using Laplace transforms.	**08 Hours**
Module 4	**Introduction to Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability, Bayes's theorem, problems.	**08 Hours**
Module 5	**Linear Algebra:** Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the concepts of integral calculus, Higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

4. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.

Reference Books:

1. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
2. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Signal Conditioning and Data Acquisition Circuits [21BR42]

SemesterIV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems). **Operational Amplifier Characteristics:** DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. **Basic op-amp applications:** Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	**08 Hours**
Module 2	**Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator. **Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astablemutivibrator, Monostablemultivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).	**08 Hours**
Module 3	**Voltage Regulators:**Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator. **Active filters:**First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).	**08 Hours**
Module 4	**555 Timer:** Description of Functional Diagram, Monostable operation, Applications of MonostableMultivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of AstableMultivibrator: FSK Generator and Pulse Position Modulation. **Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation	**08 Hours**
Module 5	**Data Acquisition Systems:**Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system. Single channel and Multi-channel data acquisition. **Data Converters:**Digital to AnalogConverters:Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only).	**08 Hours**

	Analog to Digital Converters:Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications	

Course outcomes:

After Studying this course, students will be able to

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

Text and Reference Books:

Text Books:

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

Reference Books:

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

Biomedical Transducers and Instrumentation [21BR43]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Measurement, Functional Elements of Measurement System and Transducers:** Measurement, Significance of measurement, Instruments and measurement systems, Electronic instruments, Analog and digital modes of operation, Functions of instruments and measurement systems, Applications of measurement systems, Basic medical instrumentation system, Performance requirements of medical instrumentation systems, PC based medical instruments, General constraints in design of medical instrumentation systems. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	**08 Hours**
Module 2	**Bioelectric Signals and Electrodes:**Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes– Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.	**08 Hours**
Module 3	**Measurement of Displacement:** Introduction, Principles of Transduction: Variable resistance devices, Variable Inductance Transducer, Synchros and Resolvers, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Strain:** Introduction, Electrical Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, Semiconductor strain gauges (principle, types & list of characteristics only), Materials for strain gauges. Wheatstone bride circuit for strain gauges, Applications.	**08 Hours**
Module 4	**Measurement of Temperature**: Introduction, Resistance type temperature sensors, Platinum resistance thermometer, Thermistors (principle, types & characteristics), Thermocouples, Solid state sensors – principle and working of AD590 (characteristics and features), and LM35 (characteristics and features), Quartz thermometer, Temperature measurement by radiation methods, Optical pyrometer. **Measurement of Force**: Introduction, Force measuring sensor – Load cells – Column type devices, Proving rings, Cantilever beam,Hydraulic load cell, Electronic weighing system.	**08 Hours**
Module 5	**Flow Measurement**: Introduction, Classification of Flow Meters, Head type flow meters – Orifice meter and Venturi	**08 Hours**

	tube, Rotameter, Electromagnetic Flow Meter, Ultrasonic flow meter, Laser anemometer, Rotor torque mass flow meter. **Measurement of Pressure**: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle, schematic & working, no derivation), Piezoelectric pressure transducer, Pressure multiplexer.	

Course outcomes:

At the end of the course the student will be able to:

- Define the measurement, instrument, transducer, and explain the basic medical instrumentation system.
- Explain the principle, construction and working of transducers for the measurement of displacement and strain.
- Discuss the principle, construction and working of transducers for the measurement of temperature and force.
- Illustrate the methods for the measurement of flow and pressure.
- Use the above transducers for the measurement of physiological signals.

Text and Reference Books:

Textbooks:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.(Module-1).
2. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003. (Module-1 & 2)
3. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3, 4 & 5).

Reference Books:

1. Electronic Instrumentation and Measurements - David A Bell, 3rd Edition, Oxford University Press, 2013.
2. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
3. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
4. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.

Microcontroller and Embedded Systems [21BR44]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Microprocessors versus Microcontrollers, ARM Embedded Systems:** The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions	**08 Hours**
Module 2	**Introduction to the ARM Instruction Set :** Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs	**08 Hours**
Module 3	**Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.	**08 Hours**
Module 4	**Embedded System Design Concepts:** Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes,non-operational quality attributes, Embedded 08 Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development.	**08 Hours**
Module 5	**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues-Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment-Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Describe the architectural features and instructions of ARM microcontroller

- Apply the knowledge gained for Programming ARM for different applications.
- Interface external devices and I/O with ARM microcontroller.
- Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware /software co-design and firmware design approaches.
- Demonstrate the need of real time operating system for embedded system applications

Text and Reference Books:

Text Books:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider‟s Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Microcontroller and Embedded Systems Lab

Sl. No.	Course Content
	List of Experiments
PART A: Conduct the following experiments by writing program using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool.	
1	Write a program to multiply two 16 bit binary numbers
2	Write a program to find the sum of first 10 integer numbers.
3	Write a program to find factorial of a number
4	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers .
7	Write a program to arrange a series of 32 bit numbers in ascending/descending order.
8	Write a program to count the number of ones and zeros in two consecutive memory locations.
PART –B Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.	
9	Display "Hello World" message using Internal UART.
10	Interface and Control a DC Motor.
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13	Interface a DAC and generate Triangular and Square waveforms.
14	Interface a 4x4 keyboard and display the key code on an LCD.
15	Demonstrate the use of an external interrupt to toggle an LED On/Off
16	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Control Systems [21BR45]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Modelling of Systems and Block diagram: I**ntroduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modelling of physical systems-Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics. Introduction to Simulation package for practical component.	**08 Hours**
Module 2	**Signal Flow graph:** Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula. Time response analysis: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.	**08 Hours**
Module 3	**Concepts of stability:** The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion. The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique. Numerical problems on all topics.	**08 Hours**
Module 4	**Frequency domain Analysis:** Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. Numerical problems on all topics. Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics.	**08 Hours**
Module 5	**State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase Variables. Derivation of transfer functions from the state model. Numerical problems on all topics.	**08 Hours**

PRACTICAL COMPONENT: Using suitable simulation software, demonstrate the operation of the following:

1. Determination of time response specification of a first order, second order and third order system taking suitable transfer functions.
2. Determination of time response specification of a second order underdamped system, for different damping factors.
3. Determination of frequency response of a second order System

4. Determination of frequency response of a lead lag compensator
5. Using suitable simulation package, plot Root locus plot for the given transfer function and analyse for stability.
6. Using suitable simulation package, plot Bode plot for the given transfer function and analyse for stability.
7. Using suitable simulation package, plot Nyquist plot for the given transfer function and analyse for stability.
8. Using suitable simulation package, obtain the time response from state model of a system.

Course outcomes:

After studying this course, students will able to:

- Apply modelling knowledge in implementation physical systems.
- Understand the reduction of block diagram &analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis

Text and Reference Books:

Text Books:

1. I.J. Nagarath and M. Gopal, "Control Systems Engineering",5th edition,New Age International (P) Limited, Publishers,– 2012.
2. K. Ogata, "Modern Control Engineering",4thEdition, Pearson Education Asia/ PHI, 2002

Reference Books:

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

Signal Conditioning and Biomedical Transduers Lab [21BRL46]

Semester IV			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

Sl. No.	Course Content
1	To design and implement • Inverting Amplifier and Inverting Attenuator • Non-Inverting Amplifier and Voltage Follower
2	To realize • Full wave Precision rectifier • Voltage regulator using IC 723
3	To design and implement • Butterworth I order Low-pass filter • Butterworth II order High-pass filter
4	To design and implement • RC Phase shift oscillator • Wein Bridge oscillator
5	To realize • ZCD • Positive and Negative Voltage level detectors
6	To design and implement • AstableMultivibrator using 555 timer • Mono-stable Multivibrator using 555 timer
7	To realizeSample and Hold circuit using discrete components
8	To realizeProgrammable Gain Amplifier using Analog Mux
9	Measurement of displacement using LVDT and finding the sensitivity & resolution.
10	Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.
11	Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity.
12	Temperature measurement using AD590/LM35: Plotting the characteristics and finding their sensitivity.

Course outcomes:

After studying this course, students will able to;

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

Text and Reference Books:

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

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & CYBER LAW (21CPH47)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Indian Constitution:** Definition ofConstitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the ConstituentAssembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	03 Hours
Module 2	**Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's):**Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP"s and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.	03 Hours
Module 3	**Union Executive:** Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	03 Hours
Module 4	**State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	03 Hours
Module 5	**Professional Ethics:** Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. **Cyber Laws:** Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. **Computer & Cyber Security:** (a) Types of Attacks, (b) Network Security (c) Overview of Security threats, (d) Hacking Techniques, (e) Password cracking (f) Insecure Network connections, (g) Malicious code (h) Concept of Fire wall Security	04 Hours

DIRECTOR
Mysore University
School of Engineering
...gangotri, Mysuru - 06

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

- Have constitutional knowledge and legal literacy.

- Understand Engineering and Professional ethics and responsibilities of Engineers.
- Understand cyber threats & cyber laws, acts and their powers.

Reference Books:

1. Shubham Singla, „Constitution of India, Professional Ethics & Human Rights", CENGAGE Publications 2018.
2. Cyber Law & Cyber Crimes by Advocate Prashant Mali; Snow White publications, Mumbai.
3. Cyber Law in India by Farooq Ahmad; Pioneer Books.

ABILITY ENHANCEMENT COURSE II (21AEC48)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.	**03 Hours**
Module 2	**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.	**03 Hours**
Module 3	**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (Samples of resumes)	**03 Hours**
Module 4	**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles. Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.	**04 Hours**
Module 5	**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.	**03 Hours**

Course Outcomes:

At the end of the course the students will be able to:

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Reference Books:

1. Sanjay Kumar and Pushpalata, „Communication Skills", Oxford University Press. 2018.
2. M. Ashraf Rizvi, „Effective Technical Communication", McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. „Technical Communication", Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.

DIRECTOR
Mysore University
School of Engineering
Manasagangotri, Mysuru - 06

UNIVERSITYOF MYSORE
(Re-accredited by NAAC with 'A' Grade)
(NIRF-2022: Ranked 33rd in University Category and 54th in Overall Category)

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Manasagangotri Campus, Mysuru

Prof. Mahadeva Prasad M
Chairman, Bio Medical and Robotic Engineering

Email:prasada9@gmail.com
Mobile No.8172 290156, 9448411435

No. MUSE/235/2022-23

Dated 13.09.2022

To

The Registrar,
University of Mysore
Crawford Hall
Mysuru.

Sir,

Sub: **Proceeding** of **BoS in Bio Medical and Robotic Engineering-reg**
Ref: No.UA2 /134/2021-22 dated 08.09.2022.

With reference to the above subject, I am herewith enclosing the **Proceeding of Board of Studies in BoS in Bio Medical and Robotic Engineering** held on **13.09.2022** at 10.00 AM along with (1) **Scheme, Syllabus and Regulations, (2) Panel of Examiners for 2022-23** both **hard and soft copies.**

Yours faithfully

(Prof. MahadevaPrasad M)
Chairman
BoS in Bio Medical and Robotic Engineering

Copy to:
The Dy. Registrar (Academic), University of Mysore, Mysuru.

Proceeding of the Board of Studies in Bio Medical and Robotic Engineeringof Mysore University School of Engineering held on 13th Sept. 2022 at at VijnanaBhavan, Manasagangotri, Mysuru – 570 006.

Members Present

1	Prof. Mahadeva Prasad M	Chairman
2	Prof. Ananthapadmanabha T	Member
3	Prof. Chandrashekar M Patil	Member
4	Prof. Bindu A. Thomas	Member
5	Prof. Mahesh Rao	Member
6	Prof. RavichandraKulkarani	Member
7	~~Prof. Ravikumar~~	~~Member~~
8	Prof. Mallikarjun S Holi	Member
9	Dr.M.S. MallikarjunaSwamy	Member

Members Absent : 1) Prof. Ravikumar
2) Prof. M.S. Mallikarjuna Swamy.

The Chairman welcomed the members present in the meeting. The following agenda was taken up for discussion.

Agenda 1: Scheme from III to VIII Semesters for B.E. in Bio Medical and Robotic Engineering.

The Chairman explained that the Scheme has been framed on the lines of guidelines of AICTE/VTU and within the framework of NEP – 2020 from III to VIII. The Scheme to include the Basic Science Courses (BSC), Engineering Science Courses (ESC), Professional Core Courses(PCC), Professional Elective Courses (PEC), Open Elective Courses (OEC), Integrated Professional Core Courses (IPCC), Project Work, Internship (INT), Non-Credit Mandatory Courses (NCMC), Ability Enhancement Course (AEC), Universal Human Value Courses (UHV) and Languages. The Members of the Board examined and approved the Scheme for B.E.Bio Medical and Robotic Engineering from III Semester to VIII Semester within the ambit of 160 credits for the entire B.E. course. The Scheme is enclosed in the **Annexure I.**

Agenda 2: Syllabus for III and IV semesters B.E. Bio Medical and Robotic Engineering

The Members of the Board has examined, discussed and approved the Syllabus for III and IV semester B.E. Bio Medical and Robotic EngineeringCourse. The Syllabus is enclosed in the **Annexure II.**

Agenda 3: Regulations Governing the B.E Courses of Mysore University School of Engineering.

The Board has examined and discussed the draft Regulations Governing the B.E Courses of Mysore University School of Engineering(MUSE). The members of the Board taken note of VTU's implementation of NEP 2020. The Board also examined AICTE's letter dated 06.07.2022 for implementation of Credit Framework for the Movement from Professional/Vocational Education to Engineering and Technology and approve to incorporate the credit framework. The Board approved Regulations which governs B.E. courses of MUSE, UoM and enclosed in the **Annexure III.**

Agenda 4: Panel of Examiners for 2022-23

The Board has prepared and approved Panel of Examiners for the year 2022-23 (**Annexure IV**)

Agenda 5: Any Other subject with the permission of Chair: Nil

The meeting ended with a word of thanks.

(Prof. Mahadeva Prasad M)
Chairman
BoS in Bio Medical and Robotic Engineering

Sl No.	Name	Chairman/ Member	Signature
1	Prof. Mahadeva Prasad M	Chairman	
2	Prof. Ananthapadmanabha T	Member	
3	Prof. Chandrashekar M Patil	Member	13/1/22
4	Prof. Bindu A. Thomas	Member	
5	Prof. Mahesh Rao	Member	
6	Prof. RavichandraKulkarani	Member	
7	Prof. Ravikumar	Member	Not Present.
8	Prof. Mallikarjun S Holi	Member	
9	Dr.M.S. MallikarjunaSwamy	Member	Not Present.

MYSORE UNIVERSITY SCHOOL OF ENGINEERING

Scheme ofTeachingandExamination2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effectivefromtheacademicyear2021–2022)

B.E. in Biomedical and Robotic Engineering [BR]

III SEMESTER

Sl. No.	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT31	Engineering Mathematics-III	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR32	Analog Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR33	Digital Circuit Design	BM & RE	BM & RE	3	2	0	03	50	50	100	4
4	PCC	21BR34	Basics of Human Anatomy and Physiology	BM & RE	BM & RE	3	0	0	03	50	50	100	3
5	PCC	21BR35	Fundamentals of Robotics	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL36	Analog and Digital Circuit Design Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	CEE	21CIV37	Environmental Studies	CEE	CEE	1	0	0	NA	50	-	50	
8	UHV	21UHV38	Universal Human Values and Professional Ethics	Basic Science	Basic Science	1	0	0	NA	50	-	50	
Total						**16**	**08**	**03**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship

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

9	NCMC	21MATDIP31	Additional Mathematics-1	Basic Science	Basic Science	2	2	0	03	50	50	100	0
10	NCMC	21KANDIP32	Technical Kannada	Basic Science	Basic Science	0	2	0	-	50	-	50	0

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

Credit Definition:
- 1-hour lecture **(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

AICTE Activity Points to be earned by students admitted to BE/B.Tech., day college programme (For more details refer to Chapter 6, AICTE Activity Point Programme, Model Internship Guidelines): Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry toUoM. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, the minimum hours' requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

DIRECTOR
Mysore University
School of Engineering
Manasagangotri, Mysuru - 06

MYSORE UNIVERSITYSCHOOLOFENGINEERING

Scheme ofTeachingandExamination2021-2022 (As per NEP-2020)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effectivefromtheacademicyear2021–2022)

B.E. in Biomedical and Robotic Engineering[BR]

IV SEMESTER

Sl. No	Course & Course Code		Course Title	Teaching Dept.	Paper Setting Board	Teaching Hours/week			Examination				Credits
						Theory/Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P					
1	BSC	21MAT41	Engineering Mathematics-IV	Basic Science	Basic Science	2	2	0	03	50	50	100	3
2	PCC	21BR42	Signal Conditioning and Data Acquisition Circuits	BM & RE	BM & RE	3	2	0	03	50	50	100	4
3	PCC	21BR43	Biomedical Transducers and Instrumentation	BM & RE	BM & RE	3	0	0	03	50	50	100	3
4	IPCC	21BR44	Microcontroller and Embedded Systems	BM & RE	BM & RE	3	0	2	03	50	50	100	4
5	PCC	21BR45	Control Systems	BM & RE	BM & RE	3	2	0	03	50	50	100	4
6	IPCC	21BRL46	Signal Conditioning and Biomedical Transducers Lab	BM & RE	BM & RE	0	0	3	03	50	50	100	2
7	HSMC	21CPH47	Constitution of India, Professional Ethics and Cyber Law	Basic Science	Basic Science	1	0	0	NA	50	-	50	1
8	HSMC	21AEC48	Ability Enhance Course-II	BM & RE	BM & RE	1	0	0	NA	50	-	50	1
9	INT	21INT49	Summer Internship-I	(To be carried out during the intervening vacations of IV and V semesters)					-	-	-	-	-
Total						**16**	**06**	**05**	**18**	**400**	**300**	**700**	**22**

Note: BSC: Basic Science Courses, PCC: Professional Core Courses, IPCC: Professional Lab Courses, CEE: Civil Environmental Engineering, UHV: Universal Human Values, HSMC: Humanity, Social Science and Management Courses. NCMC: Non-credit mandatory course, INT: Internship.

Summer Internship-I (21INT59): shall be carried out at industrial (State and Central Government /Non-government organizations (NGOs)/Micro, Small and Medium Enterprise (MSME)/Innovation centers/ Incubation centers. The internship can also be Rural internship. All the students admitted shall have to undergo a mandatory internship of 04 weeks during the intervening vacation of IV and V semesters. A University Viva-Voce examination (Presentation followed by Question & Answer session) shall be conducted during V semester and the prescribed credit shall be included in the V semester. The internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements. (The faculty coordinator or mentor has to monitor the students' internship progress and interact to guide them for the successful completion of the internship.)
Summer Internship-I: SEE shall be through seminar and viva-voce.

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

10	NCMC	21MATDIP41	Additional Mathematics-II	Basic Science	Basic Science	02	02	-	03	50	50	100	0
11	NCMC	21ENGDIP42	Technical English	Basic Science	Basic Science	-	2	-	-	50	-	50	0

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

Credit Definition:
- 1-hour lecture**(L)** per week per semester = **1 Credit**
- 2-hour tutorial **(T)** per week per semester = **1 Credit**
- 2-hour Practical/Drawing **(P)** per week per semester = **1 Credit**

- **Four-credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **25** hours of Teaching-Learning process.
- **One credit** courses is to be designed for **15** hours of Teaching-Learning process.

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

Engineering Mathematics-III [21MAT31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Fourier Series:** Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Application of Practical harmonic analysis.	**08 Hours**
Module 2	**Fourier Transforms:** Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.	**08 Hours**
Module 3	**Difference Equations and Z-Transforms:** Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.	**08 Hours**
Module 4	**Partial Differential Equations (PDE's):** Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only. Solution of Lagrange's linear PDE. Derivation of one-dimensional heat equation and wave equation. Solution of one-dimensional heat equation and wave equation by the method of separation of variables.	**08 Hours**
Module 5	**Statistical Methods:** Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems. **Curve Fitting:** Curve fitting by the method of least squares-fitting the curves of the form- $y = ax + b$, $y = ax^b$ and $y = ax^2 + bx + c$.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of Fourier Series, Fourier Transforms, Z-Transforms, Partial Differential Equations, Some concepts of statistical analysis and curve fitting.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. E. Kreyszig: Advanced Engineering Mathematics, John Wiley & Sons, 10th Ed.(Reprint), 2017.
2. B.S. Grewal: Higher Engineering Mathematics, Khanna Publishers, 44th Ed., 2017.
3. B.V.Ramana: "Higher Engineering Mathematics" 11th Edition, Tata McGraw-Hill, 2010.

Reference Books:

1. Srimanta Pal & Subobh C Bhunia: “Engineering Mathematics”, Oxford University Press, 3rd Reprint, 2016.
2. C.Ray Wylie, Louis C.Barrett : “Advanced Engineering Mathematics", 6th Edition, 2. McGrawHill Book Co., New York, 1995.
3. S.S.Sastry: “Introductory Methods of Numerical Analysis”, 11th Edition, Tata McGraw-Hill, 2010
4. N.P.Bali and Manish Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications. Latest edition, 2014.
5. Chandrika Prasad and Reena Garg “Advanced Engineering Mathematics”, Latest edition, Khanna Publishing, 2018.

Additional Mathematics-I [21MATDIP31]

Semester III			
No. of Teaching hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Complex V a r i a b l e s :** Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof). **Vector Algebra:** Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.	**08 Hours**
Module 2	**Differential Calculus**: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.	**08 Hours**
Module 3	**Vector Differentiation**: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vectorfields-Problems.	**08 Hours**
Module 4	**Numerical Methods:** Finite differences. Interpolation/ extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)-Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.	**08 Hours**
Module 5	**Ordinary differential equations (ODE's)**. Introduction-solutions of first order and first-degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the basic concepts of complex trigonometry, differential calculus and vector differentiation, Numerical methods, Ordinary Differential Equations of first order.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text Books:

1. S C Chapra and R P Canale, *Numerical Methods for Engineering*, 15th Edition, Tata McGraw Hill
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
3. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
4. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Analog Circuit Design [21BR32]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**BJT Biasing:** Introduction, operating point, Fixed-bias configuration, Emitter-bias configuration, Voltage-divider biasing, Collector feedback bias, Emitter follower configuration. Current mirror circuits, Bias stabilization.	**08 Hours**
Module 2	**AC Analysis of BJT:** Introduction, BJT modeling, r_e transistor model: Common Emitter and fixed bias configuration, Voltage-divider bias, CE Emitter-bias Configuration, Emitter follower configuration, Cascaded Systems, mention of Cascode & Darlington connection and its application. The Hybrid equivalent model, Approximate Hybrid equivalent circuit: Fixed bias configuration, Voltage-divider configuration, Hybrid π model.	**08 Hours**
Module 3	**FET Biasing:** Introduction, Fixed-bias configuration, Self-bias configuration, Voltage-divider biasing. **FET Amplifiers:** Introduction, JFET Small signal model, JFET AC equivalent circuit, Fixed- bias configuration, Self-bias configuration with by passed source resistance, Voltage-divider configuration, Source follower configuration.	**08 Hours**
Module 4	**BJT and JFET Frequency Response:** Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, High frequency response of BJT Amplifier, High frequency response of FET Amplifier.	**08 Hours**
Module 5	**Power Amplifiers:** Introduction, Series Fed Class A Amplifier, Transformer-Coupled Class A Amplifier, Class B Amplifier operation. **Class B amplifier circuits:** Transformer-Coupled Push-Pull and Complementary–Symmetry circuits, Amplifier Distortion. **Feedback and Oscillator Circuits:** Feedback concepts, Feedback connection types, effects of negative feedback, Practical feedback circuits: BJT current series and FET voltage shunt feedback configurations. Oscillator operation, Barkhaunsen's criteria, RC phase oscillator using BJT.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Design and implement a biasing circuit for BJT and FET
- Model the BJT/FET amplifier for ac analysis
- Analyze Frequency response of BJT and FET amplifier
- Acquire the knowledge of classifications of Power amplifier and its operation
- Understand the feedback concepts and designing of oscillator circuits

Text and Reference Books:

Text Book:

Robert L Boylestad and Louis Nashelsky, Electronic Devices and Circuit Theory, 10th Edition, Pearson Prentice Hall, 2009

Reference Books:

1. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008
2. Anil K Maini, VarshaAgarwal, Electronic Devices and Circuits, Wiley, 2012.
3. Jacob Millman, Christos C. Halkias,Integrated Electronics: Analog and Digital Circuits and Systems, McGraw-Hill, 2015

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/108102112
2. https://nptel.ac.in/courses/108105158
3. http://elearning.vtu.ac.in/econtent/ECE.php#
4. http://elearning.vtu.ac.in/econtent/courses/video/ECE/06ES32.html
5. http://elearning.vtu.ac.in/econtent/courses/video/ECE/Analog_Electronics_Lab.html

Digital Circuit Design [21BR33]

Semester III			
No. of Teaching Hour/Week	3	**CIE Marks**	50
No. of Tutorial Hours/Week	2	**SEE Marks**	50
Total No. of Lecture Hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Principles and Design of Combinational Logic:** Theorems and Properties of Boolean algebra, Boolean Functions, Definition of combinational logic, Canonical forms, Generation of switching equations from Truth Tables, Relevant Problems	**08 Hours**
Module 2	**Karnaugh Maps:** Minimum forms of switching functions, two and three variable Karnaugh maps, four variable Karnaugh maps, determination of minimum expressions using essential prime implicants, Quine-McClusky Method: determination of prime implicants. Related Problems.	**08 Hours**
Module 3	**Logic Circuit Design:** Arithmetic Operation, Combinational Circuit, Binary Adder, Binary Subtractor, Binary Parallel Adder, The Look-Ahead-Carry Binary Adders, Comparator. **Data Processing:** Introduction, Decoders: One-to-Two Line Decoder, Two-to-Four Line Decoder, Three-to-Eight Line Decoder, Encoders: Four-to-Two Line Encoder, Four-to-Two Line Priority Encoders, Multiplexers: Two-to-One Multiplexer, Four-to-One Multiplexer, Eight-to-One Multiplexer, Cascading of Multiplexer using Enable	**08 Hours**
Module 4	**Latches and Flip-Flops:** Set Reset Latch, Gated Latches, Edge-Triggered D Flip Flop 3, SR Flip Flop, J K Flip Flop, T Flip Flop, Relevant Problems.	**08 Hours**
Module 5	**Design of Sequential Circuits:** Introduction, Notations, Moore and Mealy Sequential Circuits, Analysis of Asynchronous Sequential Circuits. **Registers and Counters:** Introduction, Registers, Shift Registers, Ripple Counters, Synchronous counters, timing sequences, shift registers, design of Binary counters, counters for other sequences, counter design using SR and J K Flip Flops.	**08 Hours**

Course outcome:

After Studying this course, students will be able to

- Ability to apply the knowledge of mathematics and science to understand the operation of logic circuits and performance parameters.
- Ability to apply the simplification techniques/methods to optimize and implement the digital functions/circuits.
- Ability to analyze the given logic circuit based on the knowledge of digital elements
- Ability to design a combinational and sequential logic circuit for the given requirements/specifications
- Ability to understand and design the State machines with state graphs for sequential design

Text and Reference Books:

Text Books:

1. Charles H. Roth. Jr, Larry L. Kenny, "**Fundamentals of Logic Design**", 7th edition, Cengage Learning, ISBN: 978-1133628477.
2. Morris Mano , "**Digital Logic and Computer Design**", Pearson, 2016, ISBN: 9789332542525.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009, Dremtech Press

Reference Books:

1. Tomas Lang, Jaime H Moreno, "**Introduction to Digital System**", Milos Ercegovac, John Wiley, 2005, ISBN:978-8126522514.
2. John M Yarbrough, "**Digital Logic Applications & Design**", Cengage Delmar Learning India Pvt, 2015, ISBN: 9788131500583.

Basics of Human Anatomy and Physiology [21BR34]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Homeostasis, Tissue, Cartilage:** Levels of structural complexity, The internal environment and homeostasis, Communication, Movement of substances within the body, Body fluids, Cell structure and functions. Tissues: Epithelial tissue (all types), Connective tissue (all types), Cartilage- Hyaline cartilage, Fibrocartilage, Elastic cartilage.	**08 Hours**
Module 2	**Cardiovascular System:** Introduction, Blood vessels- Arteries and Arterioles, Veins and Venules, Capillaries. Control of blood vessel diameter, Blood supply- internal respiration, cell nutrition. Heart- position, structure - pericardium, myocardium, endocardium, interior of the heart. Flow of blood through the heart, blood supply to heart. Conducting system of the heart, factors affecting heart rate, Cardiac cycle, cardiac output, blood pressure, control of blood pressure, pulse and factors affecting the pulse rate. Circulation of the blood- pulmonary circulation, systemic circulation-aorta (different parts of aorta & their blood supply, in brief). Summary of the main blood vessels (arteries & veins, brief explanation with flow diagram only)	**08 Hours**
Module 3	**Nervous System:** Functional Components of nervous system, Neurons: Properties of neurons, Cell bodies, Axon and Dendrites, Nerve impulse (action potential). Types of nerves, Synapse and neurotransmitters, neuromuscular junction. Central nervous system: Meninges, ventricles of the brain and CSF. Brain: Cerebrum, functions of cerebrum, functional areas of the cerebrum, Brainstem, Cerebellum, Spinal cord- grey matter, white matter, Spinal nerves (in brief list & functions only), Cranial nerves (in brief list & functions only), Autonomic nervous system (in brief)- functions and effects.	**08 Hours**
Module 4	**Respiratory System:** Organs of respiration, Nose and Nasal cavity- position, structure and functions, Pharynx - position, structure, functions. Larynx - position, structure and functions. Trachea - position, structure, functions, Bronchi, bronchioles and alveoli – structure and functions, Lungs- position, associated structure, pleura and pleural cavity. Respiration - muscles of respiration, cycle of respiration, variables affecting respiration, lung volumes and capacity. **Digestive System:** Introduction, Organs of the digestive system, Basic structure of the alimentary canal, Stomach - Structure, gastric juice and functions of stomach.	**08 Hours**
Module 5	**Urinary System:** Introduction, Kidneys – Gross structure of kidney, microscopic structure of kidney, Functions of kidney. **Skeletal System:** Bone - Types of bone, Bone structure, microscopic structure of bone, Functions of bone. Skull bones	**08 Hours**

	(name and position only), Sinuses, Fontanelles, Vertebral column - characteristics of typical vertebra, Different parts of vertebral column (name and position only), Features of vertebral column, Functions of vertebral column. Bones of Thoracic cage (name and position only), Bones of shoulder girdle and upper limb (name and position only), Bones of pelvic girdle and lower limb (name and position only). **Muscles and Joints:** Muscle tissue: Skeletal muscle, Smooth muscle, Cardiac muscle, functions of muscle tissue. Types of joint- Fibrous, Cartilaginous, Synovial, Characteristics of synovial joints, shoulder joint, Hip joint, Knee joint.	

Course outcomes:

After Studying this course, students will be able to

- Describe internal environment of human body and explain the fundamental concept of homeostasis.
- Explain the structure and functioning of various types of tissues.
- Describe the structure and explain the functioning of various nervous system, cardiovascular system, respiratory system, digestive system and musculoskeletal system.
- Demonstrate and analyze various physiological parameters in normal and abnormal conditions.

Text and Reference Books:

Text Books:

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

Reference Books:

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

Fundamentals of Robotics [21BR35]

Semester III			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Robotics:** Introduction to Robotics and Automation technologies, Brief history of robotics, Robot Anatomy, Four common configurations of Robot, Robot motions-Linear, Rotational, Revolving, twisting, Cylindrical, Spherical. **Degrees of Freedom of Robot,** Introduction to degrees of freedom, three degrees of freedom associated with arm and body polar Robot. Three degrees of freedom associated with robot wrist, Joint notation scheme. Work Volume, links and joints. Introduction to End Effectors-types-basic definitions and operations, Spatial Resolution, Accuracy, Repeatability, and Compliance.	**08 Hours**
Module 2	**Robot Control Systems:** Introduction to Mathematical model of spring mass damper system. The Four types of Robot controls: Limited sequence robots, Playback robots with point to point control, playback robots with continuous path control, intelligent control. Robot controllers-On-off, proportional, integral, proportional-plus-integral, proportional-plus-derivative, proportional-plus integral plus derivative.	**08 Hours**
Module 3	**Robot ARM Kinematics:** Introduction to manipulator kinematics, Robot position representation, Forward transformation of a 2-degree of freedom Arm, Reverse Transformation of the 2-Degree of freedom Arm. **Robot ARM Dynamics:** Introduction to robot arm dynamics, understanding of Dynamics using Euler-Lagrangian-formation method. Only Introduction to Denavit–Hartenberg parameters. Simple problems on transformations.	**08 Hours**
Module 4	**Robot Sensors and Actuators: Feedbackcomponents**: Internal state sensors, external state sensors position,velocitysensors, Resolvers, Encoders.Tactile sensor, Force sensors, Joint sensing, Tactile array sensors, Proximity and range sensors, Introduction to functions of Machine vision systems only.	**08 Hours**
Module 5	**Introduction to Robot Programming:**Methods of Robot Programming-Lead through methods, Textural robot languages, Powered lead through, manual lead through. Introduction to generations of Robot Programming Languages-First Generation Languages-Second generation languages. Robot language structure block diagram. Definitions of Robot Language Elements and its functions, Robot Applications in Engineering and Specific applications in healthcare/Biomedical.-Practical demo	**08 Hours**

Course outcomes:

After studying this course, students will able to:

1. Comprehend basic concepts of robot which includes Degrees of freedom, links, joints, robot performances.
2. Develop the control aspect of robotic systems.
3. Analyze the different transformations associated with robot kinematics and robot arm dynamics, motion equations.
4. Illustrate different attributes of robot sensors and actuators.
5. To comprehend the basics/ fundamentals of Robot programming and its structure, to understand the applications of robotics in engineering and healthcare sectors.

Text and Reference Books:

Text Books:

1. Mikell P Groover, Industrial Robotics-Technology, Programming and Applications 2nd edition, Tata McGraw Hill
2. Robert J Schilling, Fundamentals of Robotics,2003.
3. Richard D.Klafter, Robotics Engg. PHI, 2003.
4. R.K.Mittal and J.Nagarath, Robotics and Control,Tata McGraw Hill, Year 1995.

Reference Books:

1. K.S.Fu, R.C.Gonzales and Lee. Robotics, McGraw Hill International, 2008.
2. Ganesh S Hegde, Industrial Robotics –Second Edition.

Analog and Digital Circuit Design Lab [21BRL36]

Semester III			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

List of Experiments

Sl No.	Course Content
1.	Study and plot the input and output characterises of CE transistor
2.	Study and plot the drain and transfer characteristics of FET
3.	Find the Efficiency and ripple factor of full-wave bridge rectifier
4.	Study the frequency response of CE amplifier with and without bypass capacitor
5.	Study the frequency response of CC amplifier and find the input and output impedances.
6.	Study of BJT based RC-Phase Shift Oscillator
Circuit Analysis using PSpice/Multisim	
7.	Analysis of voltage-divider biasing of BJT and FET.
8.	Analysis of two-stage RC-Coupled CE amplifier
9.	AC analysis of BJT with Voltage divider and Darlington configurations
10.	Analysis of frequency response of voltage divider biased single stage BJT and FET.
11.	Study of FET based Colpits and Hartley and oscillator
12.	Analysis of Series-FED Class A and Complementary Push-Pull Amplifiers

Course Outcome

After Studying this course, students will be able to

- Design and Test rectifiers circuits
- Design and Test BJT/JFET biasing circuits.
- Plot the frequency response of amplifier circuits
- Analyze the limitation in bandwidth of single stage and multi stage amplifier.
- Simulate and analyze amplifier, oscillator and power amplifier circuits using PSpice.

Digital Circuit Design Lab

Sl. No.	Course Content
List of Experiments	
1	Simplification, realization of Boolean expressions using logic gates and Universal gates.
2	Realization of half and full adders, half and full subtractor using logic gates.
3	(a) Realization of parallel adder and parallel subtractor using 7483 chip (b) Demonstration of BCD to Excess–3 code conversion and vice versa.
4	Application of the IC's – MUX–74153 for half and full adders, DEMUX – 74139 for 3 – bit binary to Gray and BCD to Excess–3 code converters.
5	Realization of 2 – bit comparator using gates and basic operational study of Priority encoder using 74147
6	Operational verification of Flip–Flops: (i) T type (ii) D type and iii) J–K Master slave.
7	Realization of 3 bit binary, and modulo N counters and display the count on seven segment display.
8	Realization of Shift left, Shift right, SIPO, SISO, PISO, PIPO register operations using 7495
9	Design and implementation of Multiplexer and De-multiplexer using logic gates
10	Design and implementation of encoder and decoder using logic gates
11	Design and implementation of 3-bit synchronous up/down counter
12	Design the Ring counters and Johnson counter.

Open ended Experiments:

1. Design and implement a circuit to synthesize clock signal of given frequency.
2. Design and implement a circuit to count event and latch it.
3. Design and implement a circuit to control traffic signal (Simple function).

Course Outcome

After Studying this course, students will be able to

- Analyzeand optimize the logic circuit for given Booleanexpressions.
- Design and Implement combinational digital circuits
- Design and Implement Sequential digital circuits
- Design and Develop a logic circuit for given problem.

Environmental Studies (21CIV37)

Semester III (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction:** Environment - Components of Environment **Ecosystem**: Types & Structure of Ecosystem, Balanced ecosystem Human Activities – Food, Shelter, And Economic & Social Security. **Impacts**: Impacts of Agriculture & Housing Impacts of Industry, Mining & Transportation Environmental Impact Assessment, Sustainable Development.	**03 Hours**
Module 2	**Natural Resources, Water resources –** Availability & Quality aspects, Water borne diseases & water induced diseases, Fluoride problem in drinking water Mineral resources, Forest Wealth Material Cycles – Carbon Cycle, Nitrogen Cycle & Sulphur Cycle. **Energy** – Different types of energy, Conventional sources &Non-Conventional sources of energy Solar energy, Hydro electric energy, Wind Energy, Nuclear energy, Biomass & Biogas Fossil Fuels, Hydrogen as an alternative energy.	**04 Hours**
Module 3	**Environmental Pollution** – Water Pollution, Noise pollution, Land Pollution, Public Health Aspects. **Global Environmental Issues:** Population Growth, Urbanization, Land Management, Water & Waste Water Management	**03 Hours**
Module 4	**Air Pollution & Automobile Pollution:** Definition, Effects – Global Warming, Acid rain & Ozone layer depletion, controlling measures. **Solid Waste Management**, E –Source, Segregation, Transportation, and Waste Treatment and Management &**Biomedical Waste Management** - Sources, Characteristics & Disposal methods.	**03 Hours**
Module 5	Applications of GIS & Remote Sensing and Smart Technologies in Environmental Engineering Practices. **Environmental Legislations:** Acts, Rules& Regulations, Role of government, Legal aspects, Role of Nongovernmental Organizations (NGOs), Environmental Education & Women Education.	**03 Hours**

Course outcomes:

After Studying this course, students will be able to

- Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.
- Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- Demonstrate Solid Waste Management.
- Apply knowledge and technology in environmental practices
- Build inquisitiveness to protect environment through societal interventions

Text Books:

1. Benny Joseph, “Environmental Studies”, Tata McGraw – Hill Publishing Company Limited, 2005.
2. R.J.Ranjit Daniels and JagadishKrishnaswamy, “Environmental Studies”, Wiley India Private Ltd., New Delhi, 2009.
3. R Rajagopalan, “Environmental Studies – From Crisis to Cure”, Oxford University Press, 2005.
4. Aloka Debi, “Environmental Science and Engineering”, Universities Press (India) Pvt. Ltd. 2012.

Universal Human Value and Professional Ethics [21UHV39]

Semester III			
No. of Teaching hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	-
Total No. of Lecture hours	16	**Exam Hours**	-
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Value Education:** Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations	**03 Hours**
Module 2	**Harmony in the Human Being:** Understanding Human being as the Co-existence of the Self and the Body, Distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health	**03 Hours**
Module 3	**Harmony in the Family and Society:** Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society, Vision for the Universal Human Order	**03 Hours**
Module 4	**Harmony in the Nature/Existence:** Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence	**03 Hours**
Module 5	**Implications of the Holistic Understanding – a Look at Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-Typical Case Studies, Strategies for Transition towards Value-based Life and Profession	**04 Hours**

Course outcomes:

The course and further follow up is expected to positively impact common graduate attributes like:

- Holistic vision of life
- Socially responsible behaviour and Environmentally responsible work
- Ethical human conduct.

- Having Competence and Capabilities for Maintaining Health and Hygiene
- Appreciation and aspiration for excellence (merit) and gratitude for all

Textbook and Reference Books :

1. R R Gaur, R Asthana, G P Bagaria,The Textbook "A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 447-1 b.
2. R R Gaur, R Asthana,The Teacher's Manual for "A Foundation Course in Human Values and Professional Ethics"

Engineering Mathematics-IV [21MAT41]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Calculus of complex functions:** Review of function of a complex variables, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in Cartesian and polar forms and consequences. **Construction of analytic functions:** Milne-Thomson method-Problems.	**08 Hours**
Module 2	**Conformal transformations:** Introduction. Discussion of transformations:$w = z^2$, $w = e^z$, $w = z + {}^{1}_{z}(z \text{ G } 0)$. Bilinear transformations- Problems. **Complex integration:** Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.	**08 Hours**
Module 3	**Numerical Solutions of Ordinary Differential Equations (ODE's):** Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's predictor and corrector method (No derivations of formulae)-Problems. Numerical Solution of Second Order ODE's - Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).	**08 Hours**
Module 4	**Probability Distributions:** Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.	**08 Hours**
Module 5	**Joint probability distribution:** Joint Probability distribution for two discrete random variables, expectation and covariance. **Sampling Theory:** Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.	**08 Hours**

Course outcomes: At the end of the course the students will be able to:

- Explain the concepts of integral calculus, higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

Reference Books:

1. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.
2. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
3. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Additional Mathematics-II [21MATDIP41]

Semester IV			
No. of Lecture hour/Week	2	**CIE Marks**	50
No. of Tutorial hours/week	1	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	2:1:0	**Credits**	00

Modules	Course Content	Teaching Hours
Module 1	**Integral Calculus**: Review of elementary integral calculus. Reduction formulae for $sin^n x, cos^n x$ (with proof) and $sin^m x cos^n x$(without proof) and evaluation of these with standard limits-Examples. Double integrals-Simple examples. Beta and Gamma functions- Simple problems	**08 Hours**
Module 2	**Higher order ODE's:** Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. [Particular Integral restricted to$R(x) = e^{ax}, \sin ax / \cos axforf(D)y = R(x)$].	**08 Hours**
Module 3	**Laplace Transform:** Definition and Laplace transforms of elementary functions (statements only)-problems. Inverse Laplace Transform: Inverse Laplace transforms by method of partial fractions, Convolution theorem to find the inverse Laplace transforms. Solution of linear differential equations using Laplace transforms.	**08 Hours**
Module 4	**Introduction to Probability:** Introduction. Sample space and events. Axioms of probability. Addition and multiplication theorems. Conditional probability, Bayes's theorem, problems.	**08 Hours**
Module 5	**Linear Algebra:** Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.	**08 Hours**

Course outcomes:

At the end of the course the students will be able to:

- Explain the concepts of integral calculus, Higher order differential equations, Laplace transforms, Probability and Linear Algebra.
- Apply the above concepts of the syllabus in their respective branches of engineering.
- Analyse the solutions of engineering problems using these concepts.

Text and Reference Books:

Text Books:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, Latest edition, Wiley Publications.
2. B.S. Grewal, *Higher Engineering Mathematics*, Latest edition, Khanna Publishers.
3. B.V. Ramana, *Higher Engineering Mathematics*, Latest edition, Tata McGraw Hill.

4. Srimanta Pal & Subodh C. Bhunia: *"Engineering Mathematics"* Oxford University Press, 3rd Reprint, 2016.

Reference Books:

1. N.P Bali and Manish Goyal: *"A textbook of Engineering Mathematics"* Laxmi Publications, Latest edition.
2. H.K.Dass and Er. Rajnish Verma: *"Higher Engineering Mathematics"* S.Chand Publication (2014).

Signal Conditioning and Data Acquisition Circuits [21BR42]

SemesterIV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems). **Operational Amplifier Characteristics:** DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. **Basic op-amp applications:** Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	**08 Hours**
Module 2	**Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator. **Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astablemutivibrator, Monostablemultivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).	**08 Hours**
Module 3	**Voltage Regulators:**Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator. **Active filters:**First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).	**08 Hours**
Module 4	**555 Timer:** Description of Functional Diagram, Monostable operation, Applications of MonostableMultivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of AstableMultivibrator: FSK Generator and Pulse Position Modulation. **Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation	**08 Hours**
Module 5	**Data Acquisition Systems:**Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system. Single channel and Multi-channel data acquisition. **Data Converters:**Digital to AnalogConverters:Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only).	**08 Hours**

	Analog to Digital Converters:Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications	

Course outcomes:

After Studying this course, students will be able to

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

Text and Reference Books:

Text Books:

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

Reference Books:

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

Biomedical Transducers and Instrumentation [21BR43]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:0	**Credits**	03

Modules	Course Content	Teaching Hours
Module 1	**Measurement, Functional Elements of Measurement System and Transducers:** Measurement, Significance of measurement, Instruments and measurement systems, Electronic instruments, Analog and digital modes of operation, Functions of instruments and measurement systems, Applications of measurement systems, Basic medical instrumentation system, Performance requirements of medical instrumentation systems, PC based medical instruments, General constraints in design of medical instrumentation systems. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	**08 Hours**
Module 2	**Bioelectric Signals and Electrodes:**Sources of Biomedical Signals, Origin of Bioelectric Signals, Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), Electrooculogram (EOG), Electroretinogram (ERG), Recording Electrodes– Electrode-tissue interface, Electrolyte-Skin interface, polarization, skin contact impedance, motion artifacts, Silver-Silver Chloride electrodes, Electrodes for ECG, Electrodes for EEG, Electrodes of EMG, Electrical conductivity of electrode jellies and creams, microelectrodes.	**08 Hours**
Module 3	**Measurement of Displacement:** Introduction, Principles of Transduction: Variable resistance devices, Variable Inductance Transducer, Synchros and Resolvers, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Strain:** Introduction, Electrical Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, Semiconductor strain gauges (principle, types & list of characteristics only), Materials for strain gauges. Wheatstone bride circuit for strain gauges, Applications.	**08 Hours**
Module 4	**Measurement of Temperature**: Introduction, Resistance type temperature sensors, Platinum resistance thermometer, Thermistors (principle, types & characteristics), Thermocouples, Solid state sensors – principle and working of AD590 (characteristics and features), and LM35 (characteristics and features), Quartz thermometer, Temperature measurement by radiation methods, Optical pyrometer. **Measurement of Force**: Introduction, Force measuring sensor – Load cells – Column type devices, Proving rings, Cantilever beam,Hydraulic load cell, Electronic weighing system.	**08 Hours**
Module 5	**Flow Measurement**: Introduction, Classification of Flow Meters, Head type flow meters – Orifice meter and Venturi	**08 Hours**

	tube, Rotameter, Electromagnetic Flow Meter, Ultrasonic flow meter, Laser anemometer, Rotor torque mass flow meter. **Measurement of Pressure**: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle, schematic & working, no derivation), Piezoelectric pressure transducer, Pressure multiplexer.	

Course outcomes:

At the end of the course the student will be able to:

- Define the measurement, instrument, transducer, and explain the basic medical instrumentation system.
- Explain the principle, construction and working of transducers for the measurement of displacement and strain.
- Discuss the principle, construction and working of transducers for the measurement of temperature and force.
- Illustrate the methods for the measurement of flow and pressure.
- Use the above transducers for the measurement of physiological signals.

Text and Reference Books:

Textbooks:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.(Module-1).
2. Handbook of Biomedical Instrumentation- R S Khandpur, 2nd edition, Tata McGraw Hill, 2003. (Module-1 & 2)
3. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3, 4 & 5).

Reference Books:

1. Electronic Instrumentation and Measurements - David A Bell, 3rd Edition, Oxford University Press, 2013.
2. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
3. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
4. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.

Microcontroller and Embedded Systems [21BR44]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:0:1	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Microprocessors versus Microcontrollers, ARM Embedded Systems:** The RISC design philosophy, The ARM Design Philosophy, Embedded System Hardware, Embedded System Software. ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline, Exceptions, Interrupts, and the Vector Table , Core Extensions	**08 Hours**
Module 2	**Introduction to the ARM Instruction Set :** Data Processing Instructions , Programme Instructions, Software Interrupt Instructions, Program Status Register Instructions, Coprocessor Instructions, Loading Constants ARM programming using Assembly language: Writing Assembly code, Profiling and cycle counting, instruction scheduling, Register Allocation, Conditional Execution, Looping Constructs	**08 Hours**
Module 3	**Embedded System Components:** Embedded Vs General computing system, History of embedded systems, Classification of Embedded systems, Major applications areas of embedded systems, purpose of embedded systems Core of an Embedded System including all types of processor/controller, Memory, Sensors, Actuators, LED, 7 segment LED display, stepper motor, Keyboard, Push button switch, Communication Interface (onboard and external types), Embedded firmware, Other system components.	**08 Hours**
Module 4	**Embedded System Design Concepts:** Characteristics and Quality Attributes of Embedded Systems, Operational quality attributes,non-operational quality attributes, Embedded 08 Systems-Application and Domain specific, Hardware Software Co-Design and Program Modelling, embedded firmware design and development.	**08 Hours**
Module 5	**RTOS and IDE for Embedded System Design:** Operating System basics, Types of operating systems, Task, process and threads (Only POSIX Threads with an example program), Thread preemption, Multiprocessing and Multitasking, Task Communication (without any program), Task synchronization issues-Racing and Deadlock, Concept of Binary and counting semaphores (Mutex example without any program), How to choose an RTOS, Integration and testing of Embedded hardware and firmware, Embedded system Development Environment-Block diagram (excluding Keil), Disassembler/decompiler, simulator, emulator and debugging techniques, target hardware debugging, boundary scan.	**08 Hours**

Course outcomes:

After Studying this course, students will be able to

- Describe the architectural features and instructions of ARM microcontroller

- Apply the knowledge gained for Programming ARM for different applications.
- Interface external devices and I/O with ARM microcontroller.
- Interpret the basic hardware components and their selection method based on the characteristics and attributes of an embedded system.
- Develop the hardware /software co-design and firmware design approaches.
- Demonstrate the need of real time operating system for embedded system applications

Text and Reference Books:

Text Books:

1. Andrew N Sloss, Dominic Symes and Chris Wright, ARM system developers guide, Elsevier, Morgan Kaufman publishers, 2008.
2. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education, Private Limited, 2nd Edition.

Reference Books:

1. Raghunandan.G.H, Microcontroller (ARM) and Embedded System, Cengage learning Publication,2019
2. The Insider‟s Guide to the ARM7 Based Microcontrollers, Hitex Ltd.,1st edition, 2005.
3. Steve Furber, ARM System-on-Chip Architecture, Second Edition, Pearson, 2015.
4. Raj Kamal, Embedded System, Tata McGraw-Hill Publishers, 2nd Edition, 2008.

Microcontroller and Embedded Systems Lab

Sl. No.	Course Content
	List of Experiments
PART A: Conduct the following experiments by writing program using ARM7TDMI/LPC2148 using an evaluation board/simulator and the required software tool.	
1	Write a program to multiply two 16 bit binary numbers
2	Write a program to find the sum of first 10 integer numbers.
3	Write a program to find factorial of a number
4	Write a program to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5	Write a program to find the square of a number (1 to 10) using look-up table.
6	Write a program to find the largest/smallest number in an array of 32 numbers .
7	Write a program to arrange a series of 32 bit numbers in ascending/descending order.
8	Write a program to count the number of ones and zeros in two consecutive memory locations.
PART –B Conduct the following experiments on an ARM7TDMI/LPC2148 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.	
9	Display "Hello World" message using Internal UART.
10	Interface and Control a DC Motor.
11	Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
12	Determine Digital output for a given Analog input using Internal ADC of ARM controller.
13	Interface a DAC and generate Triangular and Square waveforms.
14	Interface a 4x4 keyboard and display the key code on an LCD.
15	Demonstrate the use of an external interrupt to toggle an LED On/Off
16	Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.

Control Systems [21BR45]

Semester IV			
No. of Teaching hour/Week	3	**CIE Marks**	50
No. of Tutorial hours/week	2	**SEE Marks**	50
Total No. of Lecture hours	40	**Exam Hours**	03
L: T:P	3:1:0	**Credits**	04

Modules	Course Content	Teaching Hours
Module 1	**Modelling of Systems and Block diagram: I**ntroduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modelling of physical systems-Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics. Introduction to Simulation package for practical component.	**08 Hours**
Module 2	**Signal Flow graph:** Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula. Time response analysis: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.	**08 Hours**
Module 3	**Concepts of stability:** The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion. The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique. Numerical problems on all topics.	**08 Hours**
Module 4	**Frequency domain Analysis:** Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. Numerical problems on all topics. Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics.	**08 Hours**
Module 5	**State space Analysis:** Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase Variables. Derivation of transfer functions from the state model. Numerical problems on all topics.	**08 Hours**

PRACTICAL COMPONENT: Using suitable simulation software, demonstrate the operation of the following:

1. Determination of time response specification of a first order, second order and third order system taking suitable transfer functions.
2. Determination of time response specification of a second order underdamped system, for different damping factors.
3. Determination of frequency response of a second order System

4. Determination of frequency response of a lead lag compensator
5. Using suitable simulation package, plot Root locus plot for the given transfer function and analyse for stability.
6. Using suitable simulation package, plot Bode plot for the given transfer function and analyse for stability.
7. Using suitable simulation package, plot Nyquist plot for the given transfer function and analyse for stability.
8. Using suitable simulation package, obtain the time response from state model of a system.

Course outcomes:

After studying this course, students will able to:

- Apply modelling knowledge in implementation physical systems.
- Understand the reduction of block diagram &analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis

Text and Reference Books:

Text Books:

1. I.J. Nagarath and M. Gopal, "Control Systems Engineering",5th edition,New Age International (P) Limited, Publishers,– 2012.
2. K. Ogata, "Modern Control Engineering",4thEdition, Pearson Education Asia/ PHI, 2002

Reference Books:

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

Signal Conditioning and Biomedical Transduers Lab [21BRL46]

Semester IV			
No. of Lecture hour/Week	-	**CIE Marks**	50
No. of Tutorial hours/week	-	**SEE Marks**	50
Total No. of Lecture hours	03	**Exam Hours**	03
L: T:P	0:0:2	**Credits**	02

Sl. No.	Course Content
1	To design and implement • Inverting Amplifier and Inverting Attenuator • Non-Inverting Amplifier and Voltage Follower
2	To realize • Full wave Precision rectifier • Voltage regulator using IC 723
3	To design and implement • Butterworth I order Low-pass filter • Butterworth II order High-pass filter
4	To design and implement • RC Phase shift oscillator • Wein Bridge oscillator
5	To realize • ZCD • Positive and Negative Voltage level detectors
6	To design and implement • AstableMultivibrator using 555 timer • Mono-stable Multivibrator using 555 timer
7	To realizeSample and Hold circuit using discrete components
8	To realizeProgrammable Gain Amplifier using Analog Mux
9	Measurement of displacement using LVDT and finding the sensitivity & resolution.
10	Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.
11	Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity.
12	Temperature measurement using AD590/LM35: Plotting the characteristics and finding their sensitivity.

Course outcomes:

After studying this course, students will able to;

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

Text and Reference Books:

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

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS & CYBER LAW (21CPH47)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Introduction to Indian Constitution:** Definition ofConstitution, Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the ConstituentAssembly. Preamble of Indian Constitution & Key concepts of the Preamble. Salient features of India Constitution.	03 Hours
Module 2	**Fundamental Rights (FR's), Directive Principles of State Policy (DPSP's) and Fundamental Duties (FD's):**Fundamental Rights and its Restriction and limitations in different Complex Situations. DPSP"s and its present relevance in Indian society. Fundamental Duties and its Scope and significance in Nation building.	03 Hours
Module 3	**Union Executive:** Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.	03 Hours
Module 4	**State Executive & Elections, Amendments and Emergency Provisions:** State Executive, Election Commission, Elections & Electoral Process. Amendment to Constitution (Why and How) and Important Constitutional Amendments till today. Emergency Provisions.	03 Hours
Module 5	**Professional Ethics:** Definition of Ethics & Values. Professional & Engineering Ethics. Positive and Negative aspects of Engineering Ethics. **Cyber Laws:** Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. **Computer & Cyber Security:** (a) Types of Attacks, (b) Network Security (c) Overview of Security threats, (d) Hacking Techniques, (e) Password cracking (f) Insecure Network connections, (g) Malicious code (h) Concept of Fire wall Security	04 Hours

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

- Have constitutional knowledge and legal literacy.

- Understand Engineering and Professional ethics and responsibilities of Engineers.
- Understand cyber threats & cyber laws, acts and their powers.

Reference Books:

1. Shubham Singla, „Constitution of India, Professional Ethics & Human Rights", CENGAGE Publications 2018.
2. Cyber Law & Cyber Crimes by Advocate Prashant Mali; Snow White publications, Mumbai.
3. Cyber Law in India by Farooq Ahmad; Pioneer Books.

ABILITY ENHANCEMENT COURSE II (21AEC48)

Semester IV (Common to all branches)			
No. of Lecture hour/Week	1	**CIE Marks**	50
No. of Tutorial hours/week	0	**SEE Marks**	00
Total No. of Lecture hours	16	**Exam Hours**	00
L: T:P	1:0:0	**Credits**	01

Modules	Course Content	Teaching Hours
Module 1	**Technical Report Writing:** Introduction to Technical writing process, Understanding of writing process, Introduction to various Technical Report writing.	**03 Hours**
Module 2	**Art of condensation and Paragraph Writing:** Introduction and importance, Types and principles of condensation. Importance of paragraph writing, Features and its construction styles.	**03 Hours**
Module 3	**Business Report Writing:** Introduction, Definition and Salient features of Business reports. Significance and types of report writing. (Formal and Informal). Resume building and Types of resumes. (Samples of resumes)	**03 Hours**
Module 4	**Technical Articles and Proposals:** Nature and significance, Types of technical Articles Journal articles and conference papers. Elements of technical articles. Introduction to technical proposal writing, Purpose, importance, structure and types of technical proposals.	**04 Hours**
Module 5	**Social media posts and Blog Writing:** Ethics and practices of social media posts, Principles and fundamentals, Guiding principles for composition of articles, some common pitfalls. Maintaining common etiquette. Blogs and Blog writings strategies.	**03 Hours**

Course Outcomes:

At the end of the course the students will be able to:

- Effectively communicate in technical matters.
- Practice preparation of gist, abstract and notes from a technical article.
- Prepare a business proposals and reports.
- Write and respond in social media and write blogs.

Reference Books:

1. Sanjay Kumar and Pushpalata, „Communication Skills", Oxford University Press. 2018.
2. M. Ashraf Rizvi, „Effective Technical Communication", McGraw Hill, 2018.
3. Gajendra Singh Chauhan and et.al. „Technical Communication", Cengage Publication, 2018.
4. Meenakshi Raman and Sangeeta Sharma, Technical Communication Principles and Practice, Oxford University Press, 2018.

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