Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur 440033

Scheme and Syllabus for

Bachelor of Technology (Electrical Engineering)

Submitted by

Board of Studies in Electrical Engineering

FYUG Engineering Curriculum: NEP-Electrical Engineering

Vision

To provide quality professional education to aspiring students to produce globally competent technocrats, who can address challenges of industry and society to achieve sustainable socio-economicdevelopment.

Mission

To produce graduates possessing sound fundamental knowledge of Electrical Engineering

To provide technical manpower for industry to solve problems with multidisciplinary approach.

To encourage students for scholarly research in emerging areas of electrical engineering

To inculcate ethical and social values.

Program Educational Objectives (PEOs)

PEO1	Electrical engineer graduate shall be ready for modern technologies of electrical power system, energy industry and non-conventional energy sources.
PEO2	Electrical engineer graduate shall be able to enhanced analytical skill to solve industrial problem and work as a entrepreneur
PEO2	Electrical engineer graduate shall be able promote the awareness of green technologies by considering environmental aspects.

Program Outcomes (PO'S)

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	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.
PO3	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.
PO4	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.
PO5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6	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.
PO7	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.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10	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.
PO11	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.
PO12	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.

Program Specific Outcomes (PSO)

PSO1	Interpret, identify, analyze, and evaluate problems in power system operation, control and design.
PSO2	Demonstrate knowledge to develop, control and assess electrical and electronic systems.

ANNEXURE I

Semester wise Credit Distribution Structure for Four Year UG Electrical Engineering (Major) and Minor in Multidisciplinary

Semester	Category	I	II	III	IV	V	VI	VII	VIII	Credits
Basic Science Course	BSC	3 * 2 = 6	4 * 2 = 8	--	--	--	--	--	--	14
Engineering Science Course	ESC	4 * 2 = 8	4	--	--	--	--	--	--	12
Program Core Course (PCC)	Program Courses	--	2	4 * 2 = 8	4 * 2 = 8	(4 * 2) + 2 = 10	(4 * 2) + 1= 9	0	4 +4=8	45
Program Elective Course (PEC)	Program Courses	--	--	--	--	4	(4 * 2) - 1= 7	2	3 * 2 = 6	19
Multidisciplinary Minor (MDM)	Multidisciplinary Courses	--	--	2	2	4	2	2	2	14
Open Elective (OE) Other than a particular program	OE	--	--	4	2	2	--	--	--	8
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	2	2	--	2	--	2	--	--	8
Ability Enhancement Course (AEC -01, AEC-02)	Humanities Social Science and Management (HSSM)	2	--	--	2	--	--	--	--	4
Entrepreneurship/Economics/Management Courses	(HSSM)	--	--	2	2	--	--	--	--	4
Indian Knowledge System (IKS)	(HSSM)	--	2	--	--	--	--	--	--	2
Value Education Course (VEC)	(HSSM)	--	--	2	2	--	--	--	--	4
Research Methodology	Experiential Learning Courses	--	--	--	--	--	--	4	0	4
Comm. Engg. Project (CEP)/Field Project (FP)	ELC	--	--	2	--	--	--	--	--	2
Project	ELC	--	--	--	--	--	--	--	4	4
Internship/ OJT	ELC	--	--	--	--	--	--	12	--	12
Co-curricular Courses (CC)	Liberal Learning Courses	2	2	--	--	--	--	--	--	4
Total Credits (Major)		**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**

ANNEXURE II

SCHEME OF TEACHING & EXAMINATION (I – VIII SEMESTER)

B.Tech. Sem –I (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	BSC - I	BEL1T01	Engineering Mathematics-I	ASH	3	-	-	3	3	70	30	45	-	-	-
2	BSC - II	BEL1T02	Applied Physics	ASH	2	-	-	2	3	70	30	45	-	-	-
3	BSC - II	BEL1P02	Applied Physics Lab	ASH	-	-	2	1	-	-	-	-	25	25	25
4	ESC – I	BEL1T03	Basics of Electrical & Electronics Engineering	EE	3	-	-	3	3	70	30	45	-	-	-
5	ESC – I	BEL1P03	Basics Electrical & Electronics Engineering Lab	EE	-	-	2	1	-	-	-	-	25	25	25
6	ESC – II	BEL1T04	Engineering Graphics	ME	3	-	-	3	3	70	30	45	-	-	-
7	ESC – II	BEL1P04	Engineering Graphics Lab	ME	-	-	2	1	-	-	-	-	-	50	25
8	AEC-I	BAE1T01	Communication Skills	ASH	1	0	0	1	2	35	15	23			
9	AEC-I	BAE1P01	Communication Skills	ASH	0	0	2	1	`--	`--	`--	--	25	25	25
9a	VSC – I	BVS1P01	Basics of Solar PV Plant Installation	EE	-	-	4	2	-	-	-	-	50	50	50
10	CC-I	BCC1P01	Refer CC Basket	ASH	-	-	4	2	-	-	-	-	-	100	50
			Total		**12**	**0**	**16**	**20**		**315**	**135**		**125**	**275**	

B.Tech. Sem –II (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	BSC - III	BEL2T05	Engineering Mathematics-II	ASH	3	-	-	3	3	70	30	45	-	-	-
2	BSC - IV	BEL2T06	Applied Chemistry	ASH	3	-	-	3	3	70	30	45	-	-	-
3	BSC - IV	BEL2P06	Applied Chemistry Lab	ASH	-	-	2	1	-	-	-	-	-	50	25
4	ESC – III	BEL2T07	Engineering Mechanics	CV	3	-	-	3	3	70	30	45	-	-	-
5	ESC – III	BEL2P07	Engineering Mechanics Lab	CV	-	-	2	1	-	-	-	-	25	25	25
6	PCC – I	BEL2T08	Elements of Electrical Engineering & Measurements	EE	2	-	-	2	3	70	30	45	-	-	-
7	PCC – I	BEL2P08	Elements of Electrical Engineering & Measurements	EE	-	-	2	1	-	-	-	-	25	25	25
8	SEC – I	BSE2P01	Refer SEC Basket	-	-	-	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**	**0**	**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 project etc

B.Tech.Sem –III (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC – II	BEL3T09	Network Analysis	EE	3	-	-	3	3	70	30	45	-	-	-
2	PCC – II	BEL3P09	Network Analysis Lab	EE	-	-	2	1	-	-	-	-	25	25	25
3	PCC – III	BEL3T10	Electrical Engineering Mathematics	ASH	2	-	-	2	3	70	30	45	-	-	-
4	MDM-I	BMD3T11	Analog Electronic Circuits	ETC	3	-	-	3	3	70	30	45	-	-	-
5	MDM-I	BMD3P11	Analog Electronic Circuits Lab	ETC	-	-	2	1	-	-	-	-	-	50	25
6	OE-I	BOE3T01	Open Elective-I		3	-	-	3	3	70	30	45	-	-	-
7	OE-I	BOE3P01	Open Elective-I Lab		-	-	2	1	-	-	-	-	25	25	25
8	HSSM	BHM3T01	Engineering Economics	ASH	2	-	-	2	3	70	30	45	-	-	-
9	VEC-I	BVE3T01	Constitution of India	ASH	2	-	-	2	3	70	30	45	-	-	-
10	CEP	BCE3P01	Community Engg. Project	EE	-	-	4	2	-	-	-	-	-	100	50
			Total		**15**	**0**	**10**	**20**		**420**	**180**		**50**	**200**	

B.Tech. Sem –IV (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC – IV	BEL4T12	Electrical Machines-I	EE	3	-	-	3	3	70	30	45	-	-	-
2	PCC – IV	BEL4P12	Electrical Machines-I Lab	EE	-	-	2	1	-	-	-	-	25	25	25
3	PCC – V	BEL4T13	Power Systems-I	EE	3	-	-	3	3	70	30	45	-	-	-
4	PCC – V	BEL4P13	Power Systems-I Lab	EE	-	-	2	1	-	-	-	-	-	50	25
5	MDM-II	BMD4T14	Electromagnetic Field Application in Engineering.	EE	2	-	-	2	-	70	30	45	-	-	-
6	OE-II	BOE4T02	Open Elective-II		2	-	-	2	3	70	30	45	-	-	-
7	VSC-II	BVE4P02	Electrical Workshop	EE	-	-	4	2	-	-	-	-	50	50	50
8	AEC-II	BAE4T02	Technical Report Writing	EE	2	-	-	2	3	70	30	45	-	-	-
9	HSSM-II	BHM4T02	Industrial Organization & Management	ASH	2	-	-	2	3	70	30	45	-	-	-
10	VEC-II	BVE4T02	Environmental Sciences	ASH	2	-	-	2	3	70	30	45	-	-	-
			Total		**16**	**0**	**8**	**20**		**490**	**210**		**75**	**125**	

Exit option : Award of UG Diploma in Major with 80 credits and an additional 8 credits in skill based courses , internship , mini project etc

B.Tech.Sem –V (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC – VI	BEL5T15	Electrical Machines-II	EE	3	-	-	3	3	70	30	45	-	-	-
2	PCC – VI	BEL5P15	Electrical Machines-II Lab	EE	-	-	2	1	-	-	-	-	25	25	25
3	PCC – VII	BEL5T16	Digital Electronic Circuits	EE	3	-	-	3	3	70	30	45	-	-	-
4	PCC – VII	BEL5P16	Digital Electronic Circuits Lab	EE	-	-	2	1	-	-	-	-	-	50	25
5	PCC – VIII	BEL5T17	Power Systems-II	EE	3	-	-	3	3	70	30	45	-	-	-
6	PEC-I	BEL5T18	Program Elective-I **(Refer Program Elective Basket)**	EE	3	-	-	3	3	70	30	45	-	-	-
7	PEC-I	BEL5P18	Program Elective-I Lab **(Refer Program Elective Basket)**	EE	-	-	2	1	-	-	-	-	-	50	25
8	MDM-III	BMD5T19	Programming Techniques & Simulation	EE	2	-	-	2	3	70	30	45	-	-	-
9	MDM-III	BMD5P19	Programming Techniques & Simulation Lab	EE	-	-	2	1	-	-	-	-	25	25	25
10	OE-III	BOE5T03	Open Elective-III		2	-	-	2	3	70	30	45	-	-	-
			Total		**16**	**0**	**8**	**20**		**420**	**180**		**50**	**150**	

B.Tech. Sem –VI (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC – IX	BEL6T20	Power Electronics	EE	3	-	-	3	3	70	30	45	-	-	-
2	PCC – IX	BEL6P20	Power Electronics Lab	EE	-	-	2	1	-	-	-	-	25	25	25
3	PCC – X	BEL6T21	Control System	EE	3	-	-	3	3	70	30	45	-	-	-
5	PCC – XI	BEL6T22	Microprocessors & Microcontrollers	EE	2	-	-	2	3	70	30	45	-	-	-
6	PEC-II	BEL6T23	Program Elective-II	EE	3	-	-	3	3	70	30	45	-	-	-
7	PEC-III	BEL6T24	Program Elective-III	EE	3	-	-	3	3	70	30	45	-	-	-
8	PEC-III	BEL6P24	Program Elective-III -Lab	EE	-	-	2	1	-	-	-	-	-	50	25
9	MDM-IV	BMD6T25	Basics of Data Analysis	CSE	2	-	-	2	3	70	30	45	-	-	-
10	SEC-II	BSE6P02	Electrical Equipment Maintenance	EE	-	-	4	2	-	-	-	-	50	50	50
			Total		**16**	**0**	**8**	**20**		**420**	**180**		**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 project etc.

B.Tech. Sem –VII (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	RM	BRM7T26	Research Methodology #	EE	3	-	-	3	3	70	30	45	-	-	-
2	RM	BRM7P26	Research Paper Reading and Writing	EE	-	-	2	1	-	-	-	-	-	50	25
3	PEC-IV	BEL7T27	Program Elective-IV #	EE	2	-	-	2	3	70	30	45	-	-	-
4	MDM-V	BMD7T28	Introduction to Artificial Intelligence	AIDS	2	-	-	2	3	70	30	45	-	-	-
5	OJT	BOJ7P01	Internship (12 Weeks)	EE	-	-	24	12	-	-	-	-	200	200	200
			Total		**7**	**0**	**26**	**20**		**210**	**90**		**200**	**250**	

 # Indicates that, Online Courses to be done from NPTEL. Examination will be conducted by NPTEL / RTMNU

B.Tech. Sem –VIII (Electrical Engineering –Major)

SN	Course Category	Course Code	Name of Course	BoS	Teaching Scheme (hrs)			Total Credit	Examination Scheme						
									Theory				Practical		
					TH	TU	P		Exam Hrs	SEE	CIE	Min.	SEE	CIE	Min.
1	PCC – XII	BEL8T29	Power System Protection	EE	3	-	-	3	3	70	30	45	-	-	-
2	PCC – XII	BEL8P29	Power System Protection Lab	EE	-	-	2	1	-	-	-	-	25	25	25
3	PCC – XIII	BEL8T30	Computer Application in Power Systems	EE	3	-	-	3	3	70	30	45	-	-	-
4	PCC – XIII	BEL8P30	Computer Application in Power Systems Lab	EE	-	-	2	1	-	-	-	-	-	50	25
5	PEC-V	BEL8T31	Program Elective-V	EE	3	-	-	3	3	70	30	45	-	-	-
6	PEC-VI	BEL8T32	Program Elective-VI	EE	3	-	-	3	3	70	30	45	-	-	-
7	MDM-VI	BMD8T33	Digital Signal Processing	ETC	2	-	-	2	3	70	30	45	-	-	-
8	Project	BPR8P01	Project	EE	-	-	8	4	-	-	-	-	100	100	100
			Total		**14**	**0**	**12**	**20**		**350**	**150**		**125**	**175**	

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

Abbreviations

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

LIST OF PROGRAM ELECTIVE COURSES (PEC) ELECTRICAL ENGINEERING

S.N.	Semester	Category	Course code	Course name
1	5th	PEC-I	BEL5T18A	PLC and SCADA
2			BEL5T18B	Electrical Machine Design
3			BEL5T18C	Electrical Power Utilization
4	6th	PEC-II	BEL6T23A	Renewable Energy Sources
5			BEL6T23B	Electric Drives & Control
6			BEL6T23C	Demand Side Management & Audit
7		PEC-III	BEL6T24A	Optimization Techniques
8			BEL6T24B	Advanced Electric Machines
9			BEL6T24C	Electrical Distribution Systems
10	7th	PEC-IV	BEL7T27A#	Advance Control Systems
11			BEL7T27B#	Electric Vehicles
12			BEL7T27C#	Electrical Installation & Design
13	8th	PEC-V	BEL8T31A	HVAC and HVDC Systems
14			BEL8T31B	Smart Grid System
15			BEL8T31C	Power System Practice
16		PEC-VI	BEL8T32A	Flexible AC Transmission Systems
17			BEL8T32B	Design of Solar Photovoltaic Systems
18			BEL8T32C	Battery Engineering

# indicates that Online Courses to be done from NPTEL. The examination will be conducted by NPTEL/RTMNU.

LIST OF INDIAN KNOWLEDGE SYSTEM COURSES (IKS) OFFERED BY ELECTRICAL ENGINEERING

(Offered by Applied Science Board and Humanities BoS)

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

First Semester Syllabus

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
FACULTY OF SCIENCE & TECHNOLOGY
B.TECH. ELECTRICAL ENGINEERING

Sem: I	**Total Hours Distribution per week**		
Total Credit: 3	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BEL1TO1**	**Engineering Mathematics -1**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives

1	The topics covered will equip them the techniques to understand advanced level mathematics and its applications that would enhance analytical thinking power.
2	The aim is to inculcate and develop the basic mathematic skills of engineering students that are imperative for effective understanding of engineering subjects.

Course Outcomes

After completion of syllabus, students would be able to

1	Analyse real world scenarios to recognize when derivatives or integrals are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
2	Appreciate ODE and system of ODEs concepts that are encountered in the real world, understand and be able to communicate the underlying mathematics involved to help another person gain insight into the situation.
3	Apply knowledge of mathematics, physics and modern computing tools to scientific and engineering problems.
4	Develop an ability to identify, formulate and/or solve real world problems.
5	Understand the impact of scientific and engineering solutions in a global and societal context.

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
Unit-1: Differential Calculus			
Successive differentiation: Leibnitz's Rule, Taylor's and Maclaurin's series for function of one variable, Indeterminate forms and L' Hospital's Rule.	5		1
Unit 2: Multivariable Calculus (Differentiation)			
Functions of several variables, First and Higher order partial derivatives, Euler's theorem, Chain rule and Total differential coefficient, Jacobians, Lagrange's method of undetermined multipliers.	5		2
Unit 3: Matrices			
Rank of a matrix, Consistency of linear system of non-homogeneous equations, Linear dependence of vectors, Eigen values and Eigen vectors, Reduction to diagonal form, Cayley-Hamilton theorem.	4		3
Unit 4: First Order Ordinary Differential Equations			
Linear, Reducible to linear and Bernoulli's differential equations, Exact differential equations (Excluding the cases of integrating factors), Application of first order differential equation to simple electrical circuits.	5		4
Unit-5: Higher Order Ordinary Differential Equations			
Higher order ordinary linear differential equations with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's homogeneous differential equations, Applications of higher order differential equations to simple electrical circuits.	5		5

Text/Reference Books:

(1) Erwin Krayzig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

(2) Ramana B.V., Higher Engineering Mathematics, Tata Mc-Graw Hill, New Delhi, 11th Reprint, 2010.

(3) N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

(4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

(5) P. N. Wartikar and J. N. Wartikar, Applied Mathematics, Volume I and II.

(6) H.K Dass, Rama Verma, Rajnish Verma, V.J. Dagwal, Sajid Anwar and D.F. Shastrakar, Engineering Mathematics, Volume I and II, S. Chand.

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FACULTY OF SCIENCE & TECHNOLOGY
B.TECH. ELECTRICAL ENGINEERING

Sem: I	**Total Hours Distribution per week**		
Total Credit: 2	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BEL1TO2**	**Applied Physics**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Outcomes

After completion of syllabus, students would be able to

1	Learn the basic concepts of the dual nature of matter and wave packet and apply them to analyze various relevant phenomena and to solve related numerical problems.
2	Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications
3	Identify and explain different types of diodes, transistors, and its applications.
4	Learn and explain quantum transitions and apply them to the working of lasers.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1: Quantum Mechanics			
Concept of wave-particle duality, De-Broglie Hypothesis, Matter Waves, Davisson-Germer Experiment; Bohr's Quantization condition. Concept of wave packets, Heisenberg Uncertainty Principle. Schrodinger wave equation (time dependent and time independent), Wave function Ψ and normalization condition, Application to one dimensional infinite potential well.	6		1
Unit 2: Wave optics			
Huygen's principle, superposition of waves and interference of light by wavefront splitting and amplitude splitting, Interference in thin films, Interference in Wedge-shaped thin film, Newton's rings, and Anti-reflection coating.	6		2
Unit 3: Semiconductor Devices			
Semiconductor, Classification, Pure and doped semiconductors. Types of Semiconductor diodes -P-N junction Diode, Tunnel Diode, Zener Diode, Light Emitting Diode (LED), Photodiode. Transistors, Hall Effect, Hall voltage, and Hall coefficient; its applications	6		3

Unit 4: Lasers			
Quantum Transitions: Absorption, Spontaneous emission & stimulated Emission, Metastable states, Principle of laser, Laser characteristics, Coherence length and coherence time, pumping schemes: Three level and four level. Optical Resonator, Construction & working of Ruby laser and He-Ne laser, Semiconductor diode laser, Applications of laser.	6		4

Suggested Text Books &Reference Books

1. P. M. Mathews and K. Venkatesan, A Textbook of Quantum Mechanics, Tata Mc Graw Hill (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. Chand Publication
6. Text book of Applied Physics, Dr. D. S. Hardas, Dr. D. S. Bhoumik, Dr.S. Shastri, Das Ganu 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 Ganu Publication ISBN-978-81-921757-7-5 (2011)
9. Applied Physics, - Dr. (Mrs)S.P. Wankhede, Dr.Shruti Patle, Dr.(Mrs.)S.U.Bhonsule and Dr.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 (India) Pvt. Ltd.(2016)
12. D. J. Griffiths, Quantum mechanics, Prentice Hall of India Private Limited, New Delhi
13. L. I. Schiff, Quantum Mechanics, TMH Publications
14. Advanced Engineering Materials - Dr. Sangeeta G. Itankar, Dr. Manjusha Dandekar, Dr. Tushar R. Shelke, Dr. Swati Fartode, Alliance & Co. ISBN 978-93-91322-12-0 (2023)
15. Applied Physics- Dr. Sangeeta G. Itankar, Dr. Manjusha Dandekar, Dr. Tushar R. Shelke, Dr. Swati Fartode, Alliance &Co. ISBN 978-93-91322-97-7 (2023)
16. David Halliday, Robert Resnick, Jearl Walker, Principles of Physics, 10th Edition, John Wiley and Sons (2017)
17. Advanced physics - Dr.Shruti Patle, Dr.(Mrs).S.U.Bhonsule, Dr.Ashish N. Bodhaye, Dr.Manohar D.Mehare DNA Publication (2019)
18. Engineering Physics - Dr.N. S. Ugemuge, Dr. (Mrs.) S.U.Bhonsule and Dr.Shruti Patle DNA Publication(2019)

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FACULTY OF SCIENCE & TECHNOLOGY
B.TECH. ELECTRICAL ENGINEERING

Sem: I	**Total Hours Distribution per week**		
Total Credit :1	**Practical (P): 2 Hrs.**		
Subject Code	**BEL1P02**	**Applied Physics Lab.**	
Examination Scheme - Practical			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
25 Marks	**25 Marks**	**25 Marks**	**--**

LIST OF PRACTICAL:

Pr. No.	**List of Practical**
1	Energy gap of semiconductor /thermistor.
2	Parameter extraction from V-I characteristics of PN junction diode.
3	Parameter extraction from V-I characteristics of Zener diode.
4	Parameter extraction from V-I characteristics of PNP/NPN transistor in CB and CE mode.
5	V-I Characteristics of Tunnel diode.
6	V-I Characteristics of Light Emitting Diodes/ Determination of Plank's constant by using LEDs.
7	Study of Diode rectification.
8	Study of Hall Effect and determination of Hall Voltage of a given sample.
9	Variation of Hall coefficient (RH) with temperature.
10	To study B-H curve and to find out the values of coercivity, retentivity, and saturation magnetization of the experimental material.
11	Determination of NA for optical fiber
12	Calibration of Time Base circuit of CRO and determination of AC, DC voltage & frequency of electrical signals using CRO.
13	To determine the number of lines per cm on a diffraction grating using a LASER beam.
14	Virtual Lab: Experiment on the determination of the thickness of a thin foil using an air wedge arrangement.
15	Virtual Lab: Experiment on the determination of the refractive indices of the material corresponding to ordinary and extra - ordinary rays.

Note: Performance of at least six experiments is compulsory in a semester.

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B.TECH. ELECTRICAL ENGINEERING

Sem: I	**Total Hours Distribution per week**	
Total Credit: 3	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**
Subject Code	**BEL1TO3**	**Basics of Electrical & Electronics Engineering**

Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives

1	To learn basic concepts and principles of Electrical and Electronics Engineering.
2	To Understand basic operation and working of electrical machines.
3	To learn the concepts of electrical & electronic circuits.

Course Outcomes

After completion of syllabus, students would be able to

1	Understand basic properties of electrical components and electrical parameters
2	Analyse DC Electric & Magnetic Circuits
3	Learn and analyse AC circuits
4	Understand working principle of electrical machines
5	Know the electronic devices and their properties & use the various electronic devices for various applications.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Circuit Elements and Parameters- Resistance, Inductance & Capacitance, Basic relations between voltage, current and resistance, classification of material according to conductivity, various effects current.	7		1
Unit 2:			
Electrical Circuit Fundamentals- DC Circuits: Types, Series, Parallel, Star, Delta and transformation Kirchhoff's Laws & Applications, Energy Sources and	5		2

Circuit Reduction, Magnetic Circuits: Flux, MMF, Reluctance, Analogy with Electric Circuits. Simple Calculations for Composite Magnetic Circuits			
Unit 3:			
AC Circuits & Fundamentals- Principle of Generation of Single Phase, Periodic Function, Average & R.M.S., Values, Steady State Behavior with Sinusoidal Excitation, Phasor Representation, Reactance & Impedance, Series & Parallel Circuit, Power Factor.	10		3
Unit 4:			
Introduction to Electrical Machines- Transformer: Basic Principles, Construction, Phasor Diagram for Transformer under no load and on load conditions, Voltage Regulation and Efficiency, DC Machines: Introduction and types, Working Principle, simple mathematical equations, other types of machines: Induction Motor, Stepper Motors (Only Working Principle)	8		4
Unit-5:			
Introduction to Electronic Components- P-N Junction Diode, Bi-junction transistor, UJT, FET etc., and their properties, Diode as a rectifier. **Fundamental Applications of Transistors-** Common emitter, common collector and common base configurations of BJT, Emitter follower, various Biasing circuits for BJT, BJT as a switch, BJT as an amplifier. Basic introduction to OP-AMP	9		5

Text & Reference Books:

1. D. C. Kulshrehtha, "Basic Electrical Engineering", Tata Mcgraw Hill, 2012
2. B.L. Theraja, “Electrical Technology”, S. Chand
3. Millman Halkias, “Electronic Devices and Circuits”, Tata McGraw Hill, 2000

Online references:

1. Basic Electrical Engineering A Web course of NPTEL by Day, Bhattacharya & Roy, Available:- www. nptel.ac.in

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B.TECH. ELECTRICAL ENGINEERING

Sem: I	Total Hours Distribution per week		
Total Credit :1	Practical (P): 2 Hrs.		
Subject Code	BEL1P03	Basics of Electrical & Electronics Engineering Lab.	
Examination Scheme - Practical			
Internal Marks:	University Marks:	Minimum Passing Marks:	Examination Duration:
25 Marks	25 Marks	25 Marks	--

Practical Course Objectives	
1	To learn basics of Electrical and Magnetic Circuits
2	To learn the basic semiconductor Electronic devices and their applications

Practical Course Outcomes	
After completing the practical course, students will be able to	
1	Understand basic properties of electrical components and electrical parameters
2	Analyse DC Electric & Magnetic Circuits
3	Learn and analyse AC circuits
4	Know the electronic devices and their properties
5	Use the various electronic devices for various applications

LIST OF PRACTICAL:

Pr. No.	List of Practical
1	To study and verification of Kirchhoff's Laws applied to direct current circuit
2	To obtain the B/H curve of a magnetic material
3	To study AC series circuits
4	To Study AC parallel circuits
5	To study characteristics of P-N Junction diode
6	To study Half and Full wave rectifier
7	To study Transistor Characteristics
8	To study of BJT as amplifier

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B.TECH. ELECTRICAL ENGINEERING

Sem: I	**Total Hours Distribution per week**		
Total Credit: 3	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BEL1TO4**	**Engineering Graphics**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives	
1	To improve imagination skills.
2	Learn to sketch and take field dimensions.
3	Learn to take data and transform it into graphic drawings.
4	Learn basic engineering drawing formats.

Course Outcomes	
After completion of syllabus, students would be able to	
1	Get acquainted with the knowledge of various lines, geometrical constructions and construction of various kinds of scales, and Ellipse.
2	Improve their imagination skills by gaining knowledge about points, lines and planes.
3	Become proficient in drawing the projections of various solids.
4	Gain knowledge about orthographic and isometric projections.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Polygons-Construction of Regular Polygons using given length of a side; Ellipse-General method and Oblong Methods for Construction of ellipse; Scales-Plain, Vernier and Diagonal Scales. Introduction to Orthographic Projections; Projections of Points; Projections of Straight Linesparallel to both planes; Projections of Straight Lines-Parallel to one and inclined to another plane.	7		1

Unit 2:			
Projections of Straight Lines inclined to both planes, determination of true lengths, angle ofinclinations and traces.	5		2
Unit 3:			
Projections of Planes; Regular Planes Perpendicular / Parallel to one Reference Plane and inclined to other Reference Plane; inclined to both the Reference Planes.	10		3
Unit 4:			
Projections of Solids-Prisms, Pyramids, Cylinders and Cones with the axis inclined to one Plane.	8		4
Unit-5:			
Conversion of Isometric Views to Orthographic Views. Conversion of Orthographic Views to Isometric Projections and Views.	9		5

Text Book:

1. Engineering Drawing by N.D. Bhat, Chariot publications

Reference Books:

1. Engineering Drawing by M.B. Shah and B.C. Rana, Pearson publishers
2. Engineering Drawing by Dhananjay A. Jolhe, Tata McGraw Hill Publishers
3. Engineering Graphics for Degree by K.C. John, PHI Publishers

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B.TECH. ELECTRICAL ENGINEERING

Sem: I	Total Hours Distribution per week		
Total Credit :1	Practical (P): 2 Hrs.		
Subject Code	BEL1P04	Engineering Graphics Lab.	
Examination Scheme - Practical			
Internal Marks:	University Marks:	Minimum Passing Marks:	Examination Duration:
50 Marks	--	25 Marks	--

LIST OF PRACTICAL:

Based on the above syllabus (Project assign /Preparation of sheets)

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Sem: I	**Total Hours Distribution per week**	
Total Credit: 1	**Lecture (L): 1 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**
Subject Code	**BAE1TO1**	**Communication Skills**
Examination Scheme		
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
15 Marks	**35 Marks**	**23 Marks**	**2 Hours**

Prerequisites: Basic knowledge of Communication Skills

Course Objectives

1	Students would be able to enhance their communication skills.

Course Outcomes

After completion of syllabus, students would be able to

1	Construct grammatically correct sentences.
2	Identify and overcome barriers of communication.
3	Demonstrate good Listening and speaking skills.
4	Develop effective reading and writing skills.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Grammar: Tenses and its types, sentences and its Types, Transformation of Sentences (Assertive, Affirmative, Negative, Interrogative, Exclamatory) Reported speech.	4		1
Unit-2			
Introduction to Communication, Importance of communication Types of communication -Verbal and non-verbal Communications: - Kinesics, Vocalics, Chronemics, Haptics, Proxemics), Barriers to communication and methods to overcome them.	3		2
Unit-3			
Introduction to LSRW Skills-, Listening Skills: Importance of listening, Types of listening, listening barriers and methods to overcome, Speaking Skills: Components of public speaking, Essential steps for public speaking, Overcoming stage fear in public speaking, Do's, and Don'ts of Public speaking	5		3

Unit-4			
Reading Skills: Importance of reading skills, Types of reading, comprehending passages, Writing Skills: Importance of effective writing, Paragraph writing, Email etiquettes.	4		4

Reference books:

1. Technical Communication by Meenakshi Raman and Sangeeta Sharma, OUP
2. Public Speaking and Influencing Men in Business by Dale Carnegie 3. Professional Communication Skills by Bhatia and Sheikh, S. Chand Publications
3. Communication Skills by Sanjeev Kumar and Pushpalata, OUP
4. Communication Skills by Lalita Bisen, Bhumika Agrawal, N. Thejo Kalyani, Himalaya Publishing House

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Sem: I	**Total Hours Distribution per week**		
Total Credit :1	**Practical (P): 1 Hrs.**		
Subject Code	**BAE1P01**	**Communication Skills**	
Examination Scheme - Practical			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
25 Marks	**25 Marks**	**25 Marks**	**--**

LIST OF PRACTICAL:

Pr. No.	**List of Practical: (Perform any 6 – 8 Practical)**
1	Barriers to Communication
2	Non-verbal Communication
3	Listening Skills
4	Reading Skills
5	Speaking Skills
6	Presentation Skills
7	Group Discussion
8	Interview Techniques
Pr. No.	**List of Practical: Beyond Syllabus**
1	Development of Word Power
2	Use of Figurative language

Suggested Textbooks/Reference Books/ Web page (URL)/Research paper, etc.

1 Technical Communication by Meenakshi Raman and Sangeeta Sharma, OUP
2 Public Speaking and Influencing Men in Business by Dale Carnegie
3 Professional Communication Skills by Bhatia and Sheikh, S. Chand Publications
4 Communication Skills by Lalita Bisen, Bhumika Agrawal, N.Thejo Kalyani, Himalaya

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B.TECH. ELECTRICAL ENGINEERING

Sem: I	Total Hours Distribution per week		
Total Credit :2	Practical (P): 4 Hrs.		
Subject Code	BVS1P03	Basics of Solar PV Plant Installation	
Examination Scheme - Practical			
Internal Marks:	University Marks:	Minimum Passing Marks:	Examination Duration:
50 Marks	50 Marks	50Marks	--

Practical Course Objectives	
1	To understand the Solar PV Technology
2	To learn the basics of Solar PV Panels
3	To prepare the design of Solar PV Plant
4	To install a small Solar PV Plant

Practical Course Outcomes	
After completing the practical course, students will be able to	
1	Compute the electricity generation from solar radiations
2	Carry out basic requirement of solar PV plants
3	Identify and use the tools used for Solar PV system installation
4	Install the Civil/Mechanical and Electrical components of a Solar PV system
5	Test and Commission Solar PV system

LIST OF PRACTICAL:

Pr. No.	List of Practical
1	To demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level
2	To demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules
3	To determine the different electrical parameters of a mono-crystalline and poly-crystalline silicon solar panel
4	To study the effect of variation in tilt angle on PV module power
5	To draw the charging and discharging characteristics of battery
6	To study solar PV inverter
7	Observe the output waveform of the inverter in auto mode
8	Workout power flow calculations of standalone PV system of load with battery
9	To study all the tools required for solar PV plant installation
10	To study the on-grid and off-grid Solar PV plant
11	To design a small Solar PV plant

Text & Reference Books:

1. Solar Photovoltaics: Fundamentals, Technologies and Applications by Chetan Singh Solanki, PHI
2. Install Your Own Solar Panels by Joseph Burdick, Philip Schmidt Storey Publishing
3. Solar PV Installer (Suryamitra) Published by Rachana Sagar Pvt Ltd.

Online references:

1. The complete Solar Energy Course Beginner to Advanced level- https://www.udemy.com/course/the-complete-solar-energy-course-beginner-to-advanced-level/

Second Semester Syllabus

RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR
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B.TECH. ELECTRICAL ENGINEERING

Sem: II	**Total Hours Distribution per week**		
Total Credit: 3	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BEL2TO5**	**Engineering Mathematics -II**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives

1	The objective of the course is to inculcate and strengthen analytic ability among the engineering students and to create zeal of working with higher mathematics and its applications in the extensive field of engineering.
2	The topics covered will serve as basic tools for specialized studies in many fields of engineering and technology.

Course Outcomes

After completion of syllabus, students would be able to	
1	Analyse real world scenarios to recognize when integrals are appropriate, formulate problems about the scenarios, creatively model these scenarios (using technology, if appropriate) in order to solve the problems using multiple approaches, judge if the results are reasonable, and then interpret and clearly communicate the results.
2	Define and understand the geometry of vector differential operators and line and surface integrals.
3	Explain and apply principles of study design and data collection.
4	Develop an ability to identify, formulate and/or solve real world problems
5	Understand the impact of scientific and engineering solutions in a global and societal context.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1: Integral Calculus			
Evaluation of Definite and Improper Integrals: Beta and Gamma functions and their properties, Mean value, Mean square value and Root mean square value, Tracing of curves (Cartesian), Applications of definite integrals to find length of curve, area, volume.	10		1

Unit 2: Multivariable Calculus (Integration)			
Multiple Integration: Double integrals (Cartesian), Change of order of integration in double integrals, Change of variables (Cartesian to Polar). Applications on Area, Mass, Volume	10		2
Unit 3: Vector Calculus			
Vector Calculus: Vector triple product, Product of four vectors, Scalar point function, Vector point function, Vector differentiation, Gradient, Divergence and Curl, Directional derivatives, Solenoidal and Irrotational motions	8		3
Unit 4: Statistics			
Fitting of a Curve by Method of Least Squares: Straight line y = a + b x, Second degree parabola y = a+bx+cx2 and curves of the type y = ae^{bx}, y = ab^{x} and y = ax^{b}, Coefficient of correlation and Lines of regression, Rank correlation.	10		4
Unit-5: Numerical Methods:			
Error Analysis, Solution of Algebraic and Transcendental Equations: Method of False position, Newton–Raphson method and its convergence, Solution of system of simultaneous linear equations: Crout's method (LU decomposition Method), Gauss-Seidel method.	8		5

Text/Reference Books:

(1) Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.

(2) Ramana B.V., Higher Engineering Mathematics, Tata Mc-Graw Hill, New Delhi, 11th Reprint, 2010.

(3) N.P. Bali and Manish Goyal, A textbook of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

(4) B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

(5) P. N. Wartikar and J. N. Wartikar, Applied Mathematics, Volume I and II.

(6) H.K Dass, Rama Verma, Rajnish Verma, V.J. Dagwal, Sajid Anwar and D.F. Shastrakar, Engineering Mathematics, Volume I and II, S. Chand.

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B.TECH. ELECTRICAL ENGINEERING

Sem: II	**Total Hours Distribution per week**	
Total Credit: 3	**Lecture (L): 3 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**
Subject Code	**BEL2TO6**	**Applied Chemistry**

Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Outcomes

After completion of syllabus, students would be able to

1	Students will be able to apply the basics concepts of electrochemistry& corrosion technology.
2	Students will know about fuels and lubricants and analyse the situation for their appropriate applications.
3	Students can analyse the various industrial problems arising due to water quality and their remediation.
4	Students will Develop the environmental awareness from the basics of green chemistry and its application.
5	Students will inculcate the use of instrumentation techniques and interpret its applications in material characterization.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1: Electrochemistry and Corrosion Technology			
A] Electrochemistry: Electrochemical & Galvanic Series, Electrochemical & Electrolytic cell, Battery: Introduction, types, characteristics, components/materials, working and applications of Lithium-cobalt oxide and metal air batteries. Super capacitors: Introduction, types (EDLC, pseudo and asymmetric capacitor) with examples and applications. Energy conversion devices: Introduction, characteristics, materials, working and applications of H2-O2 fuel cells, amorphous Si and quantum dye sensitized solar cells. **B] Corrosion:** Theories of Corrosion (Dry, Wet and Differential Aeration), Pilling-Bedworth Rule & Numerical, Factors affecting corrosion, Types of Corrosion (Intergranular & Stress), Corrosion Protection- Design & Material Selection, Cathodic Protection (Galvanic & Impressed Current)	7		1

Unit 2: Fuels & Lubricants			
A] Fuels: Introduction: Calorific value, Higher and lower calorific value; determination of calorific value by Bomb and Boy's calorimeter; numerical based on calorific value determination; Liquid fuels –fractional distillation of crude petroleum (boiling point wise separation only) use of gasoline and diesel in internal combustion engine: knocking and chemical constitution of fuel, Octane and Cetane number, doping agents, Introduction to propellants and its classification. Combustion calculations – Numericals based on combustion calculations for solid, liquid and gaseous fuels **B] Lubricants**: Lubrication, Mechanism of lubrication, types of lubricants and its properties (viscosity & viscosity index, flash & fire point, aniline point, saponification value, acid value), criterion for selection of lubricants.	7		2
Unit 3: Water Technology			
A] Water Purification Technology: Principles of coagulation and flocculation, Sterilization by using ozone and chlorine (Cl_2 gas & chloramine), Break point chlorination and its significance. Industrial Water Treatment: Softening of water-principle- reactions, advantages, limitations and comparison of Zeolite process, and De-mineralization process. Numerical based on Zeolite process. **B] Boiler Troubles–** Causes, effect on boiler operation and methods of prevention – Scales and sludges, Caustic embrittlement. Desalination of sea water- Principle, method and advantages of electro dialysis and reverse osmosis processes Waste Water Treatment (introduction and importance) –Water treatment from biological waste water to clean water production (Dissolved Air Floatation and Membrane bio reactors)	7		3
Unit 4: Green Chemistry			
A] Green Chemistry: Introduction, twelve principles of Green chemistry with examples, Numerical based on atom economy, Carbon sequestration & Carbon Credits **B] Green reagents**, Dimethyl carbonate and its applications, Supercritical carbon dioxide properties and applications Biopolymers: Classification based on type, properties and applications of collagen, chitosan, starch. Green Hydrogen Synthesis by photolysis of water, environmental benefits and applications	7		4
Unit-5: Material Characterization Techniques			
Principles and applications of – **A]** Electronic Spectroscopy (Beer-Lambert's law and its numerical), Infra-Red spectroscopy and Nuclear Magnetic Resonance spectroscopy. **B]** Thermal analysis (Thermogravimetry, Differential Thermal Analysis, Differential Scanning Calorimetry), Scanning Electron Microscopy, Transmission Electron Microscopy, Atomic Force Microscopy, Brunauer-Emmett-Teller (BET) surface area analysis, X-ray Diffraction Analysis, particle size analyser (Dynamic Light Scattering), High Performance Liquid Chromatography and Gas Chromatography	8		5

References/ Text Books

1. Engineering Chemistry, S S Dara, S Chand Publication
2. Engineering Chemistry, Jain & Jain, Dhanpat Rai Publication
3. Applied Chemistry, A V Bharati, Das Ganu Publication
4. Energy & Environment, A V Bharati, Das Ganu Publication
5. Spectroscopy, Y R Sharma, S Chand
6. Green Chemistry for Beginners, Anju Srivastava, Rakesh K. Sharma, Jenny Stanford Publishing
7. Instrumental Methods of Chemical Analysis, B. K. Sharma, Krishna Prakashan.
   https://wiki.anton-paar.com/in-en/the-principles-of-dynamic-light-scattering/
8. Fundamentals of Solid Propellant Combustion, Kuo, K.K., Summerfield, M., Progress in Astronautics & Aeronautics, Vol. 90, AIAA. 1984 - https://onlinecourses.nptel.ac.in/noc24_ae09/preview

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Sem: II	**Total Hours Distribution per week**		
Total Credit :1	**Practical (P): 2 Hrs.**		
Subject Code	**BEL2P06**	**Applied Chemistry Lab.**	
Examination Scheme - Practical			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
50 Marks	**--**	**25 Marks**	**--**

LIST OF PRACTICAL:

Pr. No.	**List of Practical's (Any 6-performance based and 1 virtual lab experiment)**
1	Proximate Analysis of coal
2	Estimation of viscosity of oil by Redwood Viscometer 1 or 2
3	Estimation of Flash point of lubricating oil by open/ closed cup apparatus
4	Estimation of Acid value of lubricant
5	Estimation of Consistency of grease by penetrometer
6	Estimation of Saponification value of lubricant
7	Estimation of Hardness of water (Total, Permanent & Temporary) by complexometry
8	Estimation of Alkalinity of water (Warder's Method)
9	Estimation of DO / free chlorine estimation
10	Estimation of Copper estimation (iodometrically)
11	Estimation of Ni by complexometry / gravimetry.
12	Fe (II)/ (III) estimation by redox titration.
13	Beer's Law verification by spectrophotometer.
14	Separation of copper nickel ions by paper chromatography.
15	Acid base titration by potentiometry
16	Acid base titration by conductometry
17	Virtual Lab: Experiment on Calorimetry
18	Virtual Lab: Experiment on Spectroscopy

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B.TECH. ELECTRICAL ENGINEERING

Sem: II	**Total Hours Distribution per week**		
Total Credit: 2	**Lecture (L): 2 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BEL2T08**	**Elements of Electrical Engineering & Measurements**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives	
1	To learn fundamentals of electrical circuits and analysis
2	To understand the basics of electrical machines
3	To learn the various electrical measuring instruments
4	To learn the concept of transducers

Course Outcomes	
After completion of syllabus, students would be able to	
1	Apply the concepts for analysis of single phase and three phase a.c. circuits
2	Understand the principle and working of electrical machines and their basic analysis
3	Learn the various a.c. bridges and their applications to measure R-L-C parameters
4	Understand the principle and working of electrical measuring instruments
5	Learn the concepts of transducers and their applications

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
A.C Circuits: Periodic Function, Average & R.M.S., Values, Steady State Behavior with Sinusoidal Excitation, Phasor Representation, Reactance & Impedance, Series & Parallel Circuit, Phasor diagram Power Factor, Principle of Generation of Single Phase & Three Phase Voltages, Power in Balanced Three Phase AC System	5		1
Unit 2:			
Principle and working of single-phase transformer, transformers losses, phasor diagram, d.c. machines construction and working, simple numerical analysis	5		2
Unit 3:			
Measurement of low, high and medium resistances, Principle and working of A. C. Bridge, Various types of bridges and applications for measurement of R-L-C parameters	5		3

Unit 4:			
Classification of measuring instruments, Construction and working principle of moving coil, moving iron and dynamo meter type of instruments, measurement of power, energy, power factor	5		4
Unit-5:			
Fundamentals of Sensors and transducers, classification of transducers, transducer applications for measurement of displacement, pressure, temperature etc	4		5

Text & Reference Books:

1. S.K. Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson Education, 2012
2. D. C. Kulshrehtha, "Basic Electrical Engineering", Tata Mcgraw Hill, 2012
3. Kothari D.P. and Nagrath I.J., “Theory and Problems of Basic Electrical Engineering,” Prentice Hall
4. A.K. Sawhney, “A course in Electrical & Electronics Measurement and Instrumentation”, Dhanpat rai & Sons, 2015
5. Ernest O. Doebelin, “Measurement Systems Application and Design, International Student Edition”, McGraw Hill Book Company, 1998

Online references:

1. Basic Electrical Engineering A Web course of NPTEL by Day, Bhattacharya & Roy, Available: - www. nptel.ac.in

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Sem: II	**Total Hours Distribution per week**		
Total Credit :1	**Practical (P): 2 Hrs.**		
Subject Code	**BEL2P08**	**Elements of Electrical Engineering & Measurements**	
Examination Scheme - Practical			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
25 Marks	**25 Marks**	**25Marks**	**--**

Practical Course Objectives	
1	To analyze electrical a.c. circuits
2	To understand the operating principles of electrical machines
3	To learn the use of electrical measuring instruments for measuring various parameters
4	To understand the working of transducers and their applications

Practical Course Outcomes	
After completing the practical course, students will be able to	
1	To compute the various parameters of a.c. circuits
2	To perform the short circuit test and open circuit test for the transformer
3	To measure and compute the parameters of electrical machines
4	To understand the use of a.c. bridges for R-L-C measurements

LIST OF PRACTICAL:

Pr. No.	**List of Practical**
1	To study RLC series ac circuit
2	To study resonance in RLC series ac circuit
3	To study RLC parallel ac circuit
4	To study 3-phase circuits with load connected in star and delta
5	To determine Voltage regulation and efficiency of a single-phase transformer by direct loading
6	Study of d.c. motors
7	Measurement of three phase power by Two Wattmeter method procedure
8	To study and plot the characteristics of LVDT
9	To analyse the characteristics of the Piezo electric sensor
10	To measure unknown values of given inductance and capacitance using appropriate a.c. bridge

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Sem: II	Total Hours Distribution per week		
Total Credit :2	Practical (P): 4 Hrs.		
Subject Code	BSE2P01	Electric Wiring & Illumination System	
Examination Scheme - Practical			
Internal Marks:	University Marks:	Minimum Passing Marks:	Examination Duration:
50 Marks	50 Marks	50 Marks	--

Practical Course Objectives	
1	To develop a foundational understanding of electric charge
2	To equip students with the skills to proficiently install various wiring types
3	To cultivate competence in diverse lighting systems
4	To enable students to apply their knowledge in integrating lighting with smart home platforms designing energy-efficient solutions, and implementing sustainable lighting practices and maintenance plans.

Practical Course Outcomes	
After completing the practical course, students will be able to	
1	Solve basic problems in electrical systems using fundamental electrical concepts
2	Interpret electrical wiring diagrams and troubleshoot electrical issues
3	Understand various lighting sources and smart lighting systems
4	Apply knowledge to integrate lighting with smart home platforms and design energy-efficient solutions.

LIST OF TOPICS AND EXPERIMENTS:

Pr. No.	List of Topics and Experiments
1	**Study of electrical systems fundamentals-** Introduction to Electricity**,** Basics of electric charge, voltage, resistance, current and Ohm's Law**,** Overview of circuit components (resistors, capacitors, inductors), Series and parallel circuits, Energy consumption in electrical systems, Common safety practices in electrical systems, Introduction to personal protective equipment (PPE)
2	**Study of electrical wiring systems-** Overview of wiring types (conduit, non-metallic sheathed cable, armored cable), Reading and interpreting electrical wiring diagrams, Common symbols and conventions in electrical wiring diagrams, Guidelines for installation of electrical wiring, Basic troubleshooting techniques in electrical systems
3	**Study of various Illumination Systems-** Overview of lighting sources (incandescent, fluorescent, LED), Factors influencing lighting design (purpose, aesthetics, energy efficiency),

	Introduction to manual and automated lighting controls. Smart lighting systems and their benefits, LED technology and its advantages.
4	**Design of smart home integration and sustainable lighting practices-** Overview of home automation in the context of electrical systems and lighting, Integration with smart home platforms, Design of energy-efficient lighting systems, Routine maintenance practices for lighting systems, Development of lighting maintenance plan

Text & Reference Books:

1. Handbook of Electrical Installation Practice by Geoffrey Stokes
2. Electrical Wiring Residential by Ray C. Mullin
3. Illumination and Electrification of Buildings by M. Chaudhari

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Sem: II	Total Hours Distribution per week	
Total Credit: 2	Lecture (L): 2 Hrs	Tutorial/Activity (T/A): 0 Hr.
Subject Code	BIK2T01A	Consciousness Studies

Examination Scheme			
Internal Marks:	University Marks:	Minimum Passing Marks:	Examination Duration:
30 Marks	70 Marks	45 Marks	3 Hours

Course Outcomes

After completion of syllabus, students would be able to	
1	Analyze the basics of Psychology and its applications
2	Develop knowledge about the sensory processes and perception
3	Apply various theories of classical conditioning
4	Integrate the theories of memory and behavior of mind

SYLLABUS

Details of Topic	Allotment of Hours		Mapped with CO Number
	L	T/A	CO
Unit-1			
An introduction to Psychology Introduction to Psychology, Definition of psychology, history, methods in Psychology, Subfields of Psychology and its applications	10		1
Unit 2:			
Basic Cognitive Processes Sensory processes-general characteristics of senses, visual sense, auditory sense, other senses Perceptual organization-principles of perceptual organization, object perception and perceptual constancies, influences upon perception, extrasensory perception	10		2
Unit 3: Learning			
Classical conditioning, theories about classical conditioning, Reinforcement and Punishment	9		3
Unit 4: Memory			
Theories about memory, brain and memory, long term memory, forgetting	7		4

Reference Books:

1. Clifford T. Morgan, King, Weisz and Schopler, Introduction to Psychology, McGraw Hill Education (India) Private Limited
2. Hilgard, Atkinson and Atkinson (1977). Introduction to Psychology. Tata McGraw Hill
3. Kao H.S R.& Sinha D. (Eds)(1977). Asian perspectives on psychology. New Delhi: Sage

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Sem: II	**Total Hours Distribution per week**		
Total Credit: 2	**Lecture (L): 2 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BIK2T01B**	**Preserving Art, Culture and Tradition**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives	
1	To provide overview of Indian Knowledge System (IKS) and sensitize the students to the contributions made by Indians in the field of philosophy, art and health.

Course Outcomes	
After completion of syllabus, students would be able to	
1	Interpret basics of Indian Knowledge system.
2	Integrate the teaching of Indian culture and civilization
3	Appreciate Indian artistic tradition.
4	Analyze Indian health and wellness system for healthy living

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Introduction to Indian Knowledge System Introduction and overview of Indian Knowledge system, The Vedic Corpus -Vedas, Types of Vedas, Upavedas, Types of Upavedas	9		1
Unit 2:			
Indian Culture and Civilization Indian culture and Civilization: its characteristics, Difference between Culture and Civilization, Indus valley civilization, Vedic civilization	9		2
Unit 3:			
Indian Artistic Tradition, Indian Artistic tradition: Chitrakala- Indian style painting (Madhubani, Warli, Phad, Kalamkari, Gond, Mandana), Nritya: Indian dance forms (Bharatnatyam, Kathak, Kathakali, Kuchipudi, Manipuri, Mohiniattyam) Sangeet- Carnatic music & Hindustani music	9		3
Unit 4:			
Health and Wellness Health and Wellness, Wellbeing: Mental & Physical, Dimensions of Wellness, Concept of healthy living in Ayurveda, Tri-doshas –Relationship to Health	9		4

Activity: Prepare PPTs/Posters/Videos on any two topics

Books Recommended:

1. Introduction to Indian Knowledge System by Mahadevan, B, Bhat, Vinayak Rajat,Nagendra Pavana R.N., Prentice Hall India Pvt., Limited, 2022.
2. Indian knowledge Systems, Kapil Kapoor, Avadhesh Kumar Singh, D.K, Printworld.
3. Traditional Knowledge System in India by Amit Jha, Atlantic Publishers, 2002
4. Exploring The Mysterious, By T.N. Dhar · Mittal Publications, 2004
5. Indian Art & Culture (E), By Anurag Kumar, Arihant Publication India Limited, 2016
6. A History of Indian Philosophy, Volume 2, By Surendranath Dasgupta, Diamond Publishers, 2017
7. Sri Suresh Soni, Sources of our cultural heritage, Prabhat Prakashan, 2018.
8. A Beautiful Tree by Dharampal, Rashtrotthana Sahitya, 2021

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Sem: II	**Total Hours Distribution per week**		
Total Credit: 2	**Lecture (L): 2 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BIK2T01C**	**Wellness, traditional medicines and yoga**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives	
1	The course will enable engineering students to acquire the knowledge of richness of healthy lifestyle and strong heritage of yoga and Vedas in Indian traditional system.

Course Outcomes	
After completion of syllabus, students would be able to	
1	Understand the importance of a healthy lifestyle
2	Familiarize to manage stress and health consciousness about physical and mental health.
3	Appreciate the benefits of yoga and medicinal plant.
4	Identify the social changes in Indian society.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Importance of health and wellness, Essential components of balanced diet for healthy living, Processed foods and unhealthy eating habits.	9		1
Unit 2:			
Body systems and common diseases, Sedentary lifestyle and its risk of disease, Stress, anxiety, and depression, Factors affecting mental health.	9		2
Unit 3:			
Importance and benefits of yoga, Purpose of yoga, traditional knowledge of medicinal plant, use of home available herbs and spices.	9		3
Unit 4:			
Vedas and it types, Social change in Indian society, Social stratification and class conflicts.	9		4

Textbooks/References:

1. Sociology in India – Surendra Sharma, Rawat Publication.
2. Bradfird B, Strand and Others. Fitness Education Arizona GorsuchSeani; sbrick Publishers, 1997.
3. Scott K. Powers and Stephen L. Dodd. Total Fitness: Exercise, Nutrition and wellness, Boston: Allyn and Bacon, 1999.
4. Rigveda Samhita with Sayanabhasya, Vaidik Samshodhan Mandal, Pune
5. Riksuktashati, H. D. Velankar, BharatiyaVidyaBhavan, Mumbai

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Sem: II	**Total Hours Distribution per week**		
Total Credit: 2	**Lecture (L): 2 Hrs**	**Tutorial/Activity (T/A): 0 Hr.**	
Subject Code	**BIK2T01D**	**Glimpses of ancient Science and Technology**	
Examination Scheme			
Internal Marks:	**University Marks:**	**Minimum Passing Marks:**	**Examination Duration:**
30 Marks	**70 Marks**	**45 Marks**	**3 Hours**

Course Objectives	
1	To provide the students with scientific foundation of Ancient Indian Knowledge System
2	To create awareness about scientific heritage of the ancient civilization

Course Outcomes	
After completion of syllabus, students would be able to	
1	To provide information about great mathematicians and to help students to trace, identify, practice, and develop the significant Indian mathematics
2	To understand the concept of motion and its application in Indian ancient physics literature.
3	To understand the concepts of basic chemical & metallurgical process of ancient and medieval India.

SYLLABUS

Details of Topic	**Allotment of Hours**		**Mapped with CO Number**
	L	**T/A**	**CO**
Unit-1			
Mathematics in India: Introduction of inception of Mathematics from vedic periods. Great Mathematician and their contribution (e.g. Arytabhatta, Bhaskara, Brahmagupta, Ramanujan,Pingala, Bhaskara-II), Sulbhasutras (Pythagoras theorem), Square, Square root, Square root ofimperfect Squares, Magic Squares, Value of Pi.	12		1
Unit 2:			
Physics in India: Vaisheshikadarshan Atomic theory & law of motion, theory of Panchmahabhoota, Brihath Shathaka (divisions of the time, unit of distance), Bhaskarachaya (Introduction to theory of Gravity, Suryasiddhanta & Sidhantashriomani), Lilavati (Gurutvakashan Shakti).	12		2
Unit 3:			
Chemistry in India: Vatsyayana, Nagarjuna, Vagbhaṭa –building of Theras-Shala(laboratory), working arrangements of Ras-Shala, material and equipment, Yaśodhara Bhaṭṭa-process of distillation, apparatus. Metallurgy in India: Survarṇa (gold) and its different types, properties, Rajata(silver), Tamra (copper), Loha(iron), Jasta (zinc), Naga /Sisa(lead), Pittala (brass).	12		3

Reference Books Recommended:

1. Kapur K and Singh A.K (Eds) 2005). Indian Knowledge Systems, Vol. 1. Indian Institute of Advanced Study, Shimla. Tatvabodh of Sankaracharya, Central Chinmay Mission Trust, Bombay,1995
2. Dharmpal, Indian Science and Technology in the eighteen century, Rashtrottahanasahitya, 1983
3. S Biswal, B L Ray, Vedic Science and technology, DK Print world, 2009
4. A.K. Bag, History of technology in Indian (Set 3 vol), Indian Nation Science Academy, 1997.
5. A Gosh, History of Science in India (Volume-I Part-II Astronomy), the national academy ofscience, India & the Ramkrishna mission institute of culture, 2014