Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur-440033

Scheme and Syllabus for

Bachelor of Technology (Fire Engineering)

Submitted by

Board of Studies in Fire Engineering

Vision and Mission of the Institution

Vision

To develop an institution of excellence in training and research to build capacities in prevention, protection and firefighting needs of our nation and the world at large.

Mission

- **M1.** To recognize well educated fire professionals in order to prevent and protect people's life and property from fire and other accidents.
- **M2.** To ensure maximum performance and render remarkable service by providing an effective and well-timed firefighting, rescue and lifesaving operations.
- **M3.** To encourage, endorse and endure scientific research in Science, Technology and Engineering for fire & emergency services.
- **M4.** To undertake collaborative research and consultancy for long-term interaction with leading organizations.

Vision and Mission of the Department of Fire Engineering

Vision

Provide professionals in the field of fire engineering to build capacities in prevention, protection and firefighting needs across the globe.

Mission

- **M1.** To create graduates possessing sound knowledge of fire engineering to serve society.
- **M2.** To engage the graduates in fire service activities that promotes protection of life, property and fire emergencies
- **M3.** To produce graduates having ethical values and leadership qualities in societal and environmental concern.
- **M4.** To develop entrepreneurs for fire prevention and fire protection

Program Educational Objectives (PEOs):

- **PEO1.** Adopt professional behavior, ethical attitude, discipline, team work in fire service organizations.
- **PEO2.** Exhibit the technical competence in solving fire engineering problems that are economically feasible and socially acceptable.
- **PEO3.** Pursue in special career and/or higher education by utilizing the knowledge acquired through the fire service experience.

Program Outcomes (PO): Engineering Graduates will be able to:

- **PO1.** **Engineering knowledge:** An ability to apply knowledge of mathematics, science and engineering fundamentals to the solution of fire engineering problems.
- **PO2.** **Problem Analysis:** An ability to design and conduct experiments, as well as to analyse and interpret data.
- **PO3.** **Design and Development of Solution:** An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- **PO4.** **Conduct investigation of Complex problems:** Knowledge of research methodology, data interpretation to provide valid conclusion of contemporary issues.
- **PO5.** **Modern Tool Usage:** An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
- **PO6.** **The Engineer and Society:** An ability to apply reasoning informed by the contextual knowledge to assess health, safety and cultural issues relevant to the professional engineering practices.
- **PO7.** **Environmental and Sustainability:** The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
- **PO8.** **Ethics:** Apply ethical principles, commit to professional ethics, discipline and responsibilities of engineering practice.
- **PO9.** **Individual and Team Work:** An ability to function on multidisciplinary teams.
- **PO10.** **Communication:** An ability to communicate effectively.
- **PO11.** **Project management and Finance:** An ability to demonstrate knowledge and understanding of engineering and management principles and application to the project work.
- **PO12.** **Life-long learning:** Recognition of the need for, and an ability to engage in lifelong learning.

Program Specific Outcomes (PSO): At the end of the program, the student

- **PSO1.** Perform the fire ground operations for discipline, team building, unity and synergy in fire service administration
- **PSO2.** Maintain the fire-fighting appliances and equipment for fire prevention and protection.

ANNEXURE I

Illustrative Semester wise Credit distribution structure for FYUG Engineering Program – Fire Engineering

Semester		I	II	III	IV	V	VI	VII	VIII	Total Credits
Basic Science Course	BSC	6	8	--	--	--	--	--	--	14
Engineering Science Course	ESC	8	4	--	--	--	--	--	--	12
Programme Core Course (PCC)	Program Courses	--	02	4 * 2 = 8	4 * 2 = 8	4 * 2 + 2 = 10	4 * 2 = 8	04	--	40
Programme Elective Course (PEC)		--	--	--	--	03	4 * 2 = 8	3 * 2 = 6	--	17
Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	02	02	03	02	02	--	11
Open Elective (OE)		--	--	04	02	02	--	--	--	08
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	02	--	02	02	02	--	--	10
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	02	--	--	02	--	--	--	--	04
Entrepreneurship/Economics/ Management Courses		--	--	02	02	--	--	--	--	04
Indian Knowledge System (IKS)		--	02	--	--	--	--	--	--	02
Value Education Course (VEC)		--	--	02	02	--	--	--	--	04
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--	04	--	04
Comm. Engg. Project (CEP)/Field Project (FP)		--	--	02	--	--	--	--	--	02
Project		--	--	--	--	--	--	04	04	08
Internship/ OJT		--	--	--	--	--	--	--	12+4=16	16
Co-curricular Courses (CC)	Liberal Learning Courses	02	02	--	--	--	--	--	--	04
Total Credits (Major)		**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**

ANNEXURE II

Teaching and Examination Scheme

B. Tech. Sem-I (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	BSC-I	BFE1T01	Mathematics-1	ASH	3	-	-	3	3	70	30	45	-	-	-
2	BSC-II	BFE1T02	Physics	ASH	2	-	-	2	3	70	30	45	-	-	-
3	BSC-II	BFE1P02	Physics Laboratory	ASH	-	-	2	1	-	-	-	-	-	50	25
4	ESC-I	BFE1T03	Basic Electrical Engineering	FE	3	-	-	3	3	70	30	45	-	-	-
5	ESC-I	BFE1P03	Basic Electrical Engineering Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
6	ESC-II	BFE1T04	Engineering Graphics	FE	3	-	-	3	3	70	30	45	-	-	-
7	ESC-II	BFE1P04	Engineering Graphics Laboratory	FE	-	-	2	1	-	-	-	-	-	50	25
8	AEC-I	BAE1T01	Academic report Writing	ASH	2	-	-	2	3	70	30	45	-	-	-
9	VSC-I	BVS1P01	Fire Ground Operation-1	FE	-	-	4	2	-	-	-	-	50	50	50
10	CC-I	BCC1P01	Refer CC Basket	ASH	-	-	4	2	-	-	-	-	-	100	50
Total					**13**	**-**	**14**	**20**		**350**	**150**		**75**	**275**	

B. Tech. Sem-II (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	BSC-III	BFE2T05	Mathematics-II	ASH	4	-	-	4	3	70	30	45	-	-	-
2	BSC-IV	BFE2T06	Chemistry	ASH	3	-	-	3	3	70	30	45	-	-	-
3	BSC-IV	BFE2P06	Chemistry Laboratory	ASH	-	-	2	1	-	-	-	-	-	50	25
4	ESC-III	BFE2T07	Basic Electronics & Communications	FE	2	-	-	2	3	70	30	45	-	-	-
5	ESC-III	BFE2P07	Basic Electronics & Communications Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
6	ESC-IV	BFE2P08	Workshop Practices	FE	-	-	2	1	-	-	-	-	25	25	25
7	PCC-I	BFE2T09	Fundamentals of Fire Engineering	FE	2	-	-	2	3	70	30	45	-	-	-
8	SEC-I	BSE2P01	Fire Ground Operation-2	FE	-	-	4	2	-	-	-	-	50	50	50
9	IKS-I	BIK2T01	Refer IKS Basket	ASH	2	-	-	2	3	70	30	45	-	-	-
10	CC-II	BCC2P01	Refer CC Basket	ASH	-	-	4	2	-	-	-	-	-	100	50
Total					**13**	**-**	**14**	**20**		**350**	**150**		**100**	**250**	

Exit Option: Award of UG Certificate in Major with 40 credits and an additional 8 credits in skill-based courses, internship, mini projects

B. Tech. Sem-III (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC-II	BFE3T10	Structural Fire Engineering	FE	3	-	-	3	3	70	30	45	-	-	-
2	PCC-II	BFE3P10	Structural Fire Engineering Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
3	PCC-III	BFE3T11	Fire Hydraulics	FE	3	-	-	3	3	70	30	45	-	-	-
4	PCC-III	BFE3P11	Fire Hydraulics Laboratory	FE	-	-	2	1	-	-	-	-	-	50	25
5	MDM-I	BMD3T12	Thermodynamics	FE	2	-	-	2	3	70	30	45	-	-	-
6	OE-I	BOE3T01	Open Elective-1 Refer OE Basket	FE	4	-	-	4	3	70	30	45	-	-	-
7	HSSM-I	BHM3T01	Fundamentals of Management	FE	2	-	-	2	3	70	30	45	-	-	-
8	VEC-I	BVE3T01	Constitution of India	ASH	2	-	-	2	3	70	30	45	-	-	-
9	CEP	BCE3P01	Fire Ground Operation-3	FE	-	-	4	2	-	-	-	-	-	100	50
Total					**16**	**-**	**8**	**20**	**18**	**420**	**180**	**270**	**25**	**175**	**100**

B. Tech. Sem-IV (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC-IV	BFE4T13	Fire Protection	FE	3	-	-	3	3	70	30	45	-	-	-
2	PCC-IV	BFE4P13	Fire Protection Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
3	PCC-V	BFE4T14	Heat and Mass Transfer	FE	3	-	-	3	3	70	30	45	-	-	-
4	PCC-V	BFE4P14	Heat and Mass Transfer Laboratory	FE	-	-	2	1	-	-	-	-	-	50	25
5	MDM-II	BMD4T15	Renewable Energy Sources	FE	2	-	-	2	3	70	30	45	-	-	-
6	OE-II	BOE4T02	Open Elective-II Refer OE Basket	FE	2	-	-	2	3	70	30	45	-	-	-
7	VSC-II	BVS4P02	Fire Ground Operations-4	FE	-	-	4	2	-	-	-	-	50	50	50
8	AEC-II	BAE4T02	Professional report Writing	ASH	2	-	-	2	3	70	30	45	-	-	-
9	HSSM-II	BHM4T02	Innovation, Business Models and Entrepreneurship	FE	2	-	-	2	3	70	30	45	-	-	-
10	VEC-II	BVE4T02	Environmental Science	FE	2	-	-	2	3	70	30	45	-	-	-
Total					**16**	**-**	**8**	**20**	**-**	**490**	**210**	**-**	**75**	**125**	**-**

Exit Option: Award of UG Diploma in Major and Minor with 80 credits and an additional 8 credits in skill-based courses, internship, mini projects etc.

B. Tech. Sem-V (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC-VI	BFE5T16	Fire Risk Assessment	FE	3	-	-	3	3	70	30	45	-	-	-
2	PCC-VI	BFE5P16	Fire Risk Assessment Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
3	PCC-VII	BFE5T17	Fire Dynamics	FE	3	-	-	3	3	70	30	45	-	-	-
4	PCC-VII	BFE5P17	Fire Dynamics Laboratory	FE	-	-	2	1	-	-	-	-	-	50	25
5	PCC-VIII	BFE5T18	Fire Code & Standards	FE	2	-	-	2	3	70	30	45	-	-	-
6	PEC-I	BFE5T19	Elective-I Refer Program Elective Basket	FE	3	-	-	3	3	70	30	45	-	-	-
7	MDM-III	BMD5T20	Automobile Engineering	FE	2	-	-	2	3	70	30	45	-	-	-
8	MDM-III	BMD5P20	Automobile Engineering Laboratory	FE	-	-	2	1	3						
8	SEC-II	BSE5P02	Fire Ground Operation-5	FE	-	-	4	2	-	-	-	-	50	50	50
9	OE-III	BOE5T03	Open Elective-III Refer OE Basket	FE	2	-	-	2	3	70	30	45	-	-	-
Total					**15**	**-**	**10**	**20**	**-**	**420**	**180**	**-**	**75**	**125**	**-**

B. Tech. Sem-VI (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC-IX	BFE6T21	Fire Testing	FE	3	-	-	3	3	70	30	45	-	-	-
2	PCC-IX	BFE6P21	Fire Testing Laboratory	FE	-	-	2	1	-	-	-	-	25	25	25
3	PCC-X	BFE6T22	Fire Modelling	FE	3	-	-	3	3	70	30	45	-	-	-
4	PCC-X	BFE6P22	Fire Modelling Laboratory	FE	-	-	2	1	-	-	-	-	-	50	25
5	PEC-II	BFE6T23	Elective-II Refer Program Elective Basket	FE	4	-	-	4	3	70	30	45	-	-	-
6	PEC-III	BFE6T24	Elective-III Refer Program Elective Basket	FE	4	-	-	4	3	70	30	45	-	-	-
7	MDM-IV	BMD6T25	Internet of Things	FE	2	-	-	2	3	70	30	45	-	-	-
8	SEC-III	BSE6P03	Fire Ground Operations-6	FE	-	-	4	2	-	-	-	-	50	50	50
Total					16	-	8	20		350	150		75	125	

Exit Option: Award of UG Degree B. Voc/B.Sc in Major with 120 credits and an additional 8 credits in skill-based courses, internship, mini projects etc.

B. Tech. Sem-VII (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC-XI	BFE7T26	Fire Arson and Investigation	FE	4	-	-	4	3	70	30	45	-	-	-
2	PEC-IV	BFE7T27	Elective-IV Refer Program Elective Basket	FE	3	-	-	3	3	70	30	45	-	-	-
3	PEC-V	BFE7T28	Elective-V Refer Program Elective Basket	FE	3	-	-	3	3	70	30	45	-	-	-
4	MDM-V	BMD7T29	Instrumentation and Control	FE	2	-	-	2	3	70	30	45	-	-	-
5	RM	BRM7T30	Research Methodology#	FE	4	-	-	4	3	70	30	45	-	-	-
6	Project-I	BPR7P01	Project-I	FE	-	-	8	4	-	-	-	-	100	100	100
Total					16	-	8	20		350	150		100	100	

 # Indicates that, online course to be done from NPTEL/SWAYAM. Examination will be conducted by NPTEL/RTMNU.

B. Tech. Sem-VIII (Fire Engineering-Major)

S. No	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (Hours)			Total Credits	Examination Scheme						
									Theory				Practical		
					Theory	Tutorial	Practical		Exam Hours	SEE	CIE	Min.	SEE	CIE	Min.
1	Project-II	BPR8P02	Project-II	FE	-	-	8	4	-	-	-	-	100	100	100
2	OJT-I	BOJ8P01	Internship	FE	-	-	8	4	-	-	-	-	-	100	50
3	OJT-II	BOJ8P02	Training & Attachment	FE	-	-	24	12	-	-	-	-	200	200	200
Total							40	20		0	0		300	400	

4-Years Bachelor's Degree (B. Tech.) in Engg. /Tech. with Multidisciplinary Minor

LIST OF INDIAN KNOWLEDGE SYSTEM COURSES (IKS) BASKET
FIRE ENGINEERING BOS

(Offered by Applied Science Board and Humanities)

S.N.	Semester	Category	Course code	Course name
1	2nd sem	IKS-I	BIK2T01A	Consciousness Studies
2			BIK2T01B	Preserving Art, Culture and Tradition
3			BIK2T01C	Wellness, traditional medicines and yoga
4			BIK2T01D	Glimpses of ancient Science and Technology

LIST OF PROGRAM ELECTIVE COURSES (PEC) Fire Engineering

S.N.	Semester	Category	Course code	Course name
1	5th	PEC-I	BFE5T19A	Electric Fire Safety Practice and Standards
2			BFE5T19B	Health, Safety and Environmental Management in Petroleum and Offshore Engineering
3			BFE5T19C	Safety in Construction
4	6th	PEC-II	BFE6T23A	Fire and Life Safety Audit
5			BFE6T23B	Offshore Structures Under Special Environmental Loads Including Fire Resistance
6			BFE6T23C	Nuclear Reactors and Safety
7		PEC-III	BFE6T24A	Electrical Failures and Explosions: Prevention and Troubleshooting.
8			BFE6T24B	Hydrogen Energy: Production, Storage, Transportation and Safety
9			BFE6T24C	Computational Fluid Dynamics
10	7th	PEC-IV	BFE7T27A	Chemical Process Safety
11			BFE7T27B	Safety Practices in Chemical and Nuclear Industries
12			BFE7T27C	Natural Hazards
13		PEC-V	BFE7T28A	Fire Safety Management
14			BFE7T28B	Electrical Safety and Risk Analytics
15			BFE7T28C	Industrial Safety Engineering

Abbreviations:

- Generic/ Open Electives: OE
- Vocational Skill and Skill Enhancement Courses: VSEC
- Vocational Skill Courses: VSC
- Skill Enhancement Courses: SEC
- Ability Enhancement Courses: AEC
- Indian Knowledge System: IKS
- Value Education Courses: VEC
- On Job Training: Internship/ Apprenticeship: OJT
- Field projects: FP
- Community engagement project: CEP
- Co-curricular Courses: CC
- Research Methodology: RM
- Research Project: RP
- Liberal Learning Course: Lib. Learn
- Courses on Humanities, Social Science, and Management: HSSM
- Semester End Examination: SEE
- Continuous Internal Evaluation: CIE

Course Code	BFE1T01							
Category	Basic Science Course							
Course Title	Mathematics-I							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - I			
	3	-	-	3				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100	45	-	-	-	-
Pre-requisites (if any):	Knowledge of elementary calculus, Linear Algebra							

Course Objectives: The objectives of this course are

1. To provide students with a comprehensive understanding of advanced mathematical concepts and techniques that are crucial for solving problems in science and engineering.
2. To equip students with the knowledge and skills needed to handle matrices, solve polynomial and transcendental equations, understand the intricacies of differential equations, and apply transforms to solve real-world problems.
3. To instill an appreciation for the convergence of sequence and series and to develop the ability to test for convergence.
4. To proficient in applying these mathematical concepts and methods to analyze and solve problems in their respective fields of study.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Analyse and formulate solutions to problems involving matrix algebra, enabling the resolution of linear equations and the diagonalization of matrices.
2. Design and implement numerical methods to accurately solve polynomial and transcendental equations and to perform precise numerical integration.
3. Synthesize and evaluate numerical methods to solve ordinary and partial differential equations, ensuring the stability and convergence of the solutions.
4. Apply and assess the effectiveness of Laplace and Fourier transforms in solving differential equations and in evaluating integrals, demonstrating a deep understanding of the underlying principles and theorems.
5. Investigate and determine the convergence of sequences and series, and proficiently represent functions as power and Fourier series.

Mathematics – I

Unit I **(08 Hrs)**

Algebra of matrices, Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, Orthogonal transformation and quadratic to canonical forms.

Unit II **(07 Hrs)**

Solution of polynomial and transcendental equations – Bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, Interpolation using Newton's forward and backward difference formulae. Central difference interpolation: Gauss's forward and backward formulae. Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules.

Unit III **(07 Hrs)**

Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-
Kutta method of fourth order for solving first and second order equations. Milne's and Adam's predicator-corrector methods. Partial differential equations: Finite difference solution two-dimensional Laplace equation and Poisson equation, Implicit and explicit methods for one dimensional heat equation (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for wave equation.

Unit IV **(07 Hrs)**

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier transforms.

Unit V **(07 Hrs)**

Convergence of sequence and series, tests for convergence, power series, Taylor's series. Series for exponential, trigonometric and logarithmic functions; Fourier series: Half range sine and cosine series, Parseval's theorem.

Text Book/ Reference Book

1) D. Poole, "Linear Algebra: A Modern Introduction", Brooks/Cole, 2005.
2) B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers, 2010.
3) V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West press, 2005.
4) G.B. Thomas and R.L. Finney, "Calculus and Analytic geometry", Pearson, 2002.
5) T. Veerarajan, "Engineering Mathematics", McGraw-Hill, New Delhi, 2008.
6) B. V. Ramana, "Higher Engineering Mathematics", McGraw Hill, New Delhi, 2010.
7) N.P. Bali and M. Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 2010.
8) E. Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 2006.

E-Resources and other digital material:

1. Engineering Mathematics - I, IIT Kharagpur by Prof. Jitendra Kumar https://nptel.ac.in/courses/111105121
2. https://www.coursera.org/specializations/mathematics-engineers
3. https://www.edx.org/learn/math/schoolyourself-introduction-to-algebra
4. https://www.youtube.com/playlist?list=PLUl4u3cNGP63oTpyxCMLKt_JmB0WtSZfG
5. https://www.youtube.com/playlist?list=PL49CF3715CB9EF31D

Course Code	BFE1T02							
Category	Basic Science Course							
Course Title	Physics							
Scheme and Credit	Th	T/A	Pr	Credits	Semester – I			
	2	-	-	2				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100	45	-	-	-	-
Pre-requisites (if any):	-							

Course Objectives: - The objectives of this course are

1) To provide students with a comprehensive understanding of advanced physics concepts, including wave theory, quantum mechanics, crystallography, and optics, with a focus on their applications in technology and research.
2) To equip students with the knowledge and skills needed to analyze physical phenomena, perform experiments, and interpret results accurately.
3) To proficient in applying these physics concepts and methods to solve problems, conduct research, and develop technologies in their respective fields of study.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Analyze and apply principles of wave theory and interference to interpret light phenomena and diffraction.
2. Utilize concepts of quantum mechanics to analyze and interpret the behaviors and properties of particles at the quantum level.
3. Examine crystal structures and apply knowledge of crystallography to interpret and analyze crystallographic data.
4. Evaluate and apply the principles of optical fibers for various applications, including communication systems and sensors.

Physics

Unit I **(06 Hrs)**

Huygen's principle, superposition of waves and interference of light by wave front splitting and amplitude splitting, Interference in thin films, Interference in Wedge shape thin film, Newton's rings, Anti-reflection coating. Fraunhoffer diffraction from a single slit and a circular aperture, Diffraction grating and its resolving power.

Unit II **(06 Hrs)**

Planck's Hypothesis, Properties of Photons, Compton Effect: Equations for energy and momentum conservation, Expression for Compton shift & its interpretation. Concept of wave particle duality, de-Broglie Hypothesis, Matter Waves, Davisson-Germer Experiment; Bohr's Quantization condition. Wave function ψ and normalization condition, concept of wave packets, Heisenberg Uncertainty Principle. Schrodinger wave equation (time dependent and time independent).

Unit III **(06 Hrs)**

Crystal structure, Meaning of lattice and basis, Unit cell: primitive and non-primitive unit cell; Cubic crystal structure: Simple, Body and Face cantered cubic structures, Unit cell characteristics: Effective number of atoms per unit cell, atomic radius, nearest neighbor distance, coordination number, atomic packing fraction, void space, density. Crystal planes and Miller indices, Inter-planar distance and its co-relation with Miller indices and lattice parameter, Bragg's law of X-ray diffraction.

Unit IV **(06 Hrs)**

Optical fibers: Propagation by total internal reflection, structure and classification (based on
material, refractive index and number of modes), Modes of propagation in fiber, Acceptance angle, Numerical aperture, Attenuation and dispersion. Light sources and Detectors, Applications of optical fiber as Sensors - i) Temperature Sensor ii) Pollution / Smoke detector iii) Liquid level sensor, Fiber optic communication system.

Text Book/ Reference Book

1. P. M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata Mc GrawHill (1977).
2. J. L. Powell and B. Crasemann, Quantum Mechanics, Narosa Publishing House (1993).
3. Charles Kittel, Introduction to Solid State Physics,Wiley Eastern, 5th edition, (1983).
4. A. J. Dekker, Solid State Physics, Prentice Hall of India (1971).
5. A Textbook of Engineering Physics, Dr. M. N. Avdhanulu, Dr. P. G. Kshirsagar, S. ChandPublication
6. Text book of Applied Physics, Dr. D. S. Hardas, Dr. D. S. Bhoumik, Dr. S. Shastri, DasGanu Publication ISBN-978-93-84336-59-2 (2021)
7. Applied Physics, M. N. Avdhanulu, Shilpa A. Pande, Arti R. Golhar, Mohan Giriya, S.Chand
8. A Text Book of Engineering Physics Dr. Devashree Hardas & Dr. Ashish Panat, Das GanuPublication ISBN-978-81-921757-7-5 (2011)
9. Applied Physics, - Dr. (Mrs) S.P.Wankhede, Dr.ShrutiPatle, Dr.(Mrs.) S.U.Bhonsule andDr.N. S. Ugemuge. DNA Publication ISBN-978-81-945174-6-7 (2020)
10. Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles by R. Eisberg and R.Resnick, Wiley and Sons
11. Engineering Physics, second edition, Sanjay Jain, G. Sahasrabudhe, University's Press

E-Resources and other digital material:

1. Applied Physics, IIT Roorkee by Akhilesh Kumar Mishra https://www.youtube.com/watch?v=U2Qhpa2Zmm4&list=PLLy_2iUCG87B_Tmfs0y2tR8GNIkyRIKpW
2. Solid State Physics by Prof. Nirmal Ganguli-IISER Bhopal, https://onlinecourses.nptel.ac.in/noc21_ph21/preview
3. Basic courses-Engineering physics by M K Shrivastava, Department of Physics IIT, Roorkee https://www.youtube.com/watch?v=fIVlzKB4bBQ&list=PLbMVogVj5nJQgjnHCN9L4QkINYOQomSOd

Course Code	BFE1P02							
Category	Basic Science Course							
Course Title	Physics Laboratory							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - I			
	-	-	2	1				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	-	-	-	-	50	-	50	25
Pre-requisites (if any):	-							

Laboratory Outcomes: Upon successful completion of this practical course, students will be able to:

1. Conduct and analyze interference experiments to understand light behavior in thin films.
2. Apply optical principles to determine the properties of lenses and prisms accurately.
3. Investigate diffraction patterns and crystal structures to understand material properties and light interactions.
4. Evaluate Planck's constant and optical fiber properties, applying knowledge of quantum and optical physics.
5. Assess electronic properties and circuit behaviours through calibration and analysis of electrical signals and components.

List of Experiments: -

1. **Interference in Thin Films:** Students will study the interference patterns in wedge-shaped thin films to understand light wave interference and film properties.
2. **Radius of Curvature of a Plano Convex Lens:** By utilizing Newton's Rings, students will determine the radius of curvature of a plano convex lens, applying principles of optics.
3. **Diffraction due to Plane Diffraction Grating:** Students will observe and analyze diffraction patterns due to a plane diffraction grating to understand light diffraction and grating properties.
4. **Determination of Principal Refractive Indices of a Prism:** Through experimentation, students will determine the principal refractive indices of a prism, applying knowledge of refraction and prism properties.
5. **Determination of Planck's Constant:** Using LEDs, students will conduct experiments to determine Planck's constant, applying principles of quantum mechanics.
6. **Comparative Study of Cubic Crystal Structure:** Students will perform a comparative study of cubic crystal structures using models to understand crystallography and material properties.
7. **Determination of NA for Optical Fiber:** Students will determine the numerical aperture for optical fibers to understand fiber optics and optical communication principles.
8. **Determination of e/m of an Electron:** By using the bar magnet method (Thomson's method), students will determine the charge-to-mass ratio of an electron, applying knowledge of electromagnetism.
9. **Calibration of Time Base Circuit of CRO:** Students will calibrate the time base circuit of CROs and determine the frequency of electrical signals to understand circuit behaviors and signal processing.

10. **Determination of Phase of Electrical Signals:** Using CRO, students will determine the phase of electrical signals, applying knowledge of signal processing and circuit analysis.
11. **Determination of AC and DC Voltage:** Students will use CRO to determine AC and DC voltage of electrical signals, applying principles of electrical circuits and voltage analysis.

Note: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

Course Code	BFE1T03							
Category	Engineering Science Course							
Course Title	Basic Electrical Engineering							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - I			
	3	-	-	3				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100	45	-	-	-	-
Pre-requisites (if any):	-							

Course Objectives: - The objectives of this course are

1) To develop the ability to apply the fundamental laws and elements of electrical circuits.
2) To learn the principles of magnetism as well as design considerations for air gaps in magnetic circuits.
3) To develop knowledge on principles of design of static and rotating machines.
4) To introduce the students to the general structure of the electrical industry structure for transferring electric power from generating stations to the consumers.
5) To gives a comprehensive idea in utilization of electrical power such as electric heating, electric welding and illumination, electric traction.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Create a prototype circuit using network analysis and simplification theorems
2. Develop the basic electromagnetic concepts for industry applications
3. Classify and compare different types of Electrical machines
4. Analyze the fundamental operations of electrical power systems
5. Develop mathematical and simulation programs to solve various real life multi-disciplinary topics through electrical circuits.

Basic Electrical Engineering

Unit I: Electrical Circuits & Analysis (08 Hrs)

Basic concepts of Electricity, Circuit elements, Ohm's Law, Series and Parallel circuits, Kirchhoff's Laws, Network analysis, Network Theorems, Delta/Star & Star/Delta Transformation, alternating current fundamentals, important A.C. terminology, Series and Parallel A.C. Circuits, Resonance in A.C. Circuits, Polyphase A.C. Circuits.

Unit II: Electromagnetic Circuits (07 Hrs)

Basic concepts of electromagnetism, important terminology of magnetism, magnetic circuit, analysis of magnetic circuit, Classification of magnetic materials, B & H Curve, Hysteresis Loop, Electromagnetic Induction, Faraday's laws of electromagnetic induction, methods of producing induced E.M.F, self-induction, and mutual induction.

Unit III: Electrical Machines (07 Hrs)

Transformer: principle, working, E.M.F. equation, open circuit & short circuit tests, Load test, losses, regulation, and efficiency. Induction Motors: Single phase induction motors, three phase induction motors: principle, working, types, Slip, torque-slip characteristics, losses, methods starting. D.C. Generators & Motors: principle, working, E.M.F. equation, types, losses, armature reaction, characteristics. Synchronous machines: principle, working, E.M.F. equation, no load and loading conditions, phasor diagrams.

Unit IV: Electrical Power Systems **(07 Hrs)**

Generation of electrical energy, important terms and factors, introduction to Generation, transmission & Distribution, Electric supply systems, overhead and underground lines, distribution of electric power, faults in power system, switch gear equipment, arc phenomenon, arc extinction, and protection of electric power systems.

Unit V: Utilization of Electrical Energy **(07 Hrs)**

Economics of power generation, cost of electrical energy, tariff, types of tariffs, power factor studies and improvement methods, Basic concept of Illumination, definitions of luminous flux, luminous intensity, candle power, illumination, luminance, luminous efficiency (lumens/watt), different types of lamps, working principle of Incandescent lamp/Fluorescent/ Sodium Vapour/ Mercury vapour/CFL Lamps, Electric Heating and different methods, Electric welding and Electric Traction.

Text Book/Reference Books:

1. Basic Electrical Engineering: D.C. Kulshreshtha, Revised 1st edition, Tata Mc-Graw Hill Education Pvt. Ltd.
2. A Text Book of Electrical Technology: B. L. Thareja and A. K. Thareja, S. Chand Publication (Volume I, II & III).
3. Electrical Machinery by P.S Bimbhra:
4. Engineering Electromagnetics 7th Edition by W H Hayt, J A Buck
5. Circuit Theory: Analysis and Synthesis (English) 6th Edition by A Chakraborty
6. Power Systems Engineering by Nagrath and Kothari
7. Power Systems by JB Gupta & CL Wadhwa
8. Fundamentals of Electric Circuits (Edition 5) by Charles K. Alexander, Matthew N. O. Sadiku
9. Utilization of Electrical Power including Electric drives and Electric traction by J.B. Gupta, S.K. Kataria & Sons.
10. Generation, Distribution and Utilization of Electrical Energy – by C.L.Wadhwa New Age international (P) Limited,Publishers,1997

E-Resources and other digital material:

1. Basic Electrical Circuits by Prof. Gajendranath Chowdary-IIT Hyderabad https://onlinecourses.nptel.ac.in/noc23_ee81/preview
2. Basic Electrical Technology - (Electrical Engineering course from IISc Bangalore) NPTEL Lecture Videos by Prof. L. Umanand from IISc Bangalore. https://nptel.ac.in/courses/108108076

Course Code	BFE1P03							
Category	Engineering Science Course							
Course Title	Basic Electrical Engineering Laboratory							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - I			
	-	-	2	1				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	-	-	-	-	25	25	50	25
Pre-requisites (if any):	-							

Basic Electrical Engineering Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Explain the concept of circuit laws and network theorems and apply them to laboratory measurements.
2. Characterize the performance of an electric circuit as well as solving both single phase and three phase circuits.
3. Acknowledge the principles of operation and the main features of electric machines and their applications

List of Experiments:

1. Verification of Ohm's Law
2. Verification of KCL
3. Verification of KVL
4. OC & SC tests on single phase transformer.
5. Load test on single phase transformer.
6. To generate various signals and sequences (Periodic and aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp.
7. To perform the operations on signals and sequences such as addition, multiplication, scaling, shifting, folding and compute energy and power.
8. To study the operation and verification of Kirchhoff's current law and voltage law using simulation.
9. To study the operation and calculation of current in each branch using mesh analysis using simulation
10. To study the operation and calculation of node voltages and current in each branch by nodal analysis using simulation
11. To study the operation superposition Theorem using simulation
12. To study the operation Thevenin's Theorem using simulation
13. To study the operation Norton's Theorem using simulation
14. To study the operation Maximum Power Transfer Theorem using simulation

NB: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

Course Code	**BFE1T04**							
Category	**Engineering Science Course**							
Course Title	**Engineering Graphics**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - I**			
	3	-	-	3				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	30	70	100	45	-	-	-	-
Pre-requisites (if any):								

Course Objectives: The objectives of this course are

1. Acquire basic knowledge about engineering drawing language line types, dimension methods, and simple geometrical construction. To draw conic sections by various methods, Involutes, cycloid and spiral.
2. To acquire basic knowledge about physical realization of engineering objects and shall be able to draw its different views. To imagine visualization of lateral development of solids.
3. To visualize three-dimensional engineering objects and shall be able to draw their isometric views.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Implementing the basic knowledge of engineering graphics to construct projection of point and line.
2. Interpret the knowledge of orthographic projection to convert 3-dimensional object into 2 dimensional.
3. Apply the knowledge to understand the concept of projection of plane.
4. Apply the knowledge of isometric projection to construct 3- dimensional object
5. Sketching the various layout, symbols for drawing safety and operation

Engineering Graphics

Unit I **(08 Hrs)**

Introduction to Engineering Graphics: Use of various drawing instruments, Sizes of drawing sheets, different types of lines used in drawing practice, Dimensioning linear, angular, aligned system, unidirectional system, Introduction to scales & scale factor (RF). Construction of conic section by using various methods. Ellipse, Parabola and Hyperbola, Engineering Curves: Cycloid, Involute, Archimedean Spiral. Introduction to AutoCAD

Unit II **(07 Hrs)**

Basics of Orthographic Projections: Basic principles of orthographic projection, reference planes, concepts of four quadrants, methods of orthographic projections. First angle projections, Projections of Points and Lines: Projections of points in all possible positions w.r.t. reference planes. Projections of lines when it is perpendicular to one of the reference planes, when line is inclined to one & parallel to other reference plane. Lines inclined to both reference planes. (Lines in First Quadrant Only)

Unit III **(07 Hrs)**

Projection of planes: Types of planes, position of planes parallel to one of the reference planes, Perpendicular to one & inclined to other reference plane. Inclined to both reference planes. Types of Auxiliary Planes, projection on auxiliary planes. (Exclude determination of true shape). Projection of Solids: Types of solids, Simple positions, Axis inclined to one plane & parallel to another plane (only two stage)

Unit IV **(07 Hrs)**

Isometric View and Projection: Definition of isometric projection/view, Isometric scale, isometric lines, planes, Isometric to Orthographic projection

Unit V **(07 Hrs)**

Basics of Layout Drawings for Safety Operations: Importance of plan reading, use and value of plans and Explanation of common symbols, interpretation of symbols, Introduction of Building plan and identifying the building layout, Graphic symbols for fire protection symbols as per IS 12407 – 1988 (e 2002), Basic knowledge on piping symbols.

Text Book/ Reference Book

1. Bhatt, N. D. and Panchal, V. M., (2016). "Engineering Drawing", Charotar Publication, Anand, India.
2. Dhawan, R. K., (2000). "A Textbook of Engineering Drawing", S. Chand, New Delhi
3. Jolhe. D. A., (2015), "Engineering Drawing", Tata McGraw Hill, New Delhi.
4. Shah P.J., (2012) "Basics of Engineering Graphics", S. Chand, New Delhi.
5. IS 12407 – 1988 (R: 2002)
6. Shah, Kale & Patki, “Building Drawing”, Tata McGraw-Hill Education
7. Peter Smith, The Fundamentals of Piping Design, Gulf Publishing Company.

E-Resources and other digital material:

1. Engineering Graphics and Design by Prof. Naresh Varma Datla, Prof. S. R. Kale | IIT Delhi https://onlinecourses.nptel.ac.in/noc23_me144/preview
2. Engineering Drawing - (Mechanical Engineering course from IIT Kanpur) NPTEL Lecture Videos by Dr. Anupam Saxena from IIT Kanpur https://www.nptelvideos.com/course.php?id=758

Course Code	**BFE1T04**							
Category	**Engineering Science Course**							
Course Title	**Engineering Graphics**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - I**			
	-	-	2	1				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	-	-	-	-	50	-	50	25
Pre-requisites (if any):								

Engineering Graphics Laboratory

Laboratory Outcomes:

1. Draw the fundamental engineering objects using basic rules and able to construct the lines, simple geometries. Construct the various engineering curves using the drawing instruments.
2. Draw two dimensional and three-dimensional objects. Precisely using drawing equipment.
3. Draw the development of lateral surfaces for cut section of geometrical solids precisely using drawing equipment.
4. Draw a simple isometric projection from given orthographic views precisely using drawing equipment.

List of Experiments:

1. Construction of lines and basic polygons
2. Construction of engineering curves
3. Construction of conic section by using various methods
4. Introduction of AutoCAD, use of various commands in AutoCAD
5. Projection of Straight lines (Minimum 4 problems, 1 Sheet in AutoCAD)
6. Projection of planes -(Minimum 4 problems, 1 Sheet in AutoCAD)
7. Projection of Solids- -(Minimum 3 problems)
8. Orthographic Drawing (Minimum 2 problem)
9. Isometric View (Minimum 4 problems)
10. Isometric to orthographic projection (Minimum 2 problem)
11. Draw various symbols of fire safety operations
12. Residential and Industrial Building plans with fire exits

NB: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

Course Code	**BAE 1T01**							
Category	**Ability Enhancement Course**							
Course Title	**Academic Report Writing**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - I**			
	2	-	-	2				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	30	70	100	45	-	-	-	-
Pre-requisites (if any):	Basic knowledge on English grammar and Microsoft Office							

Course Objectives: - The objectives of this course are

1. To equip students with the necessary thought processes, language and composition skills to construct a variety of reports for technical audiences.
2. To refine the writing skills in the genre of report writing and learn the key principles of report writing.
3. To gain knowledge of various text editing, Schematics and graphs plotting, data organizing software tools.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the writing process and develop well-structured and meaningful written reports.
2. Craft texts in different genres (e.g., summary, problem statement, annotations, etc.).
3. Distinguish between different audience types and construct texts that suit their needs.
4. Knowledge on various drafting, editing software tools for technical report preparation.

Academic Report Writing Course Content

Unit I **(06 Hrs)**

An Approach to Academic Writing: Audience, Purpose and Strategy, Organization, Style, Language Focus: The Vocabulary Shift—Verbs, Nouns, Other Parts of Speech, Other Stylistic Features, Flow, Linking Words and Phrases, Presentation, Positioning.

Unit II **(06 Hrs)**

Problem Statement, Process Report, and Solution: The Structure of Problem-Solution Texts, Language Focus: Mid-Position Adverbs, Procedures and Processes, -ing Clauses to Indicate Cause and Effect, Passive Voice, Flow of Ideas in a Process Description, Indirect Questions, Introducing the Solution.

Unit III **(06 Hrs)**

Writing a Technical Report: Parts of the Technical Report and Their Layout, Collecting and Ordering the Material, Tables and Figures, Literature Citations, The Text of the Technical Report, Completion of the Technical Report, and References.

Unit IV **(06 Hrs)**

Tools and Techniques: Various word processors, e.g, MS Word, Libra-office, Schematic diagrams: Microsoft Visio, Equations: MathType, Data organization and Plotting: Origin, MS Excel Referencing: Endnote, and Mendely, Latex etc. Making effective presentations using Power Point and Beamer, Uses of plagiarism detection tools.

Text Book/ Reference Book

1. John M. Swales & Christine B. Feak, "Academic Writing for Graduate Students: Essential Skills and Tasks" Michigan ELT, 2012.
2. J. Gerson, Steven M. Gerson, "Technical Communication: Process and Product Sharon" Pearson Education Limited 2014
3. Microsoft Office 2016, by Joan Lambert and Curtis Frye, Microsoft Press, Washington 98052-6399
4. LATEX for Beginners, Edition 5, March 2014 Document Reference: 3722-2014
5. Essential LATEX ++, Jon Warbrick with additions by David Carlisle, Michel Goossens, Sebastian Rahtz, Adrian Clark January 1994

E-Resources and other digital material:

1. https://www.youtube.com/watch?v=Xp2PVO3do34&list=PLbMVogVj5nJSZB8BV29_sPwwkzMTYXpaH&index=17
2. https://www.youtube.com/watch?v=G7sxgZ83WBM&list=PLbMVogVj5nJSZB8BV29_sPwwkzMTYXpaH&index=18

Course Code	BVS1P01							
Category	**Vocational Skill Course**							
Course Title	**Fire Ground Operation-I**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - I**			
	-	-	4	2				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	-	-	-	-	50	50	100	50
Pre-requisites (if any):	Nil							

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Exhibit discipline by performing exercises and squad drills as per established procedures.
2. Demonstrate commanding capability as commander to command the squad as per prescribed procedures.
3. Demonstrate discipline qualities by instilling skills and attitude of precision, and respond to words of command.
4. Personal behavior in uniform service.
5. Identify and describe concept and construction of Hose, Hydrant, Ladder, Knots & Lines, Pump, Foam, B.A set

Fire Ground Operation-I

1. **Discipline:** Ground decorum, mess decorum, Communication skill, Talking with senior officers, Faculty Members, Ground instructors and seniors, Dress code (Hostel, Mess, Ground, Academic), Dining Hall Discipline and Dining table etiquettes.

2. **Physical Exercise:** Running, Full body Rotational exercise, Abdominal Exercise, jumping, stretching, Monitoring Levels of Fitness, Pulse, Blood Pressure, Body fat, Aerobic exercises, capacity, Strength, Flexibility.

3. **Squad Drill**: Aim of drill, the principles of good instruction, Notes of drill instructors, definitions, Timing of words of command, Technique of instruction, Arrangement and conclusion of instructional periods, Position of the fireman at attention, Stand at ease, Stand easy turning and inclining, Dressing, Forming up in three ranks, Numbering, Proving, Open and close order march, Dismissing and falling out, Sizing, Getting on parade, Length of pace and time of marching, Marching, Marching in quick time, Elementary instruction, Formation of squad with intervals, the regulation of pace, Halt (quick time, slow time), Marching in slow time, Position in marching (slow time), Slow march, Stepping out and stepping short, side pace, Paces forward and to the rear, Wheeling, Turning and diagonal march in slow time, Marching in line and changing direction in quick time, Forming squad, Forming squad on the march in slow time, Forming squad on the march in quick time, Saluting at the halt, Saluting on the march, Marching off in single file, Reforming three ranks, Courtesy, Terminology.

4. Introduction to the basic concept of Hose, Hydrant, Ladder, Knots & Lines, Pump, Foam, B.A set

Text books/Reference books:

1. Fire Service Drill Book, GoI, MHA Publication
2. Fire Service Manual, HM Fire service manual
3. Fire Fighters Handbook, Delmar
4. Manual of Firemanship

Course Code	BFE2T05							
Category	Basic Science Course							
Course Title	Mathematics-II							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - II			
	4	-	-	4				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100	45	-	-	-	-
Pre-requisites (if any):	Mathematics-I							

Course Objectives: The objectives of this course are

1. To provide students with a profound understanding of advanced mathematical concepts including calculus, multiple integrations, probability, statistics, and curve fitting.
2. To equip students with the analytical skills needed to evaluate definite and improper integrals, apply theorems to analyze surfaces and volumes, understand the properties and applications of multiple integrations, and comprehend advanced probability and statistical concepts.
3. To apply these mathematical concepts and methods to analyze, design, and solve problems in their respective fields of study, and to make informed decisions based on statistical data.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Analyze and apply concepts of integrals, evolutes, and involutes to solve problems related to surface areas and volumes of revolutions.
2. Formulate and solve problems using multiple integration techniques and apply theorems of Green, Gauss, and Stokes in various coordinate systems.
3. Design and assess probability models, applying concepts of discrete random variables and probability distributions to solve complex problems.
4. Interpret statistical data to evaluate measures of central tendency, correlation, and regression, and apply various probability distributions to assess statistical parameters.
5. Construct curve-fitting models using the method of least squares and test the significance of statistical data to make informed decisions.

Mathematics – II Course Content

Unit I **(10 Hrs)**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle’s theorem, Mean value theorems, Taylor’s and Maclaurin theorems with remainders; Indeterminate forms and L'Hospital's rule; Maxima and minima.

Unit II **(10 Hrs)**

Multiple Integration: double and triple integrals (Cartesian and polar), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes by (double integration) Center of mass and Gravity (constant and variable densities). Theorems of Green, Gauss and Stokes, orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

Unit III **(10 Hrs)**

Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

Unit IV **(9 Hrs)**

Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

Unit V **(9 Hrs)**

Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas

and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Text Book/ Reference Book

1. B. V. Ramana, “Higher Engineering Mathematics”, McGraw Hill, New Delhi, 2010.
2. B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2000.
3. W. E. Boyce and R. C. DiPrima, “Elementary Differential Equations and Boundary Value Problems”, Wiley India, 2009.
4. S. L. Ross, “Differential Equations”, Wiley India, 1984.
5. E. A. Coddington, “An Introduction to Ordinary Differential Equations”, Prentice Hall India, 1995.
6. E. L. Ince, “Ordinary Differential Equations”, Dover Publications, 1958.
7. G.F. Simmons and S.G. Krantz, “Differential Equations”, McGraw Hill, 2007.
8. G.B. Thomas and R.L. Finney, “Calculus and Analytic geometry”, Pearson, 2002.
9. T. Veerarajan, “Engineering Mathematics”, McGraw-Hill, New Delhi, 2008.
10. N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
11. E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
12. P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
13. S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
14. W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.

E-Resources and other digital material:

1. Higher Engineering Mathematics by Dr. P. N. Agrawal IIT Roorkee https://onlinecourses.nptel.ac.in/noc19_ma22/preview

Course Code	**BFE2T06**							
Category	**Basic Science Course**							
Course Title	**Chemistry**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - II**			
	3	-	-	3				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	30	70	100	45	-	-	-	-
Pre-requisites (if any):								

Course Objectives: - The objectives of this course are

1) To provide students with a comprehensive understanding of energy, fuels, polymers, nanomaterial and environmental chemistry, focusing on their applications, properties, and impacts.
2) To equip students with the knowledge and skills needed to analyze energy sources, evaluate fuel properties, understand polymer synthesis and properties, and assess environmental impacts and solutions.
3) To proficient in applying these chemistry concepts and methods to solve problems, conduct research, and develop sustainable solutions in their respective fields of study.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Analyze and apply knowledge of energy basics and fuels, evaluating their thermal contents and calorific values.
2. Assess the properties and quality of liquid and gaseous fuels and apply knowledge of combustion calculations and fuel processing methods.
3. Develop and assess sustainable energy solutions and waste treatment methods, applying knowledge of bio-energy and waste management technologies.
4. Acquire knowledge about polymers, nanomaterials understanding their properties, applications, and development processes, including fabrication and molding.
5. To evaluate environmental pollution levels and apply green chemistry concepts to develop sustainable and eco-friendly solutions.

Chemistry

Unit I **(08 Hrs)**

Basics of Energy - Introduction, sources and types of energy, Units of energy, Thermal Basics of energy -fuels, thermal energy contents of fuel, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer. Classification of fuels, Calorific Value (HCV & LCV). Determination of Calorific value by Bomb and Boy's Calorimeter. Solid Fuels: -Significance of Proximate and Ultimate Analysis of coal. Numerical based on Dulong's formula. Numerical on Goutal's Formula for Gross Calorific Value based on Proximate Analysis. Numerical on Calorific Value determination. Numerical on GCV& NCV by using relation formula (convert answer in joules or one of the CV given in joules).

Unit II **(07 Hrs)**

Liquid Fuel: -Fractional distillation of crude oil, Catalytic cracking and its advantages. Knocking in internal combustion petrol and diesel engine, Octane and Cetane number, Knocking and its relationship with structure of fuel, Doping agents, Power alcohol, Gasohol, Dieselhol, Aviation fuel, Bio-diesel. Gaseous Fuel:-CNG, H_2 as specialised fuel. Combustion Calculations.

Unit III **(07 Hrs)**

Bio-energy, Photolysis of water- Chemical Conversion of Solar Energy. Nuclear fuels: Numerical on Binding Energy & Average Binding Energy per Nucleon. Fuel cells-working, advantages and disadvantages of alkaline, methanol fuel cells. Classification of waste on the basis of segregation at source, hazardous solid waste management technology: Physical method, chemical method, biological treatment, Eco-friendly Incineration, Depolymerization, land fill techniques. Utilization of Biogas and Landfill Gas for Biofuels and High Value Chemicals, gasification and Utilization of Syngas, Thermochemical Conversion of Syngas.

Unit IV **(07 Hrs)**

Mechanism of polymerization and synthesis of polymers. Molecular weight, shape and conformation of polymers. Crystallinity, melting point and glass transition. Copolymerization. Viscoelasticity. Elastomers-structure, applications and curing. Conducting polymers and applications. Dendrimers. Solubility of polymers. Fabrication and moulding of polymers. Synthesis, properties and uses of PE, PVC, PMMA, formaldehyde resins, melamine-formaldehyde-urea resins. Adhesives, adhesive mechanism and applications. Composites: characteristics, types and applications. Nanocomposites. Nanomaterials in fire resistance. Metallic and nonmetallic fillers. Hydrophobic agents

Unit V **(07 Hrs)**

Air, water and noise pollution. Optimum levels of pollution. Significance and determination of COD and BOD. Solid waste treatment of collection of NKP. Greenhouse effect and global warming. e-Waste. radioactive pollution. Applications

of green chemistry and green technology. Concept of atomic and molecular economy and its use in green chemistry.

Text Book/ Reference Books

1. Text Book of Engineering Chemistry: S.S. Dara, S. Chand and Company Ltd. New Delhi.
2. Textbook of Engineering Chemistry: P.C. Jain and Monica Jain, DhanpatRai and Sons, New Delhi.
3. Materials Chemistry: A.V. Bharati and Walekar, Tech Max Publications, Pune.
4. Energy and Environment: Archana R Chaudhari and Aditi Pandet, S. Chand Publication.
5. A Text book of Engineering Chemistry: Shashi Chawla; DhanpatRai & Sons, New Delhi.
6. Applied Chemistry by N. Krishnamurthy: P. Vallinavagam. and K. Jeysubramanian TMH.
7. Applied Chemistry for Engineers: T.S. Gyngell.
8. Fuels and Combustion: Amir Circar, Orient Longmans.
9. Fundamentals of Engineering Chemistry (Theory and Practice) :S. K. Singh (New AgeMaterials)
10. Environmental Chemistry: B. K. Sharma.
11. "Green Chemistry: An Inclusive Approach" by Bela Torok
12. SFPE Handbook of fire protection Engineering by Morgan J. Hurly and Daniel
13. Nanomaterials in Extreme Environments: Fundamentals and Applications by Rostislav
14. Flame Retardant Polymer Nanocomposites by Alexander Morgan
15. Industrial Energy Management and Utilization: L.C. Witte, P.S. Schmidt and D.R. Brown(Hemisphere Publishing Corporation,Washington, 1998
16. Energy and Environment- NPTEL lecture notes

Note: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

E-Resources and other digital material:

1. https://youtu.be/I_co2mlOB70?feature=shared
2. https://youtube.com/playlist?list=PLLy_2iUCG87BQKE4xHVjabFUdfX2k6C4_&feature=shared
3. https://youtu.be/LBc1OwcbXeY?feature=shared
4. https://youtube.com/playlist?list=PLLy_2iUCG87CZ8WsOQA3WWb1IqAuAlAuB&feature=shared

Course Code	BFE2P06							
Category	Basic Science Course							
Course Title	Chemistry Laboratory							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - II			
	-	-	2	1				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	-	-	-	-	50	-	50	25
Pre-requisites (if any):								

Laboratory Outcomes: Upon successful completion of this practical course, students will be able to:

1. Accurately determine the flash points of samples using different apparatus, understanding fuel safety and characteristics.
2. Evaluate the quality of oil and biodiesel by assessing neutralization numbers and viscosity at varying temperatures.
3. Conduct and interpret various water quality tests, applying analytical chemistry principles to assess ion concentrations, chemical oxygen demand, and turbidity.
4. Analyze coal to determine its moisture, volatile matter, and ash content, understanding its composition and energy content.
5. Observe and understand advanced analytical techniques through demonstrations, gaining insights into calorific value determination and flue gas estimation.

Chemistry Laboratory

List of Experiments: -

1. **Determination of Flash Point by Cleveland's Open Cup Apparatus:**Students will learn to determine the flash point of a given sample, understanding the temperature at which the sample can vaporize to form an ignitable mixture in air.
2. **Determination of Flash Point by Abels/ Pensky Martens Close Cup Apparatus:**This will teach students another method to determine the flash point, focusing on the safety and characteristics of different fuels.
3. **Determination of Neutralisation Number (Acid Value) of Oil:**Students will assess the quality of oil by determining its acid value, which indicates the amount of base required to neutralize it.
4. **Determination of Viscosity by Redwood Viscometer:**Students will learn to measure the viscosity and specific gravity of Biodiesel at different temperatures, understanding the flow characteristics of the fluid.
5. **Determination of Sulphate Concentration in a Given Water Sample:**Students will determine the sulphate concentration in water, which is crucial for assessing water quality and its suitability for various uses.
6. **Determination of Amount of Chloride by Mohr's Method:**This will teach students to determine chloride concentration in water, understanding the implications of chloride presence in water quality.
7. **Determination of COD of Water Sample:**Students will learn to determine the Chemical Oxygen Demand (COD) of water, which is a measure of the amount of oxygen required to oxidize organic and inorganic matter in water.

8. **Determination of Total Solids, Suspended Solids, and Total Dissolved Solids and pH of water:** Students will assess the quality of water by determining the amount of solids present, understanding the implications of different solids on water quality.
9. **Determination of Turbidity by Nephelometry:** Students will learn to measure the turbidity of water, which is crucial for assessing water clarity and quality.
10. **Proximate Analysis of Coal:** Students will determine the percentage of Moisture, Volatile Matter, and Ash in coal, understanding the composition and quality of coal.
11. **Determination of % Carbon by Carbon Residue Conradson Apparatus:** Students will learn to determine the carbon residue in samples, understanding the implications of carbon residue on fuel quality.
12. **Determination of molecular weight of a polymer by viscosity measurements:** This will teach students to determine the molecular wight for understanding its suitability for various applications.
13. **Determination of Calorific Value of Solid/Liquid Fuels (Virtual):** Through virtual demonstration, students will learn to determine the calorific value of fuels, understanding the energy content of different fuels.
14. **Estimation of Flue Gas by Orsat's Apparatus (Virtual):** Through virtual demonstration, students will learn to estimate the composition of flue gas, understanding the implications of different gas components on air quality and combustion efficiency.
15. **Determination of Grease Consistency by Penetrometer:** Students will learn to determine the consistency of grease, which is crucial for its application in lubrication of various machinery components.

Note: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

Course Code	BFE2T07							
Category	Engineering Science Course							
Course Title	Basic Electronics & Communications							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - II			
	2	-	-	2				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100	45	-	-	-	-
Pre-requisites (if any):								

Course Objectives: The objectives of this course are

1) To learn the characteristics of diodes, transistors, OP-amps of analog electronic components
2) To design the various combinational and sequential logic circuits used for processing and transmission of data.
3) To develop an overall approach for students from construction of control rectifier, inverter, choppers, study its specification, the functionality, design, and practical applications
4) To describe the mathematical techniques of generation, transmission, and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals.
5) To analyze error performance of a digital communication system in presence of noise and other interferences.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Apply the concepts of analog electronic to enhance the technology
2. Design the digital electronic kits for ease of operation in engineering
3. Analyze the power electronic circuits for automation in industries
4. Demonstrate good working of analog and digital communications systems

Basic Electronics & Communication Course Content

Unit I: Analog Electronics (08 Hrs.)

P-N junction diode; Simple diode circuits: clipping, clamping, rectifiers; Operational amplifier and its applications; Zener diode; BJT; FET; MOSFET; LED; photo diode and solar cell;

Unit II: Digital Electronics (08 Hrs.)

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Logic simplification using K-map, Logic ICs, half and full adder/subtractor, code converters, multiplexers, decoders; Sequential circuits; Data converters;

Unit III: Power Electronics (08 Hrs.)

Thyristors – Silicon Controlled Rectifiers (SCR's); Basic theory of operation of SCR; Static and Dynamic characteristics of SCR; Turn on and turn off methods; series and parallel connections of SCR's; Introduction to Triac, GTO, IGBT; Introduction to AC-DC Converters, DC-DC Converters (Choppers), AC-AC Converters (AC Voltage Controllers) & Frequency Changers (Cyclo-Converters), DC-AC Converters (Inverters)

Unit IV: Analog & Digital Communications (08 Hrs.)

Analog communications: amplitude modulation and demodulation, angle modulation and demodulation, spectra of AM and FM, superheterodyne receivers, circuits for analog communications. basics and fundamentals of the differences between the digital and analog communication system, critical aspects of a digital communication system, different components of digital communication system.

Text Books / Reference Books:

11. Electronic Devices and Circuit Theory by Boylestad
12. Digital Design by M.Morris Mano
13. Integrated Electronics : Analog And Digital Circuits And Systems by Christos C. Halkias, Chetan D. Parikh Jacob Millman
14. Power Electronics by MH Rashid
15. Power Electronics by P.S.Bimbhra
16. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
17. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
18. Floyd," Electronic Devices" Pearson Education 9th edition, 2012.
19. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
20. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
21. R.P. Jain, "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
22. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001
23. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
24. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
25. M. H. Rashid, "Power electronics: circuits, devices, and applications", Pearson Education India, 2009.
26. N. Mohan and T. M. Undeland, "Power Electronics: Converters, Applications and Design", John Wiley & Sons, 2007.
27. R. W. Erickson and D. Maksimovic, "Fundamentals of Power Electronics", Springer Science & Business Media, 2007.
28. L. Umanand, "Power Electronics: Essentials and Applications", Wiley India, 2009.
29. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996
30. Principles of Mobile Communications by G. Stuber, Springer, 2nd ed..
31. Wireless Communications by A. Goldsmith, Cambridge
32. Introduction to Space Time Wireless Communications by A. Paulraj, Nabar and Gore
33. Space Time Wireless Communication Systems,by Bolskei, Gesbert, et al.
34. Satellite communications, 2nd edition, by T. Pratt, C. W. Bostian, J. E. Allnut, Publisher: John Willey and sons
35. Satellite Communications Systems: systems, techniques and technology, 5th edition, by G. Maral, M. Bousquet, Z. Sun, Publisher: John Willy and sons

E-Resources and other digital material:

1. Basic Electronics By Prof. M.B. Patil IIT Bombay
   https://onlinecourses.nptel.ac.in/noc21_ee55/preview
2. Electronics & Communication Engineering by Prof. Chitralekha Mahanta, Department of Electronics and Communication Engineering IIT Guwahati
   https://archive.nptel.ac.in/courses/117/103/117103063/
3. Modern digital communication techniques by Prof. Suvra sekhar das, Department of Electrical Engineering, IIT Kharagpur
   https://archive.nptel.ac.in/courses/117/105/117105144/

Course Code	BFE2P07							
Category	Engineering Science Course							
Course Title	Basic Electronics & Communications Laboratory							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - II			
	-	-	2	1				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	-	-	-	-	25	25	50	25
Pre-requisites (if any):								

Basic Electronics & Communication Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

4. Design and test the basic electric components like diodes, transistors and zener diode
5. Understand the working of logic gates
6. Analyze the working of analog communications systems
7. Design the significant features of digital communication systems

List of Experiments:

15. To study the P-N junction diode characteristics and Zener diode characteristics
16. To identify the Input and output characteristics of transistor
17. To study and generate the sine wave, square wave and triangular wave with OP AMP function generator
18. To design and test the performance of integrator and differentiator circuits using Op-amp.
19. Verification and interpretation of truth table for AND, OR, NOT, NAND, NOR, X-OR, X-NOR Gate
20. To Verify De-Morgan's First Law
21. To study of characteristics of an SCR
22. To study amplitude modulated wave using IC 1496
23. To perform the functioning of Frequency modulation & demodulation and also calculate the modulation index
24. To study FM wave propagation through Transmitter & Receiver
25. A.C. servomotor
26. A.C. and D.C. position control.
27. Schering bridge
28. Study potentiometer
29. Kelvin’s double bridge
30. Wein’s bridge
31. Thermistor characteristics
32. D.C. servomotor
33. Wheatstone bridge
34. D.C. servo meter
35. Colpitts oscillator
36. charging and discharging of capacitors
37. sine wave, square wave and triangular wave with op amp function generator
38. integrator and differentiator circuits using op-amp
39. verification and interpretation of logic gates
40. variation of resistance in thermistor

Note: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination

Course Code	**BFE2P08**							
Category	**Engineering Science Course**							
Course Title	**Workshop Practices**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - II**			
	-	-	2	1				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	-	-	-	-	50	50	100	50
Pre-requisites (if any):	-							

Workshop Practices Laboratory

Laboratory Outcomes: Upon successful completion of the course, the student will be able to:

1. Read and interpret job drawing and plan operations.
2. Identify and select proper material, tools, equipment, machines and proper operational parameters.
3. Set tools, work piece, and machines for desired operations.
4. Complete job of Carpentry, Fitting, Welding and Smithy as per job drawing in allotted time.
5. Use safety equipment and follow safety procedures during operations.

List of Experiments:

1. Carpentry shop introduction, wood working tools and their operation demonstration
2. Perform Mortise and Tenon Joint / Dovetail joint / Half lap Joint / Bridle Joint
3. Fitting shop, Demonstration of various tools
4. Perform fitting job involving practice of chipping, filing, drilling, tapping, cutting.
5. Introduction to Welding, Arc welding demonstration
6. Joining of mild steel plates by arc welding (Butt joint and Lap joint welding)
7. Demonstration of Forging operation and introduction to forging tools
8. Forging of Hook peg / Flat chisel
9. Demonstration of Rescue tools: Breaking tools / Forcible entry tools (Fireman axe, Bolt cutter, Sledge hammer, Crow Bar, Fireman hook)
10. Introduction to Branches, Nozzles, Breaches: Jet nozzles, Multipurpose Nozzle, Foam making branch pipes, dividing breach, Collecting breach.
11. Demonstration of Suction Tool Equipment Accessories: Suction Hose, Suction Wrench, Suction Strainers, Delivery Hose.
12. Demonstration to personal protective equipment

Note: A minimum of 10 (ten) experiments, must be performed and recorded by the candidate to attain eligibility for Practical Examination.

Course Code	BFE2T09							
Category	Program Core Course							
Course Title	Fundamentals of Fire Engineering							
Scheme and Credit	Th	T/A	Pr	Credits	Semester - II			
	2		-	2				
Examination Scheme	Theory				Practical			
	CIE	SEE	Total	Min.	CIE	SEE	Total	Min.
	30	70	100		-	-	-	-
Pre-requisites (if any):	Normal background in basic Fluid Mechanics, mass momentum equation, mathematics.							

Course Objective: The objective of this module to develop understanding regarding the fire engineering science.

1) To learn the basic difference between fire prevention, fire protection and firefighting.
2) To understand the application of fire engineering in different industries.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the basic concepts of Fire Engineering
2. Analyze the basic fire prevention techniques
3. Demonstrate the fire protection techniques
4. Identify the fire-fighting techniques

Fundamentals of Fire Engineering Course Content

UNIT- I: Fire Engineering Science (6 Hours)

Mathematics, Physical properties of matter, Mechanics, Heat, Heat transmission, Thermal expansion, Hydraulics, Chemistry of Fire, Electricity.

UNIT – 2: Fire Prevention (6 Hours)

Elements of Construction, Elements of Structure, Fixed Installations–Fire doors, Smoke Ceiling, compartmentation, pressurization, etc., Fire Safety Practice, Fire Safety Management.

UNIT - 3: Fire Protection (6 Hours)

Fire Alarm & Detection Systems, Fire Extinguishers, Fire Hose reels, Fire Hose Cabinets, Fire Hydrants, Fire Pumps, etc., Fire Sprinkler systems, Fire Suppression systems, Kitchen Fire Safety, etc.

UNIT-4: Fire Fighting (6 Hours)

Incident Command, Use of Compressed Air Breathing Apparatus at Incidents, Rescue, Fire Fighting, Ventilation, Salvage, Application and Equipment, Rope and Lines, Extension Ladders

Text Book(s):

1. Ron Hirst (1989). Under downs practical fire precautions, Gower publishing company Ltd., England.
2. HMSO, (1991). Manual of firemanship-part 1 to 13. London.
3. Jain V.K. (2010). Fire safety in buildings (2nd edn.). New Age International (P) Ltd., New Delhi.
4. Barendra Mohan Sen (2013). Fire protection and prevention the essential handbook, UBS publishers and Dist., New Delhi.
5. Gupta, R.S. (2010). A Hand book of fire technology (2nd edn.). Universities Press
6. James F Cassey (1970). Fire service hydraulics (2nd edn.). Pennwell Books.
7. William E Clark (1991). Firefighting principles a practices (2nd edn). Fire Engineering Books a Videos.
8. N F P A. Fire Protection Hand Book.

Course Code	BSE2P01							
Category	**Skill Enhancement Course**							
Course Title	Fire Ground Operation-II							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - II**			
	-	-	4	2				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	-	-	-	-	50	50	100	50
Pre-requisites (if any):	Nil							

Laboratory Outcome: Upon successful completion of the course, the student will be able to:

1. Good communication skills and personal behavior.
2. Identify and describe concept and construction of firefighting hoses.
3. Describe concept and classify the types, construction and uses of firefighting hose fittings
4. Organize and execute word of command for hose drill.
5. Demonstrate execution of different types of knots and lashings used in fire and rescue service

Fire Ground Operation-II

1. **Physical Exercise**: Monitoring Levels of Fitness, Pulse, Blood Pressure, Body fat
2. **Yoga & Mediation**
3. **Squad Drill**: Clarification, Correction of faults, Inspection, Handling a squad, Questions, Communication drill and mutual drill
4. **Extinguishers**: Operation of portable extinguishers, Refilling of portable extinguishers, Inspection requirement of portable extinguishers
5. **Hose & Hose Fitting**: Types, (Delivery Hose, Suction Hose, Hose Reel-Hose), Hose binding/patching g/washing, Hose drill: Lifting, Lowering, Carrying, Laying, Connect, Disconnect, Removal of kinks, Under - running, Roll
6. **Hydrant**: Types of Hydrants, Hydrant Installation (underground and pillar post)
7. **Ladder**: Types of ladders: Hook ladder, Roof ladder, 35 ft Aluminum extension ladder, 45 ft Aluminum extension ladder, Truss - type and non-truss -type,
8. **Knots**: Introduction, Types of ropes, Rope construction, Types of knots, Types of lacing, (Round lasing, diagonal lasing, Figure of eight lasing, Square lasing), Types of lacing, knot practice (Over hand, figure of eight, Reef, Chair knot
9. **Pump**: Types of pumps
10. **Foam:** Introduction, Part identification and specification: FB -2, FB -10, FB - 5X, FB -10X, MFG - 5A, MFG -10A
11. **B. A set**: Construction features, uses
12. **P.P.E**: Introduction

Books Recommended:

1. Fire Service Drill Book, GoI, MHA Publication
2. Fire Service Manual, HM Fire service manual
3. Fire Fighters Handbook, Delmar

Course Code	**B1K2T01**							
Category	**Indian Knowledge System**							
Course Title	**Concepts and Applications in Engineering**							
Scheme and Credit	**Th**	**T/A**	**Pr**	**Credits**	**Semester - II**			
	2	-	-	2				
Examination Scheme	**Theory**				**Practical**			
	CIE	**SEE**	**Total**	**Min.**	**CIE**	**SEE**	**Total**	**Min.**
	30	70	100	45	-	-	-	-
Pre-requisites (if any):								

Course Objectives: The objective of this module is

1) To provide the basics of analog and digital electronics & communications
2) To understanding of fire and draw them together with some of the other fundamental topics required to synthesize knowledge of fire service communication.

Course Outcomes: Upon successful completion of the course, the student will be able to:

1. Understand the concepts of analog and digital electronic instruments
2. Analyze the basic fundamental operations of power electronic circuits
3. Demonstrate good comprehension working of analog communications systems
4. Identify and summarize the important features of digital communication systems
5. Understand the basic concepts of wireless communications

Concepts and Applications in Engineering Course

Unit I: Indian Knowledge System (08 Hrs.)

Indian knowledge system, need of IKS, organization, historicity, some salient aspects of IKS, Introduction to Vedas, synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, prologue on Śikṣā and Vyākaraṇa, basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

Unit II: Number systems and unit measurements (08 Hrs.)

Number systems in India - Historical evidence, Salient aspects of Indian Mathematics, Bhūta-Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight, Piṅgala and the Binary system; Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contributions, Algebra, Geometry, Trigonometry, Binary mathematics and combinatorial problems in Chandaḥ Śāstra, Magic squares in India

Unit III: Astronomy (08 Hrs.)

Introduction to Indian astronomy, Indian contributions in astronomy, The celestial coordinate system, Elements of the Indian calendar, Notion of years and months, Pañcāṅga – The Indian calendar system, Astronomical Instruments (Yantras), Jantar Mantar of Rājā Jai Singh Sawai

Unit IV: Engineering & Technology (08 Hrs.)

Wootz Steel: The rise and fall of a great Indian technology, The Indian S & T heritage, Mining and ore extraction, Metals and metalworking technology, Iron and steel in India, Lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components. Irrigation systems and practices in South India, Literary sources for science and technology, Physical structures in India, Irrigation and water management, Dyes and painting technology, The art of making perfumes, Surgical techniques, Shipbuilding, Sixty-four art forms (64 Kalās), Status of Indigenous S & T.

Unit V: Knowledge Framework (08 Hrs.)

Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action –the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya, Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge, Deductive or inductive logic framework, Potential fallacies in the reasoning process, Siddhānta: established tenets in a field of study.

Text Books / Reference Books:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), "Introduction to Indian Knowledge System: Concepts and Applications", PHI Learning Private Ltd. Delhi.
2. Pride of India: A Glimpse into India's Scientific Heritage, Samskrita Bharati, New Delhi.
3. Sampad and Vijay (2011). "The Wonder that is Sanskrit", Sri Aurobindo Society, Puducherry.
4. Bag, A.K. (1979). Mathematics in Ancient and Medieval India, Chaukhamba Orientalia, New Delhi.
5. Datta, B. and Singh, A.N. (1962). History of Hindu Mathematics: Parts I and II, Asia Publishing House, Mumbai.
6. Kak, S.C. (1987). "On Astronomy in Ancient India", Indian Journal of History of Science, 22(3), pp. 205–221.
7. Subbarayappa, B.V. and Sarma, K.V. (1985). Indian Astronomy: A Source Book, Nehru Centre, Mumbai.
8. Bag, A.K. (1997). History of Technology in India, Vol. I, Indian National Science Academy, New Delhi.
9. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
10. Banerjea, P. (1916). Public Administration in Ancient India, Macmillan, London.
11. Kapoor Kapil, Singh Avadhesh (2021). "Indian Knowledge Systems Vol – I & II", Indian Institute of Advanced Study, Shimla, H.P.

E-Resources and other digital material:

1. Indian Knowledge System (IKS): Concepts and Applications in Engineering By Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan | Indian Institute of Management Bangalore (IIMB), Chanakya University, Bangalore https://onlinecourses.swayam2.ac.in/imb23_mg53/preview