CURRICULUM 2023 (Autonomous)

Draft
Version 1.0

B.TECH
Computer Science and Engineering (CSE)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
Mar Ivanios Vidyanagar, Nalanchira,
Thiruvananthapuram – 695 015
August 2023

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

B.TECH DEGREE PROGRAMME

IN

COMPUTER SCIENCE AND ENGINEERING

CURRICULUM AND FIRST YEAR SYLLABI

2023 SCHEME

Items	Board of Studies (BOS)	Academic Council (AC)
Date of Approval	10/7/2023	09/08/2023

Head of the Department
Chairman, Board of Studies

Principal
Chairman, Academic Council

CURRICULUM

FOR

B. TECH DEGREE PROGRAMME

IN

COMPUTER SCIENCE AND ENGINEERING

2023 SCHEME

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)MAR IVANIOS VIDYANAGAR, NALANCHIRA, THIRUVANANTHAPURAM – 695015, KERALA.
Phone: 0471 2545866
Fax: 0471 2545869
Web: www.mbcet.ac.in
ail: hodcs@mbcet.ac.in

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

Vision and Mission of the Institution

Vision:
To be an Institution moulding globally competent professionals as epitomes of Noble Values.

Mission:
To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Vision and Mission of the Department

Vision:
To be a Centre of Excellence in Computer Science and Engineering providing quality education and research for the betterment of the society.

Mission:
To impart sound knowledge in theoretical and applied foundations of Computer Science and Engineering, andto train the students to solve real life issues to effectively define and shape life.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be successful professionals in Industries of core or interdisciplinary nature or entrepreneurs, demonstrating effective leadership and excellent team work.
2. Graduates will expand the horizon of knowledge through higher education or research, leading to self-directed professional development.
3. Graduates will demonstrate professional attitude and ethics while providing solutions in societal and environmental contexts.

PROGRAMME OUTCOMES (POs)

Engineering graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

Engineering Graduates will have the ability to:

1. Apply Algorithmic Principles, Programming Skills and Software Engineering Principles to design, develop andevaluate Software Systems of varying complexities.
2. Apply knowledge of System Integration to design and implement computer-based systems.
3. Solve real world and socially relevant problems with the knowledge in recent and advanced Computing Technologies.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

For the students admitted from 2023

Scheduling of Courses

i) Knowledge Segments and Credits

Every course of B. Tech Programme is placed in one of the nine categories as listed in the following table.

No semester shall have more than six lecture-based courses and two laboratory courses,

and/or drawing/seminar/project courses in the curriculum.

Sl. No.	Category	Category Code	2023
1	Humanities and Social Sciences including Management Courses	HSC	6
2	Basic Science Courses	BSC	26
3	Engineering Science Courses	ESC	24
4	Programme Core Courses, Comprehensive Course Work and Viva Voce	PCC	72
5	Programme Elective Courses	PEC	18
6	Institute Elective Courses	IEC	6
7	Project Work, Seminar, Comprehensive Viva & Internship	PWS	15
8	Mandatory Student Activities (P/F)	MSA	3
Total Mandatory Credits			**170**
	Value Added Courses (Optional) – Honours/Minor	VAC	15

ii) Semester-wise Credit Distribution

Semester	I	II	III	IV	V	VI	VII	VIII	*Total Credits*
Credits for Courses	19	21	23	22	22	25	21	14	**167**
	40		45		47		35		**167**
Credits for Activities	3								**3**
Total Credits									**170**
Value Added Courses (Optional) – Honours / Minor									**15**
Total Credits									**185**

SEMESTER I						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL10A	Linear Algebra and Calculus	3-1-0-0	4	4
B	BSC	23PYL10A	Engineering Physics	3-1-0-0	4	4
D	ESC	23ESB10E	Programming in C	2-1-2-0	5	4
E	ESC	23ESL10J/ 23ESL10L	Basics of Electrical Engineering-A Basics of Electronics Engineering	2-0-0-0 2-0-0-0	4	2 2
G	ESC	23ESL1NA	Environmental Science	2-0-0-0	2	1
S	BSC	23PYP10A	Engineering Physics Lab	0-0-2-0	2	1
T	ESC	23ESP10B	Electrical and Electronics Workshop	0-0-2-0	2	1
TOTAL					**23**	**19**

SEMESTER II						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL10B	Vector Calculus, Differential Equations and Transforms	3-1-0-0	4	4
B	BSC	23CYL10A	Engineering Chemistry	3-1-0-0	4	4
C	ESC	23ESB10A	Engineering Graphics	2-0-2-0	4	3
D	ESC	23ESB10H	Programming using Python	2-0-2-0	4	3
E	ESC	23ESL10Q	Digital Electronics	3-0-0-0	3	3
G	HSC	23HSJ1NB	Professional Communication	2-0-0-2	4	1
S	BSC	23CYP10A	Engineering Chemistry Lab	0-0-2-0	2	1
T	ESC	23ESB10P	Manufacturing and Construction Practices-B	1-0-2-0	3	2
TOTAL					**28**	**21**

SEMESTER III						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20B	Discrete Mathematical Structures	3-1-0-0	4	4
B	PCC	23CSL20A	Data Structures	3-1-0-0	4	4
C	PCC	23CSL20B	Computer Organization and Architecture	3-1-0-0	4	4
D	PCC	23CSB20C	Object Oriented Programming Concepts	3-0-2-0	5	4
E	ESC	23ESL00A	Design Engineering	2-0-0-0	2	2
G	HSC	23HSL2NA	Professional Ethics	2-0-0-0	2	1
S	PCC	23CSP20A	Hardware Lab	0-0-3-0	3	2
T	PCC	23CSP20B	Data Structures Lab	0-0-3-0	3	2
M	VAC		Minor Course	3-0-0-0	3	3
TOTAL					**27/30**	**23/26**

SEMESTER IV						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	BSC	23MAL20D	Probability, Statistics and Numerical Methods	3-1-0-0	4	4
B	PCC	23CSL20D	Operating Systems	3-1-0-0	4	4
C	PCC	23CSL20E	Database Management Systems	3-1-0-0	4	4
D	PCC	23CSL20F	Formal Languages and Automata Theory	3-1-0-0	4	4
E	HSC	23HSL2NB	Universal Human Values-II	3-0-0-0	3	1
G	ESC	23ESL2NC	Industrial Safety Engineering	2-1-0-0	3	1
S	PCC	23CSP20C	Operating Systems Lab	0-0-3-0	3	2
T	PCC	23CSP20D	Database Lab	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	3-0-0-0	3	3
TOTAL					**28/31**	**22/25**

SEMESTER V						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23CSL30A	Computer Networks	3-1-0-0	4	4
B	PCC	23CSL30B	Microprocessors and Microcontrollers	3-1-0-0	4	4
C	PCC	23CSJ30C	Web Technology	2-0-2-1	5	4
D	PEC	23CSL31X	Programme Elective Course 1	2-1-0-0	3	3
E	HSC	23HSL30A	Business Economics and Accountancy	3-0-0-0	3	3
S	PCC	23CSP30A	Microprocessor Lab	0-0-3-0	3	2
T	PCC	23CSP30B	Networking Lab	0-0-3-0	3	2
M/H	VAC		Minor/Honours Course	3-0-0-0	3	3
TOTAL					**25/28**	**22/25**

SEMESTER VI						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23CSL30D	Algorithm Analysis and Design	3-1-0-0	4	4
B	PCC	23CSL30E	Compiler Design	3-1-0-0	4	4
C	PCC	23CSL30F	Artificial Intelligence	3-0-0-0	3	3
F	PCC	23CSB30G	Software Engineering Theory and Practices	3-0-2-0	5	4
D	PEC	23CSL32X	Programme Elective Course 2	2-1-0-0	3	3
E	IEC	23IEL31X	Institute Elective 1	3-0-0-0	3	3
T	PWS	23CSS38A	Seminar	0-0-4-0	4	2
U	PWS	23CSJ38B	Mini Project	0-0-4-0	4	2
M/H	VAC		Minor/Honours Course	3-0-0-0	3	3
TOTAL					**30/33**	**25/28**

SEMESTER VII						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PCC	23CSB40A	Cyber Security	3-1-2-0	6	5
B	PCC	23CSB40B	Machine Learning	2-1-2-0	5	4
C	PEC	23CSL43X	Programme Elective Course 3/ Industry Elective	2-1-0-0	3	3
E	IEC	23IEL42X	Institute Elective 2	2-1-0-0	3	3
T	PWS	23CSV48A	Comprehensive Course Viva	0-0-2-0	2	1
U	PWS	23CSJ48B	Project / Internship*	0-0-10-0	10	5
M/H	VAC		Minor/Honours Course	0-0-6-0/ 3-0-0-0	6/3	3
TOTAL					**29/35/32**	**21/24**

SEMESTER VIII						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P-J**	**Hours**	**Credit**
A	PEC	23CSL44X	Programme Elective Course 4	2-1-0-0	3	3
B	PEC	23CSL45X	Programme Elective Course 5	2-1-0-0	3	3
C	PEC	23CSL46X	Programme Elective Course 6	2-1-0-0	3	3
U	PWS	23CSJ48C	Project / Internship*	0-0-10-0	10	5
M/H	VAC		Minor/Honours Course	0-0-6-0	6	3
TOTAL					**19/25**	**14/17**

*Students can opt for Internship either in S7 or S8. However, in S7, the internship can be permitted only if there are no pending Programme/Course requirements in the semester, that need to be completed in College in the offline mode, such as laboratory sessions.

PROGRAMME ELECTIVE I

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
D	PEC	23CSL31A	Data Science	2-1-0-0	3	3
		23CSL31B	Soft Computing	2-1-0-0	3	3
		23CSL31C	Real Time Operating Systems	2-1-0-0	3	3
		23CSL31D	Parallel Computer Architecture	2-1-0-0	3	3
		23CSL31E	Principles of Programming Languages	2-1-0-0	3	3
		23CSL31F	Artificial Neural Networks	2-1-0-0	3	3
		23CSL31G	Automated Verification	2-1-0-0	3	3

PROGRAMME ELECTIVE II

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
D	PEC	23CSL32A	Data Mining Techniques	2-1-0-0	3	3
		23CSL32B	Fuzzy Set Theory	2-1-0-0	3	3
		23CSL32C	Foundations of Security in Computing	2-1-0-0	3	3
		23CSL32D	High Performance Computing	2-1-0-0	3	3
		23CSL32E	Cloud Computing	2-1-0-0	3	3
		23CSL32F	Computational Linguistics	2-1-0-0	3	3
		23CSL32G	Model Based Software Development	2-1-0-0	3	3

PROGRAMME ELECTIVE III

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
C	PEC	23CSL43A	Big Data Analytics	2-1-0-0	3	3
		23CSL43B	Computational Complexity	2-1-0-0	3	3
		23CSL43C	Sustainable Computing	2-1-0-0	3	3
		23CSL43D	Domain Specific Accelerators	2-1-0-0	3	3
		23CSL43E	Mobile Computing	2-1-0-0	3	3
		23CSL43F	Natural Language Processing	2-1-0-0	3	3
		23CSL43G	Data Compression Techniques	2-1-0-0	3	3

PROGRAMME ELECTIVE IV

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
A	PEC	23CSL44A	Human Computer Interaction	2-1-0-0	3	3
		23CSL44B	Approximation Algorithms	2-1-0-0	3	3
		23CSL44C	Artificial Intelligence for Robotics	2-1-0-0	3	3
		23CSL44D	Hardware Security	2-1-0-0	3	3
		23CSL44E	Internet of Things	2-1-0-0	3	3
		23CSL44F	Pattern Recognition	2-1-0-0	3	3
		23CSL44G	Logic for CS	2-1-0-0	3	3

PROGRAMME ELECTIVE V

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
B	PEC	23CSL45A	Deep Learning	2-1-0-0	3	3
		23CSL45B	Algorithmic Game Theory	2-1-0-0	3	3
		23CSL45C	Knowledge Engineering and Expert Systems	2-1-0-0	3	3
		23CSL45D	Parallel Algorithms	2-1-0-0	3	3
		23CSL45E	Block Chain Technologies	2-1-0-0	3	3
		23CSL45F	Bioinformatics	2-1-0-0	3	3
		23CSL45G	Virtual and Augmented Reality Systems	2-1-0-0	3	3

PROGRAMME ELECTIVE VI

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
C	PEC	23CSL46A	Bio Inspired Optimization Techniques	2-1-0-0	3	3
		23CSL46B	Cognitive Modeling	2-1-0-0	3	3
		23CSL46C	Social Network Analysis	2-1-0-0	3	3
		23CSL46D	Image Processing Techniques	2-1-0-0	3	3
		23CSL46E	Wireless Sensor Networks	2-1-0-0	3	3
		23CSL46F	Quantum Computing	2-1-0-0	3	3
		23CSL45G	Secure Model and IoT Systems	2-1-0-0	3	3

INSTITUTE ELECTIVE

Slot	Category Code	Course Number	Courses	L-T-P-J	Hours	Credit
E	IEC	23IEL46A	Introduction to Mobile Computing	2-1-0-0	3	3
		23IEL46B	Introduction to Deep Learning	2-1-0-0	3	3
		23IEL46C	Computer Graphics and Image Processing	2-1-0-0	3	3
		23IEL46D	Python for Engineers	2-1-0-0	3	3
		23IEL46E	Object Oriented Concepts	2-1-0-0	3	3
		23IEL46F	Introduction to AI and ML	2-1-0-0	3	3

MINOR

Semester	BASKET I Specialization: SOFTWARE ENGINEERING				BASKET II Specialization: MACHINE LEARNING				BASKET III Specialization: NETWORKING			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
S3	23CSL2MA	Object Oriented Programming	3-0-0-0	3	23CSL2MC	Mathematics for Machine Learning	3-0-0-0	3	23CSL2ME	Data Communication	3-0-0-0	3
S4	23CSL2MB	Programming Methodologies	3-0-0-0	3	23CSL2MD	Concepts in Machine Learning	3-0-0-0	3	23CSL2MF	Introduction to Computer Networks	3-0-0-0	3
S5	23CSL3MA	Concepts in Software Engineering	3-0-0-0	3	23CSL3MC	Concepts in Deep Learning	3-0-0-0	3	23CSL3ME	Client Server Systems	3-0-0-0	3
S6	23CSL3MB	Introduction to Software Testing	3-0-0-0	3	23CSL3MD	Reinforcement Learning	3-0-0-0	3	23CSL3MF	Wireless Networks and IoT Applications	3-0-0-0	3
S7/S8	23CSJ4MA	Mini Project	0-0-6-0	3	23CSJ4MA	Mini Project	0-0-6-0	3	23CSJ4MA	Mini Project	0-0-6-0	3

Semester	Basket IV Specialization: Data Science				Basket V Specialization: Network Security			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
S3	23CSL2MG	Statistics for Data Science and Time Forecasting	3-0-0-0	3	23CSL2MI	Basics of Computer Systems	3-0-0-0	3
S4	23CSL2MH	Data Visualization & ML	3-0-0-0	3	23CSL2MJ	Cyber Security	3-0-0-0	3
S5	23CSL3MG	Natural Language Processing	3-0-0-0	3	23CSL3MI	Introduction to Blockchain technologies	3-0-0-0	3
S6	23CSL3MH	Deep Learning	3-0-0-0	3	23CSL3MJ	Privacy and security in IoT	3-0-0-0	3
S7/S8	23CSJ4MA	Mini Project	0-0-6-0	3	23CSJ4MA	Mini Project	0-0-6-0	3

HONOURS

Semester	BASKET I Specialization: SECURITY IN COMPUTING				BASKET II Specialization: MACHINE LEARNING				BASKET III Specialization: FORMAL METHODS			
	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit	Course Number	Course	L-T-P-J	Credit
S4	23CSL2HB	Number Theory	3-0-0-0	3	23CSL2HD	Computational Fundamentals of Machine Learning	3-0-0-0	3	23CSL2HF	Principles of Program Analysis and Verification	3-0-0-0	3
S5	23CSL3HA	Cryptographic Algorithms	3-0-0-0	3	23CSL3HC	Neural Networks and Deep Learning	3-0-0-0	3	23CSL3HE	Principles of Model Checking	3-0-0-0	3
S6	23CSL3HB	Network Security	3-0-0-0	3	23CSL3HD	Advanced Topics in Machine Learning	3-0-0-0	3	23CSL3HF	Theory of Computability and Complexity	3-0-0-0	3
S7	23CSL4HA	Cyber Forensics	3-0-0-0	3	23CSL4HC	Advanced Topics in Artificial Intelligence	3-0-0-0	3	23CSL4HE	Logic for Computer Science	3-0-0-0	3
S8	23CSJ4HB	Mini Project	0-0-6-0	3	23CSJ4HD	Mini Project	0-0-6-0	3	23CSJ4HF	Mini Project	0-0-6-0	3

SEMESTER I

Syllabus-B Tech S1

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL10A	LINEAR ALGEBRA AND CALCULUS	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW:

This course introduces students to some basic mathematical ideas and tools which are at the core of any engineering course. A brief course in Linear Algebra familiarizes students with some basic techniques in matrix theory which are essential for analyzing linear systems. The calculus of functions of one or more variables taught in this course are useful in modelling and analyzing physical phenomena involving continuous change of variables or parameters and have applications across all branches of engineering.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Solve systems of linear equations.	Apply
CO 2	Compute maxima and minima using partial derivatives.	Apply
CO 3	Compute areas and volumes of geometrical shapes using multiple integrals.	Apply
CO 4	Identify the convergence or divergence of an infinite series.	Apply
CO 5	Determine the Taylor and Fourier series expansion of functions and learn their applications.	Apply

iii) SYLLABUS

Basics of Linear Algebra – Solution of systems of linear equations, row echelon form, rank, eigen values and eigen vectors, diagonalization of matrices, orthogonal transformation, quadratic forms.

Partial Differentiation and Applications – Limit and continuity of functions of two or more variables, partial derivatives, chain rule, total derivatives, maxima and minima

.

Multiple Integrals – Double and triple integrals, double integrals over rectangular and non-rectangular regions, changing the order of integration, finding areas and volume, mass and center of gravity.

Infinite series – Convergence and divergence of Infinite series, geometric series and p-series, test of convergence, Alternating series, absolute and conditional convergence

Taylor series, Binomial series and series representation of exponential, trigonometric, logarithmic functions –Fourier Series– Euler's formulas, Fourier sine and cosine series, Half range expansions

iv) a) TEXT BOOKS

1. H. Anton, I. Biven, S. Davis, "Calculus", Wiley, 10th Edition, 2015.

2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2016.

b) REFERENCES

1) J. Stewart, Essential Calculus, Cengage, 2nd Edition, 2017

2) G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9thEdition, Pearson, Reprint, 2002.
3) Peter V. O'Neil, Advanced Engineering Mathematics, Cengage, 7th Edition2012.

v) CONTINUOUS ASSESSMENT

Attendance	**5 marks**
CA Exams (2 numbers)	**10 marks each**
Assignment	**15 marks**
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23PYL10A	ENGINEERING PHYSICS (FOR ALL BRANCHES)	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW: The aim of the course is to develop scientific attitude in students and offer them an understanding of physical concepts behind various engineering applications. It creates an urge in students to think creatively in emerging areas of Physics.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Describe the characteristics of different types of oscillations and waves.	Understand
CO 2	Explain natural physical processes and related technological advances using principles of optics	Understand
CO 3	Generalise the principles of quantum mechanics to explain the behavior of matter in the atomic and subatomic level	Understand
CO 4	Describe the fundamentals of lasers and the principles behind various solid state lighting devices and fiber optic communication system.	Understand
CO 5	Explain the fundamental ideas of Ultrasonics and acoustics in order to facilitate technological advancement.	Understand

iii) SYLLABUS

Oscillations and Waves: Harmonic oscillations – Damped harmonic oscillations, Forced harmonic oscillations, Q- factor, Amplitude resonance, comparison of electrical and mechanical oscillator. Wave motion – Longitudinal waves and Transverse waves, One dimensional wave equation and solution, three-dimensional wave equations, Transverse vibrations along a stretched string.

Wave Optics : Interference of light – Cosine law, Wedge shaped films - Air wedge, Newton's rings, Antireflection coating. Diffraction- comparison of Fresnel and Fraunhoferdiffraction, Fraunhofer diffraction due to double slit, grating equation, Rayleigh's criterion, resolving power and dispersive power of grating.

Quantum Mechanics & Nano technology: Wave function, Uncertainty principle, Time dependent and time independent Schrodinger wave equations, Applications of Schrodingerwave equation - particle in one-dimensional potential well, quantum mechanical tunneling. Introduction to nanoscience and technology, significance of surface to volume ratio, Quantum confinement, Characterization techniques – XRD,

UV-Visible Spectroscopy, Applications of nanomaterials.

Laser and Photonics: Principles of Laser, Properties of laser, Ruby laser and Helium neon laser, Applications of Laser. Holography-construction of hologram, reconstruction of hologram, Applications. Introduction to photonics - photonic devices - Light Emitting Diode, Solar cells, Optical fiber – Principle of OFC, Numerical aperture, Types of fibers – step index fiber, Graded index fiber, Fiber Optic Communication System, Applicationsof Optical fiber, Fibre optic sensors.

Acoustics & Ultrasonic: Acoustics - characteristics of musical sounds, absorption coefficient, reverberation time- Sabine's formula (no derivation), significance, factors affecting architectural acoustics and their remedies.

Ultrasonics - production by magnetostriction oscillator and piezoelectric oscillator, detection of ultrasonic waves - thermal and piezoelectric methods, ultrasonic diffractometer-, applications of ultrasonic waves -SONAR, NDT, medical applications.

iv) a) TEXT BOOKS

1) M.N. Avadhanulu , P.G. Kshirsagar, T.V.S Arun Murthy, *A Text book of Engineering Physics*, S. Chand &Co., Revised Edition, 2014
2) H.K. Malik, A.K. Singh, *Engineering Physics*, McGraw Hill Education, 2nd Edition,2017

b) REFERENCES

1) Arthur Beiser, *Concepts of Modern Physics*, Tata McGraw Hill Publications,6thEdition, 2003.
2) Aruldhas G., *Engineering Physics*, Prentice Hall of India Pvt Ltd., 2015
3) Ajoy Ghatak, *Optics*, Mc Graw Hill Education, 6th Edition, 2017
4) David J. Griffiths, *Introduction to Electrodynamics*, Addison-Wesley publishing, 4thEdition, 1999.
5) Choudhary, Nityanand, K. R. Deepak, S. H. Abdi, *Perspective of Engineering: Physics:I,* Acme Learning Pvt Ltd, first edition :2009.
6) A. S. Vasudeva, *A Text Book of Engineering Physics*, S. Chand &Co., first edition:2008.
7) Premlet B., *Advanced Engineering Physics*, Phasor Books,10thEdition, 2017.

v) CONTINUOUS ASSESSMENT

Attendance	:	5 marks
CA Exams (2 numbers)	:	10 marks each
Assignment	:	15 marks
Total	:	40 Marks

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESB10E	PROGRAMMING IN C	ESC	2	1	2	0	4	2023

i) COURSE OVERVIEW:

This course aims to introduce the concepts of structured programming. It covers basic concepts of C programming language including arrays, functions, pointers and files. This course involves a lab component which equips the learner to solve computational problems through programming.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the fundamentals of computer architecture and types of software.	Understand
CO 2	Develop a solution using algorithm /flowchart to a computational problem.	Apply
CO 3	Construct programs with control statements and arrays.	Apply
CO4	Make use of user defined data types or functions to solve computational problems.	Apply
CO5	Develop programs using files and pointers.	Apply

iii) SYLLABUS

Computer architecture & Programming Languages Basics of Computer architecture, Types of Programming Languages, System Software, Application Software, Introduction to structured programming, Algorithms, Flowcharts and Pseudo-codes C Programming Language Data Types, variables, keywords, Constants, Operatorsand Expressions, Control Flow Statements- Conditional statements, Iterativestatements, programs

Arrays and Strings Multidimensional arrays and matrices, String processing, searching and sorting in 1D array.

Functions– Scope of variable, Pass by reference and value methods, Recursive functions. Structures and union, Storage Classes

Pointers and Files- File Operations, Sequential access and random access, programs covering pointers and files, Introduction to data structures Types of data structure, singly linked list.

iv) a) TEXT BOOKS

1) Byron Gottfried, *Programming with C* (Schaum's Outlines Series), McgrawHill Education, 3rd Edition, 2017.
2) H. M. Deitel, P. J. Deitel, *C: How to program*, 7th Edition, Pearson Education, 2010.
3) Anita Goel, Computer Fundamentals, Pearson, 1st Edition, 2010.
4) Ellis Horowits, SartajSahini, Susan Anderson Freed, *Fundamentals of Data Structure in C*, 2ndEdition, 2008.

b) REFERENCES

1) Brian W. Kernighan and Dennis M. Ritchie, *C Programming Language*,Pearson, 2ndEdition, 2015.
2) Rajaraman V, PHI, *Computer Basics and Programming in C*, 1st Edition, 2007.
3) Anita Goel and Ajay Mittal, *Computer fundamentals and Programming in C*, 1stEdition,2013.

v) CONTINOUS ASSESSMENT

Attendance	5 marks
CA Exams (CAT1 and CAT2)	10 marks each
Assignment	15 marks
Lab Work	10 marks
Lab exam	10 marks
Total	**60 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 40 marks with a duration of 2 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL10J	BASICS OF ELECTRICAL ENGINEERING (Fractal Course) [A]	ESC	2	0	0	0	2	2023

i) COURSE OVERVIEW

This course aims to equip the students with an understanding of the fundamental principles of electrical engineering.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Apply fundamental circuit laws and principles of electromagnetism to solve simple DC electric circuits and magnetic circuits respectively.	Apply
CO 2	Solve simple AC circuits using the alternating current fundamentals.	Apply
CO 3	Explain the principle of operation and characteristics of DC Motors	Understand

iii) SYLLABUS

Basic concepts of DC circuits: Ohm's Law and Kirchhoff's laws, Star-delta conversion, Analysis of DC circuits, Mesh analysis, Node analysis.

Magnetic Circuits: Basic Terminology, Simple Magnetic circuits, Electromagnetic Induction, Faraday's laws, Lenz's law, Self-inductance and mutual inductance.

Alternating Current fundamentals: Basic definitions, Average, RMS values, AC Circuits, Phasor representation, Analysis of simple AC circuits (R, L, C, RL, RC, RLC Series circuits)

Three phase AC systems, Generation of three phase voltages, star and delta connections.

DC Motors-Constructional details of DC machines, Principle of operation, Back EMF, Torque equation, Types, Performance characteristics, Applications

iv) a) TEXT BOOKS

1) William H. Hayt., Jr., Jack E. Kemmerly, Steven M. Durbin., *Engineering CircuitAnalysis*, McGraw-Hill, 8th Edition, 2012.
2) Kothari D. P. and Nagrath I. J., *Basic Electrical Engineering*, Tata McGraw Hill,2010.
3) Fitzgerald A.E., David Higginbotham E., Arvin Grabel, *Basic Electrical Engineering*,Tata McGraw Hill, 5th Edition,2009.
4) Bimbra P. S., *Electric Machines*, Khanna Publishers, 2nd Edition, 2017.

b) REFERENCES

1) Paul Breeze, *Power Generation Technologies*, Newnes,3rd Edition, 2019.
2) Allan Hambley R., *Electrical Engineering: Principles & Applications*, Pearson Education,7th Edition, 2018.

1) Mittle V. N. and Arvind Mittal, *Basic Electrical Engineering*, McGraw Hill,2nd Edition, 2006.
2) Clayton A. E. and Hancock N. N., *The Performance and Design of Direct Current Machines*, CBS Publishers & Distributors, New Delhi, 3rd Edition, 2004.

v) CONTINUOUS ASSESSMENT

Attendance	5 marks
CA Exams (2 numbers)	10 marks each
Assignment	15 marks
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL10L	BASICS OF ELECTRONICS ENGINEERING (Fractal Course)	ESC	2	0	0	0	2	2023

i) COURSE OVERVIEW

This course aims to equip the students with an understanding of the fundamental principles of electronics and communication engineering.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Describe the principles of semiconductor devices, its characteristics and various electronic circuits	Understand
CO2	Explain the basic working of Op-Amp, logic gates, radio and cellular communication systems.	Understand

iii) SYLLABUS

PN Junction diode: Principle of operation, V-I characteristics, breakdown mechanisms, Zener diode and its characteristics. Rectifiers and Power supplies: Block diagram of a dc power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. Bipolar Junction Transistors: structure, principle of operation, relation between current gains in Common Emitter (CE), Common Base (CB) and Common Collector (CC) configurations, input and output characteristics of CE configuration. Amplifiers: Concept of voltage divider biasing, circuit diagram and working of CE (RC coupled) amplifier with its frequency response. Integrated Circuits: Analog IC; Operational Amplifier, block diagram, ideal characteristics, inverting and non-inverting Amplifier. Digital IC: Logic Gates AND, OR, NOT, Universal Gates; truth table, De-Morgans law, Realization of simple Boolean functions. Radio communication: Modulation, need for modulation, Principle of AM, mathematical expression, waveform, frequency spectrum and bandwidth of AM, Principle of FM, mathematical expression, waveform. Radio Receivers: block diagram of super heterodyne receiver (AM&FM). Mobile communication: Basic principles of cellular communications, concept of cells, frequency reuse, hand off.

iv) a) TEXT BOOKS

1) Boylested, R. L. and Nashelsky, L., *Electronic Devices and Circuit Theory*, PearsonEducation, 10th Edition, 2009.

2) Thomas l Floyd, *Digital Fundamentals*, Pearson Education, 11th Edition, 2018.

3) Ramakant A Gaykwad, *Op-Amps and Linear Integrated Circuits*, Pearson Education,4th Edition, 2015.

4) Wayne Tomasi and Neil Storey, *A Textbook on Basic Communication andInformation Engineering*, Pearson, 5th Edition, 2010.

b) REFERENCES

1) N.N. Bhargava , D.C. Kulshreshtha , S.C. Gupta, *Basic Electronics and LinearCircuits*, Tata McGraw - Hill Education, New Delhi, 2nd Edition, 2014.

v) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	5 marks
CA Exams (2 numbers)	10 marks each
Assignment	15 marks
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL1NA	ENVIRONMENTAL SCIENCE	ESC	2	0	0	0	1	2023

i) COURSE OVERVIEW

Goal of this course is to expose students to the significance of natural resource management, ecosystem restoration and biodiversity conservation. The course details the various problems related to environmental pollution and the legal provisions for environmental protection. The course also introduces the concept of sustainability, sustainable practices and the role of engineering in attaining sustainable development.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Identify the problems associated with the overutilization of natural resources and the role of engineers in natural resource management.	Apply
CO 2	Explain the concepts related to the ecosystem and the significance of ecosystem restoration and biodiversity conservation.	Understand
CO 3	Explain the causes, impacts and control measures of various types of environmental pollution.	Understand
CO 4	Summarise the various legal provisions for environmental protection.	Understand
CO 5	Discuss the concepts of sustainability and sustainable practices by utilizing engineering knowledge and principles.	Apply

iii) SYLLABUS

Module I

Interdisciplinary nature of environmental science - definition, scope and importance.

Natural resources and associated problems: Water resources- use and overutilization of surface and groundwater, floods, drought, conflicts over water. Energy resources-growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources (case studies). Food resources- effects of modern agriculture, fertilizers-pesticides problems, water logging, salinity. Land resources- land degradation, soil erosion, desertification.

Role of individuals in the conservation of natural resources, Equitable use of resources.

Module II

Ecosystem- concept, structure and function, productivity, energy flow, ecological succession, food chains and food webs, ecological pyramids, Types of ecosystems. Characteristic features and functions of the following ecosystems- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystem, Ecosystem Services.

Biodiversity and its conservation- Species and ecosystem diversity, Value of biodiversity- consumptive use, productive use, social, ethical, aesthetic values. Hotspots of biodiversity, Threats to biodiversity- habitats loss, poaching of wildlife, man-wildlife conflicts, endangered endemic species of India. Conservation of biodiversity.

Module III

Environmental Pollution- definition, causes, effects and control measures of air pollution, waterpollution, soil pollution and noise pollution. Solid and Hazardous Waste Management- causes, effects and control measures of urban and industrial wastes- 3R concept, zero waste management -case studies. Role of individual in prevention of pollution.

Module IV

Environmental ethics, Contemporary Environmental issues- global warming, climate change, sea level rise. International efforts for environmental protection, National action plan on climate change. Water conservation- rainwater harvesting, watershed management, conservation of wetlands- Ramsar sites in India. Legal provisions for environmental protection.

Module V

Sustainability- Concept, Evolution, Social, Environmental and Economic Sustainability, challenges for sustainable development, Sustainable Development Goals. Sustainability Practices- Green engineering, Sustainable habitat-Green buildings, Sustainable Urbanisation, Industrial Ecology, Circular Economy. Case studies.

iv) a) TEXT BOOKS

1) Erach Bharucha, Textbook for Environmental Studies, UGC, New Delhi, 3rd edition,2021.
2) D. D. Mishra, Fundamental Concepts in Environmental Studies, S. Chand & Co. Ltd, 4thedition, 2014.
3) Kurian Joseph and R. Nagendran, Essentials of Environmental Studies, PearsonEducation (Singapore) Pvt. Ltd, India, 2017.
4) David Allen and David R. Shonnard, Sustainable Engineering: Concepts, Design andCase Studies, 2011.

b) REFERENCES

1) Suresh K.Dhameja, Environmental Engineering and Management, S.K. Kataria & Sons,2013.
2) Bradley Striebig, Adebayo A. Ogundipe and Maria Papadakis, Engineering Applicationsin Sustainable Design and Development, 2015.

v) CONTINUOUS ASSESSMENT

Attendance	5 marks
CA Exams (2 numbers)	10 marks each
Assignment	15 marks
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23PYP10A	ENGINEERING PHYSICS LAB	BSC	0	0	2	0	1	2023

i) COURSE OVERVIEW:

The aim of this course is to enable the students to gain practical knowledge in Physics to correlate with the theoretical studies. It equips the students to utilize the acquired skills in an appropriate way to explore the prospects of modern technology. It brings more confidence in students and develop the ability to fabricate engineering and technical tools.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Determine the frequency of tuning fork using a Melde's string apparatus by setting up wave pattern in a stretched string.	Apply
CO 2	Determine the Numerical aperture and acceptance angle of opticalfiber.	Apply
CO 3	Determine the wavelength of a monochromatic beam of light and thickness of thin wire using principle of interference	Apply
CO 4	Demonstrate diffraction of light using plane transmission grating.	Apply
CO 5	Draw the I-V characteristics of non ohmic devices.	Apply

iii) SYLLABUS

1) Melde's string apparatus- Measurement of frequency in the transverse mode.
2) Wavelength measurement of a monochromatic source of light using Newton's Ringsmethod.
3) Determination of diameter of a thin wire or thickness of a thin strip of paper using airwedge method.
4) Measurement of wavelength of a source of light using grating.
5) Determination of dispersive power and resolving power of a plane transmission grating.
6) Determination of the wavelength of any standard laser using diffraction grating
7) I-V characteristics of solar cell.
8) To measure the Numerical aperture and acceptance angle of an optical fibre

iv) b) REFERENCES

1) S.L. Gupta and V. Kumar, *Practical physics with viva voce*, Pragati Prakashan Publishers,Revised Edition, 2009.
2) M.N. Avadhanulu, A.A. Dani and Pokely P.M., *Experiments in Engineering Physics*, S.Chand &Co, 2008.
3) S. K. Gupta, *Engineering Physics practicals*, Krishna Prakashan Pvt. Ltd., 2014
4) P. R.Sasikumar, *Practical Physics*, PHI Ltd., 2011.

v) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 Marks
Classwork / Assessment / Viva-voce	:	55 Marks
Written Examination	:	40 Marks
Total	:	100 Marks

vi) END SEMESTER EXAMINATIONS

NIL

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESP10B	ELECTRICAL AND ELECTRONICS WORKSHOP	ESC	0	0	2	0	1	2023

i) COURSE OVERVIEW:

To expose the students to the commonly used accessories and components in electrical installations and to provide hands on experience of wiring of electrical circuits.

To enable the students to familiarize, identify, construct, and debug the electronic components, devices and circuits. It also enables the student's engineering skills by soldering practices of electronic circuits

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Choose the appropriate tools, electrical accessories, protective elements for electrical wiring and study the different types of earthling and safety measures.	Remember
CO 2	Build a simple lighting circuit for domestic buildings using suitable accessories and materials.	Apply
CO 3	Identify the faults in electric circuits and batteries using appropriate devices.	Analysis
CO 4	Make use of a solar powered circuit and obtain its VI characteristics.	Apply
CO 5	Construct the performance characteristics of DC Motors by performing load test.	Apply
CO 6	Test various electronic components.	Understand
CO 7	Implement basic electronic circuits on breadboard.	Apply
CO 8	Implement basic electronic circuits on general purpose PCB.	Apply

iii) SYLLABUS

Familiarization/Identification of electrical accessories and protective elements, wiring of circuits using PVC conduits, wiring of simple solar chargeable circuit and determination of its characteristics, Demonstration of power distribution arrangement and earthling schemes, Identification of different types of batteries.

Familiarization of electronic equipment and commonly used tools, Familiarization and testing of electronic components, Interconnection using bread board, Diode Characteristics, Single stage RC coupled Amplifier, Truth table verification of Logic Gates, Soldering Practice, DC Power Supply, Inverting and Non Inverting amplifier using Op-amp.

iv) b) REFERENCES

1) Singh R. P., Electrical Workshop: Safety, Commissioning, Maintenance & Testing ofElectrical Equipment, Dream tech Press, 3rd Edition, 2019.
2) John H. Watt, Terrell Croft American Electricians' Handbook: A Reference Book forthe Practical Electrical Manual, McGraw-Hill, 9th Edition, 2002.
3) Navas K A, Electronics Lab Manual, , Volume 1, PHI Learning Private Limited, 5thEdition, 2015.

v) CONTINUOUS ASSESSMENT EVALUATION PATTERN

Attendance	:	5 Marks
Class work/ Assessment/ Viva Voce	:	55 Marks
Written Examination	:	40 Marks
Total	:	100 Marks

vi) END SEMESTER EXAMINATIONS

NIL

SEMESTER II

Syllabus-BTech S2

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23MAL10B	VECTOR CALCULUS, DIFFERENTIAL EQUATIONS AND TRANSFORMS	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW:

The objective of this course is to familiarize the prospective engineers with some advanced concepts and methods in Mathematics which include the Calculus of vector valued functions, ordinary differential equations and basic transforms such as Laplace and Fourier Transforms which are invaluable for any engineer's mathematical tool box. The topics treated in this coursehave applications in all branches of engineering.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Compute the derivatives and line integrals of vector functions and learn their applications.	Apply
CO 2	Evaluate surface and volume integrals and learn their inter-relations and applications.	Apply
CO 3	Solve linear ordinary differential equations.	Apply
CO 4	Apply Laplace transform to solve ODEs arising in engineering.	Apply
CO 5	Apply Fourier transforms of functions to solve problems arising in engineering.	Apply

iii) SYLLABUS

Vector Calculus – Derivative of vector function, Gradient, Divergence, Curl, Line integral,conservative fields, Green's theorem, surface integral, Gauss divergence theorem, Stokes'theorem.

Ordinary Differential Equations – Homogeneous and Non-Homogeneous linear differential Equations, Euler-Cauchy equations. Method of undetermined coefficients and Method of variation of parameters.

Laplace transforms – Laplace Transform and its inverse , shifting theorems, Laplace transformof derivatives and integrals, solution of differential equations using Laplace transform, Unit step function. Dirac delta function. Convolution theorem and its applications

Fourier Transforms – Fourier integral representation, Fourier sine and cosine integrals. Fouriertransform and inverse Fourier transform. Fourier sine and cosine transforms, inverse sine and cosine transform. Convolution theorem

iv) a) TEXT BOOKS

1) H. Anton, I. Biven S.Davis, "Calculus", Wiley, 10th edition, 2015.
2) Erwin Kreyszig, Advanced Engineering athematics, 10th Edition, John Wiley & Sons, 2016.

b) REFERENCES

1) George F Simmons: Differential Equation with Applications and its historicalNotes,2e McGraw Hill Education India 2002.
2) Hemen Datta, Mathematical Methods for Science and Engineering,CengageLearing,1st. ed .
3) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2018.

v) CONTINUOUS ASSESSMENT

Attendance	**5 marks**
CA Exams (2 numbers)	**10 marks each**
Assignment	**15 marks**
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CYL10A	ENGINEERIG CHEMISTRY (FOR ALL BRANCHES)	BSC	3	1	0	0	4	2023

i) COURSE OVERVIEW: The aim of the Engineering Chemistry program is to expose the students to basic concepts of chemistry and its Industrial as well as Engineering applications.It also let the students to familiarize with different topics such as new-generation engineering materials, storage devices, different instrumental methods etc.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO1	Apply the basic concepts of Electrochemistry in various Engineering problems.	Apply
CO2	Apply the basic concepts of UV-Visible, IR and NMR spectroscopic techniques to analyze organic compounds.	Apply
CO3	Explain the significance of conducting polymers, Nanomaterials, Alloys and composite materials in Engineering.	Understand
CO4	Explain relevant techniques used for the identification and separation of chemical compounds and mixtures.	Understand
CO5	Explain the principles of Green chemistry and various water treatment methods used for sustainability.	Understand

iii) SYLLABUS

Electrochemistry: Cell prototype- Daniel cell, Nernst equation and its uses, Primary and secondary electrodes- construction and working, applications of electrochemical series. Potentiometric titration – Acid Base titration, Fundamentals of corrosion, Galvanic series, Wetand dry corrosion – types, mechanism and its prevention.

Electrochemical power sources: different types of cells, construction, working and applications– Dry cell, Electrolytic cells, Galvanic cells, Lead-acid cell, accumulator, Lithium ion cell- different electrode materials, Fuel cells, H_2-O_2 fuel cell.

Basics of Spectroscopy: Beer Lambert's law, Principles and applications of UV-Visible spectroscopy, Fluorescence and its applications, Woodward-Feiser rule, instrumentation of UV- Visible spectroscope, colorimetry, Principles and applications of IR spectroscopy, Number of vibrational modes – CO_2 and H_2O, Determination of force constant of diatomic molecules, Principles and applications of NMR spectroscopy, Shielding, Deshielding, Chemical shift, spin- spin splitting, MRI technique.

Engineering Materials: Basics of Polymer chemistry, Types of copolymers, Preparation, properties and applications- Butadiene Styrene, Acrylonitrile Butadiene Styrene, Kevlar, conducting polymers- Polyaniline and Polypyrrole - preparation properties and applications, Organic Light Emitting Diode

Nanomaterials: Origin of nanomaterials, Classifications, Chemical synthesis-hydrolysis and reduction, Carbon Nano Tubes, Graphene, Quantum dots-applications.

Alloys and Composites: Cast iron, Principal non-ferrous alloys, need, properties and applications of composites, super alloys, Ceramics- structure and applications.

Instrumental methods in chemistry: Thermal methods, Thermo Gravimetric Analysis, Differential Thermal Analysis, Chromatography techniques- Thin Layer Chromatography, Column Chromatography, Gas Chromatography, High Performance Liquid Chromatography, Surface characterization using Scanning Electron Microscopy (SEM), X-ray Photoelectron Spectroscopy(XPS), Auger Electron Spectroscopy(AES).

Green Chemistry and Sustainability: Green chemistry – Principles, Matrices to express greenness- E-Factor, Atom Economy, Environmental Quotient, Green chemistry and Catalysis, R4M4 Models-Econoburette, Survismeter, E-waste disposal, Life Cycle Analysis, Benefits and limitations of conducting Life Cycle Analysis.

Water Technology: Water characteristics, hardness, disadvantages of hard water, Estimation of hardness- EDTA method, Ion exchange process for water softening, Dissolved Oxygen, Biological Oxygen Demand and Chemical Oxygen Demand, its estimation and significance, Municipal water treatment, disinfection of water, Reverse Osmosis, Sewage water treatment.

iv) a) TEXT BOOKS

1) D. Harvey, N. Rutledge, *Industrial Chemistry*, ETP, first edition, 2018. ISBN: 9781788820554
2) M. Arif, A. Fernandez, K. P. Nair, *Engineering Chemistry,* first edition, Owl Books,2019.
3) S. Chawla, *A text book of Engineering Chemistry*, second edition, Dhanpat Rai & Co.2017.
4) Roy Varghese., *Engineering Chemistry*, Second Edition, Crown Pubs., 2019.
5) Prasanta Rath., *Engineering Chemistry*, First Edition, Cenage Learning, 2015.

b) REFERENCES

1) C. N. Banwell, E. M. Mc Cash, *Fundamentals of Molecular Spectroscopy*, McGraw-Hill, 4th edition, 2017.
2)
3) H. H. Willard, L. L. Merritt, *Instrumental Methods of Analysis*, CBS Publishers, 7thedition, 2023.
4) A. J. Peacock, A. Calhoun, C. Hanser, *Polymer Chemistry: Properties and Application,*Verlag GmbH and Company KG, 2012.
5) C. Binns, *Introduction to Nanoscience and Nanotechnology*, Wiley, 2010.

6) Callister William.D., *Material Science and Engineering*, John Wiley, 2014.
7) Jurgen Garche, Tom Smolinka, *Electrochemical Power Sources-Fundamentals,Systems, and Applications*, Elsevier Science, Second edition, 2021.

v) CONTINUOUS ASSESSMENT

Attendance	**5 marks**
CA Exams (2 numbers)	**10 marks each**
Assignment	**15 marks**
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESB10A	ENGINEERING GRAPHICS	ESC	2	0	2	0	3	2023

i) COURSE OVERVIEW:

Aim of the course is to enable the student to effectively perform technical communication through graphical representation as per global standards. The student will be able to apply the principles of projection and will be introduced to the fundamentals of Computer AidedDrawing (CAD).

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Construct the orthographic projection of points and lines located in different quadrants.	Apply
CO 2	Prepare orthographic projection of solids by visualizing them in different positions.	Apply
CO 3	Prepare multiview projection and solid models of objects using CAD tools.	Apply
CO 4	Prepare assembly drawing of standard machine components using CAD tools.	Apply
CO 5	Construct drawings of engineering systems with CAD tools.	Apply

iii) SYLLABUS

Module 1

Introduction: Relevance of technical drawing, basic principles of engineering drawing, BIS code of practice for technical drawing, types of lines, planes of projection, orthographic projection of points in different quadrants. Projection of straight lines.

Module 2

Orthographic projection of regular solids. Introduction to section, development, isometric andperspective projection

Module 3

Introduction to Computer Aided Drawing, sketching of simple 2D geometries, editing and dimensioning of 2D geometries, creating 3D model using suitable software.

Module 4

Assembly drawing of machine components using suitable CAD software.Module 5

Plan and elevation of simple building with dimensions, electrical drawing and circuit drawingsusing suitable CAD software.

iv) a) TEXT BOOKS

1) Bhatt N.D, Engineering Drawing, Charotar Publishing House Pvt. Ltd, 53rd Edition, 2019.

2) John K.C., Engineering Graphics, Prentice Hall India Publishers, 1st Edition, 2009.

3) C. M.Agrawal, BasantAgrawal, Engineering Graphics, Tata McGraw-Hill, 1stEdition, 2012.

b) REFERENCES

1) G. S. Phull, H. S.Sandhu, Engineering Graphics, John Wiley & Sons IncPvt. Ltd, 1st Edition, 2014.
2) P. I. Varghese, Engineering Graphics, V.I.P. Publishers,21st Edition, 2010.
3) Jolhe Dhananjay, Engineering Drawing with an Introduction to AutoCAD, (1e), McGrawHill Education, 2017.

v) CONTINUOUS ASSESSMENT

Attendance	5 Marks
CA Exams (CAT1 and CAT2)	10 Marks each
Assignment	15 Marks
Lab Work	10 Marks
Lab exam	10 Marks
Total	**60 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 40 marks with a duration of 2 hours.

.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESB10H	PROGRAMMING USING PYTHON	ESC	2	0	2	0	3	2023

i) COURSE OVERVIEW:

The objective of the course is to introduce Python programming and develop programming skills to manage the development of software systems. It covers data processing in Python andintroduces Machine Learning and Artificial Intelligence- based applications and tools, Data Science and Data Visualization applications.

ii) COURSE OUTCOMES

After the completion of the course the student will be able to:

CO 1	Apply the fundamental concepts and control statements in Python	Apply
CO 2	Illustrate uses of functions and data structures in Python	Apply
CO 3	Develop programs by utilizing the modules Lists, Tuples, Sets and Dictionaries in Python	Apply
CO 4	Develop programs using OOPs Concept	Apply
CO 5	Implement programs in Python using packages and Develop GUI for python programs	Apply

iii) SYLLABUS

Basics of Python- Getting Started with Python Programming, Basic coding skills- Working with data types, Control statements, Selection structure , Iteration structure ,Functions, Python data structures: Lists , Work with tuples, Sets, Dictionaries, Strings and lists, Object Oriented Programming: Design with classes, Exceptions, Visualization and File handling modules in python -NumPy, matplotlib, pandas.

iv) a) TEXT BOOKS

1) Kenneth A Lambert., Fundamentals of Python : First Programs, 2/e, Cengage Publishing, 2016Rajaraman, V., Computer Basicsand CProgramming, Prentice-Hall India
2) David J. Pine, Introduction to Python for Science and Engineering, CRC Press, 2021

b) REFERENCES

1) Wes McKinney, Python for Data Analysis, 2/e, Shroff / O'Reilly Publishers, 2017
2) Allen B. Downey, Think Python: How to Think Like a Computer Scientist, 2/e, Schroff, 2016
3) Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016
4) David M.Baezly, Python Essential Reference. Addison-Wesley Professional; 4/e, 2009.CharlesSeverance. Python for Informatics: Exploring Information.

v) CONTINOUS ASSESSMENT

Attendance	5 Marks
CA Exams (CAT1 and CAT2)	10 Marks Each
Assignment	15 Marks
Lab Work	10 Marks
Lab exam	10 Marks
Total	**60 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 40 marks with a duration of 2 hours.

.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESL10Q	DIGITAL ELECTRONICS	ESC	3	0	0	0	3	2023

i) COURSE OVERVIEW: The goal of this course is to impart an understanding of the basic concepts of Boolean algebra and digital systems. This course covers the design and implementation of different types of practically used combinational and sequential circuits. This course helps the learners to develop application level digital logic circuits to solve real lifeproblems.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Illustrate decimal, binary, octal, hexadecimal and BCD number systems, perform conversions among them and do the operations - complementation, addition, subtraction, multiplication and division on binary numbers.	Understand
CO 2	Simplify a given Boolean Function and design a combinational circuit to implement the simplified function using Digital Logic Gates.	Apply
CO 3	Design combinational circuits - Adders, Code Converters, Encoders, Decoders, Multiplexer, Demultiplexer and design the Programmable Logic Devices -ROM and PLA.	Apply
CO 4	Design sequential circuits - Registers, Counters and Shift Registers.	Apply
CO 5	Illustrate algorithms to perform addition and subtraction on binary and BCD numbers.	Understand

iii) SYLLABUS

Number systems, Operations & Codes: Various Number systems - its arithmetic operation - Number Base Conversions- Representation of negative numbers-BCD Arithmetic.

Boolean Algebra: Postulates- Basic theorems and properties of Boolean Algebra-Boolean Functions-Simplification of Boolean Functions-Don't care Conditions-Digital Logic Gates

Combinational Logic circuits: Design procedure & Implementation of Binary Adders and Subtractors- BCD Adder-Code Converters-Decoder- Encoder-Mux - Demux .

Sequential logic circuits: Flip-flops- Triggering of flip-flops- Master Slave flip-flops - Excitationtable and Characteristic Equation-Counter Design: Asynchronous & SynchronousCounters.

Shift registers: Shift register, Ring Counter- Johnson Counter
Arithmetic algorithms: Algorithms for arithmetic operations on Binary and BCD numbers.Programmable Logic Devices: ROM-Implementation of PLA.

iv) a) TEXT BOOKS

1) M. Morris Mano, Digital Logic & Computer Design, 4/e, Pearson Education, 2013
2) Thomas L Floyd, Digital Fundamentals, 10/e, Pearson Education, 2009.
3) M. Morris Mano, Computer System Architecture, 3/e, Pearson Education, 2007.

b) REFERENCES

1) M. Morris Mano, Michael D Ciletti, Digital Design With An Introduction to theVerilogHDL, 5/e, Pearson Education, 2013.
2) Donald D Givone, Digital Principles and Design, Tata McGraw Hill, 2003.

v) CONTINOUS ASSESSMENT

Attendance	**5 marks**
CA Exams (2 numbers)	**10 marks each**
Assignment	**15 marks**
Total	**40 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 60 marks with a duration of 3 hours.

.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23HSJ1NB	Professional Communication	HSC	2	0	0	2	1	2023

i) COURSE OVERVIEW:

The objective of this course is to equip students with the necessary skills to listen, read,write, and speak so as to comprehend and successfully convey any idea, technical or otherwise, as well as give them the necessary polish to become persuasive communicators. The course aims to enhance the employability and career Skills of students and orient the students towards grooming as a professional.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Demonstrate effective language skills relevant to Engineering through writing and making presentations.	Apply
CO 2	Analyze a variety of textual and audio content for specific needs	Analyze
CO 3	Evaluate a given technical/non-technical topic.	Evaluate
CO 4	Create professional and technical documents.	Create
CO 5	Communicate proficiently in interviews and exam situations and all social situations.	Apply

iii) SYLLABUS

Module I: Communication Skills: Introducing yourself and others professionally, elevator pitch, recommendation letter, e-mails, netiquettes, telephone etiquettes, demi- official letters.

Module II: Business Communication and Technical writing: Product description, narrating an incident, report writing, agenda and minutes, memo, Asking for information and giving information, explaining processes and products, giving instructions, planning a course of action.

Module III: Creative Thinking, Critical Thinking Skills and problem solving: Expressing opinion, GD, Arguing, Reading critical texts (general and academic) and summarizing, listening and responding, Negotiation strategies and decision making skills.

Module IV: Presentation Skills: Oral Presentation Skills (Proposal presentation), Powerpoint presentation (Projects).

Module V: Interviews: CVs and Resumes LinkedIN, Job application, Types of interviews, successful interviews, interview etiquette, dress code, body language, telephone/online interviews, one-to-one interview & panel interview, FAQs related to jobinterviews.

iv) a) TEXT BOOKS

1) Meenakshi Raman and Sangeetha Sharma (2018). "Professional Communication", 3rdEdition, Oxford University Press, 2018

2) Meenakshi Raman and Sangeetha Sharma, ”Technical Communication: Principles andPractice”, 2nd Edition, Oxford University Press, 2011

3) M. Ashraf Rizvi, "Effective Technical Communication". New Delhi: Tata McGraw HillPublications, 2007.

b) REFERENCES

1. English for Engineers and Technologists (Combined edition, Vol. 1 and 2),OrientBlackswan 2010.
2. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGrawHillEducation, 2012.
3. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
4. David F. Beer and David McMurrey, Guide to writing as an Engineer, JohnWilley.New York, 2004.
5. Goodheart-Willcox, "Professional Communication", First Edition , 2017.
6. Training in Interpersonal Skills: Tips for Managing People at Work,PearsonEducation, India, 6 edition, 2015.
7. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success,PearsonEducation; 1 edition, 2013.
8. Anand Ganguly, “Success in Interview”, RPH, 5th Edition, 2016.
9. Raman Sharma, “Technical Communications”, Oxford Publication, London, 2004.

v) CONTINUOUS ASSESSMENT

Attendance	5 marks
Project report writing	10 marks
Technical presentation through PPT	10 marks
Listening Test	10 marks
Group discussion/mock job interview	10 marks
LinkedIN submission :	5 marks
Case Study:	20 marks
Project	30 marks
Total	100 Marks

vi) END SEMESTER EXAMINATIONS

NIL

.

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23CYP10A	ENGINEERING CHEMISTRY LAB	BSC	0	0	2	**0**	1	2023

i) COURSE OVERVIEW:

This course is designed to familiarize with the basic experiments in industrial chemistry and to accustom the students with the handling and analyzing chemicals and standard laboratory equipments.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Use volumetric titration techniques forquantitative analysis of water.	Apply
CO 2	Use spectroscopic techniques for analyzing and interpreting the IR spectraand NMR spectra of some organic compounds.	Apply
CO 3	Use instrumental techniques forquantitative chemical analysis.	Apply
CO 4	Organize scientific experiments as ateam to analyze the results of such experiments.	Analyze
CO 5	Interpret experimental data by themselves to apply them to real worldproblems.	Analyze

iii) SYLLABUS

1. Estimation of total hardness of water by EDTA method.
2. Analysis of IR and ^{1}H NMR spectra of organic compounds.
3. Determination of wavelength of absorption maximum and colorimetric estimation of Fe^{3+} insolution.
4. Determination of molar absorptivity of a compound.
5. Estimation of chloride in water by argentometric method.

6. Calibration of pH meter and determination of pH of a solution.
7. Potentiometric titration: Acid – base titration
8. Estimation of dissolved oxygen in water by Winkler's method.

iv) b) REFERENCES

1) R. K. Mohapatra, *Engineering Chemistry with Laboratory Experiments*, 2015, Firstedition, PHI Learning, New Delhi.

2) S. C. George, R. Jose, Lab *Manual of Engineering Chemistry*, 2019, First edition, S.Chand & Company Pvt Ltd, New Delhi.

3) E. Slowinski, W. C. Wolsey, *Chemical Principles in the Laboratory***, 2008,** CengageLearning, 11th edition, New Delhi.

v) CONTINOUS ASSESSMENT

Attendance	:	5 marks
Classwork / Assessment / Viva-voce	:	55 marks
Written Examination	:	40 marks
Total	:	100 Marks

vi) END SEMESTER EXAMINATIONS

NIL

Course Code	Course Name	Category	L	T	P	J	Credit	Year of Introduction
23ESB10P	Manufacturing and Construction Practices B	ESC	1	0	2	0	2	2023

i) COURSE OVERVIEW:

- This subject for exposing the students to the various theoretical and practical aspects of, manufacturing processes and familiarize various tools, measuring device, practices and machines used in workshop section.
- The goal of this course is to introduce the students to the field of Civil Engineering and its importance in the development of the Country. The course is designed to have lecture sessions on an introduction to the various fields of Civil Engineering and different aspects of construction. The workshop session will provide hands-on experience in certain construction-related activities including surveying and levelling.

ii) COURSE OUTCOMES

After the completion of the course, the student will be able to:

CO 1	Explain the basic manufacturing, metal joining and machining processes	Understand
CO 2	Demonstrate general safety precautions in different mechanical workshop trades.	Understand
CO 3	Prepare simple models using fitting, carpentry, sheet metal, welding and 3D printing techniques.	Apply
CO 4	Identify the tools and equipment used in fitting, carpentry, sheet metal, welding and various machine tools.	Apply
CO 5	Explain the various disciplines of Civil Engineering and its relevance in the development of the nation.	Understand
CO 6	Explain the different structural elements of a building and the building rules and regulations.	Understand
CO 7	Apply engineering principles and tools to set-out a plan, estimate the area and profile of plots, and construct masonry wall.	Apply
CO 8	Examine the quality of different building blocks.	Apply
CO 9	Make use of plumbing tools to install fixtures like tap, T-Joint, elbow, bend etc.	Apply

iii) SYLLABUS

PART-I MECHANICAL

Module 1: Introduction to Workshop practice: Workshop practice, shop floor precautions, ethics and First Aid knowledge. Studies of mechanical tools, components and their applications: Tools: Screw drivers, spanners, Allen keys, cutting pliers etc. and Accessories

Module 2: Sheet Metal–Sheet metal forming, Sheet metal cutting, Forging, Rolling, Extrusion. Welding– Elementary ideas of joining process-welding, soldering and brazing. Fitting–Study of tools, Practice in filing, cutting. Male and female joints. Carpentry– Study of tools and joints. Practice in planning, chiseling, marking and sawing.

Module 3: Machine Tools (Basic elements, Working principle and types of operations), Lathe, Drilling Machine, Shaper, planer, slotter, Milling Machine, Grinding machine Machining processes: turning, taper turning, thread cutting, shaping, drilling, grinding, milling. Introduction to CNC and 3D Printing.

Practicals:

1. Machine shop

iv) a) TEXT BOOKS

1) AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual)ISBN: 978-93-91505-332
2) Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of WorkshopTechnology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
3) Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition,Pearson Education India Edition, 2002.

b) REFERENCES

1) Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education,2008.
2) Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India,1998.
3) Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

PART-II CIVIL

Module 1: General Introduction to Civil Engineering: Relevance of Civil Engineering in the development of the nation. Brief introduction to major disciplines of Civil Engineering: Surveying, Structural Engineering, Geotechnical Engineering, Hydraulics & Water Resources, TransportationEngineering, Environmental Engineering, Construction planning & Project management, GIS.

Module 2: Structural elements of a building: Foundation, plinth, lintel, masonry wall, column, beam, slab, sunshade, parapet, staircase. Plinth area, built up area, carpet area, floor area ratio. Permission plan of a building – Demonstration. Building rules and regulations: NBC, KBR & CRZnorms.

Module 3: Surveying: Principles, instruments used. Levelling: Principles of levelling using dumpylevel - simple levelling, differential levelling. Demonstration of Total Station. Brick masonry – Types of bonds, Masonry arches, number of bricks for construction, other types of building blocks. Construction materials – cement, mortar, concrete. Plumbing tools. Types of roofs, Flooring materials

Practicals:

1. Compute area of a given plot using tape, EDM etc.

2. Levelling – Plot the longitudinal section of a road.

3. Setting out of a building: Set out a building as per the given building plan. Each groupcan set out one or two rooms of the building.

4. Construct a wall of height 50 cm and wall thickness 1½ bricks using English bond (Nomortar required) – corner portion – length of side walls 60 cm

5. Cast paver blocks using mortar and test for strength (Include sustainable materials also)

6. Tests for strength of various types of building blocks

7. Study on plumbing and install plumbing fixtures like Tap, T-Joint, Elbow, Bend,Threading etc.

8.Plan a rainwater **harvesting system**

a) TEXT BOOKS

1) B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Basic Civil Engineering, 1 st Edition, 2003, Laxmi Publications.
2) Rangwala, Essentials of Civil Engineering, 1 st Edition, 2012, Charotar Publishing House.
3) Mamlouk M. S. and Zaniewski J. P., Materials for Civil and Construction Engineering, Pearson Publishers, 4 th Edition, 2017.
4) B.C. Punmia, Ashok Kumar Jain, Arun Kumar Jain, Surveying – Volume I, 17 th Edition, 2016, Laxmi Publications.

b) REFERENCES AND CODES/RULES OF PRACTICES

1) W. B. McKay, Building Construction- Volumes 1 to 4, 4 th /5 th Edition, 2013, Pearson Education India.
2) W.F. Chen and J.Y. Richard Liew (Eds.), The Civil Engineering Handbook, 2 nd Edition, 2002, CRC Press (Taylor and Francis).
3) Kerala Municipality Building Rules, 2019, Local Self Government (RD) Department, Government of Kerala.
4) Kerala Panchayat Building Rules, 2019, Local Self Government (RD) Department, Government of Kerala.
5) SP 7 : 2016, National Building Code of India 2016 (NBC 2016), Bureau of Indian Standards, New Delhi, 2016.
6) Coastal Regulation Zone Rules (CRZ rules), 2019, Ministry of Environment, Forest, and Climate Change (MoEFCC), Government of India.
7) IPA

v) CONTINUOUS ASSESSMENT

Attendance	5 marks
CA Exams (CAT1 and CAT2)	10 Marks Each
Assignment	15 Marks
Lab Work	10 Marks
Lab exam	10 Marks
Total	**60 Marks**

vi) END SEMESTER EXAMINATIONS

There will be an end semester examination for 40 marks with a duration of 2 hours.