NETAJI SUBHAS UNIVERSITY

JAMSHEDPUR, JHARKHAND

Estd. Under Jharkhand State Private University Act, 2018

Approved by AICTE, PCI, BCI, NCTE, INC & JNRC

COURSE STRUCTURE & DETAILED SYLLABUS

OF

ELECTRONICS AND COMMUNICATION ENGINEERING

FOR

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2025-2026)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEEERING

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

Pokhari, Near Bhilai Pahadi, Jamshedpur, Jharkhand

PREAMBLE

Electronics and Communication Engineering involves scientific analysis, problem-solving and knowledge integration using appropriate tools to model, design, produce and maintains products or systems containing Electronics and Communication Engineering elements to meet the desired requirements.

The curriculum revision committee included representation from various engineering institutes, government R&D labs and manufacturing sector. The committee members met multiple times in 2021-2022 to deliberate the curriculum. They studied existing curricula at well-known universities across the world, and had extensive discussions with domain experts representing a wide range of backgrounds and experience.

The revised model curriculum takes into cognizance the prevailing and emerging requirements of the industry and society. It provides a balanced mix of courses related to science, engineering, technology and practice (labs, projects), as well as humanities.

Given the rising importance of electronics, information and communication technology in all aspects of life, the relevant courses have been introduced or strengthened.
Students are provided greater flexibility in electives based on their career aspirations. They can suitably orient themselves toward academics, research, innovation, industry, entrepreneurship or any other direction.

The revised model curriculum is aligned with the New Education Policy, which promotes holistic, experiential and inter-disciplinary education. Hands-on learning, relevant lab experiments and examples from industry have been emphasised.

VISION

To strive for excellence in education, research, and entrepreneurship, with the ultimate goal of becoming a global hub for innovation. Committed to advancing scientific and technological services, we aim to contribute meaningfully to society.

MISSION

- To provide high-quality education that nurtures innovation, entrepreneurship, and ethical values, shaping future professionals equipped for a globally competitive landscape.
- To collaborate with stakeholders by sharing institutional expertise in education and knowledge, fostering mutual growth in technical learning.
- To Cultivate an environment that encourages fresh ideas, groundbreaking research, and academic excellence, paving the way for future leaders, innovators, and entrepreneurs.
- To drive socio-economic progress by offering impactful scientific and technological solutions to society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO-1	Apply knowledge of mathematics, science, and engineering to solve complex problems in Electronics and Communication Engineering and contribute effectively to industry, research, or higher education
PEO-2	Pursue lifelong learning through professional development courses, higher education, or certifications to adapt to rapidly evolving technologies and global challenges
PEO-3	Demonstrate leadership, ethical responsibility, and the ability to work effectively in multidisciplinary teams to deliver engineering solutions for real-world problems
PEO-4	Innovate and contribute to the development of sustainable solutions addressing societal, environmental, and economic challenges through responsible engineering practices.

PROGRAM OUTCOMES (POs)

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-1	Apply the knowledge of electronics and communication engineering fundamentals to analyze, design, and maintain communication systems such as advance communication systems for wideband communication.
PSO-2	Design and implement electronic circuits, embedded systems, and control systems for applications in automation, instrumentation, and consumer electronics and use modern tools, simulation software, and programming languages for modeling, analysis, and optimization of electronics systems while considering energy efficiency and sustainability.

TABLE OF CONTENTS

B. TECH IN ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE STRUCTURE

GENERAL COURSE STRUCTURE & THEME

A. Definition of Credit:

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Practical (P) per week	0.5 Credit
2 Hours Practical (P) per week	1 Credit

B. Range of Credits: In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, the total number of credits proposed for the four-year B. Tech/B.E. in Electronics and Communication (Engineering & Technology) is kept as 160.

C. Structure of UG Program in ECE: The structure of UG program in Electronics and Communication Engineering shall have essentially the following categories of courses with the breakup of credits as given:

Sl. No	Category	Suggested Breakup of Credits (Total 160)
1	Humanities and Social Sciences including Management courses	12*
2	Basic Science courses	29*
3	Engineering Science courses `including workshop, drawing, basics of electrical/mechanical/computer etc.	27*
4	Professional core courses	58*
5	Professional Elective courses relevant to chosen specialization/branch	9*
6	Open subjects – Electives from other technical and /or emerging subjects	9*
7	Project work, seminar and internship in industry or elsewhere	16*
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)
Total		**160***

**Minor variation is allowed as per need of the respective disciplines.*

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D. Course code and definition:

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
C	Credits
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective courses
OEC	Open Elective courses
LC	Laboratory course
MC	Mandatory courses

Category-wise Courses

HUMANITIES & SOCIAL SCIENCES COURSES [HS] & MANAGEMENT COURSES

(2 compulsory + 2 others)

Number of Humanities & Social Science Courses: 4
Credits: 12

Sl.	Code No.	Subject	Semester	Credits
1	HSMC 01	Communication Skills / English (Compulsory	2	2:0:2=3
2	HSMC 02	Universal Human Values-2 (Compulsory course)	2	2:1:0=3
3	HSMC 03	Industrial Psychology	5 / 6	3:0:0=3
4	HSMC 04	Operations Research	5 / 6	3:0:0=3
5	HSMC 05	Project Management	5 / 6	3:0:0=3
6	HSMC 06	Finance & Accounting	5 / 6	3:0:0=3
			Total Credits:	**12**

BASIC SCIENCE COURSE [BSC] (Total 8)

Sl.	Code No.	Subject	Semester	Credits
1	BSC 101	Physics-1 (Electromagnetism)	1	3:1:2=5
2	BSC 201	Physics-2 (Optics & Waves)	3	3:1:2=5
3	BSC 102	Mathematics-1 (Calculus & Linear Algebra)	1	3:1:0=4
4	BSC 103	Chemistry-1	2	3:0:2=4
5	BSC 104	Mathematics-2 (ODE, Complex variables)	2	3:1:0=4
6	BSC 202	Mathematics-3 (PDE, Prob/Stat)	3	3:1:0=4
7	BSC 203	Biology for Engineers	3	3:0:0=3
8	BSC 204	Environment Science (Audit)	3	2:0:0=0
			Total Credits:	**29**

ENGINEERING SCIENCE COURSE [ESC] (Total 8)

Sl.	Code No.	Subject	Semester	Credits
1	ESC 101	Basic Electrical Engineering	1	2:1:2=4
2	ESC 102	Engineering Graphics & Design	1	1:0:4=3
3	ESC 103	Design Thinking + Idea Lab (Audit)	1	0:0:2=1
4	ESC 104	Programming for Problem Solving	2	2:0:4=4
5	ESC 105	Manufacturing Practice Workshop	2	0:0:4=2
6	ESC 201	Basic Electronic Engineering	3	3:1:2=5
7	ESC 202	Engineering Mechanics	3	3:1:0=4
8	ESC 203	Applied Thermodynamics	3	3:1:0=4
			Total Credits:	**27**

PROFESSIONAL CORE COURSES [PCC] (Total 16)

Sl.	Code No.	Subject	Semester	Credits
1	PCC-ECE401	Network Analysis	4	3:1:1=5
2	PCC-ECE402	Electronic Devices	4	3:1:1=5
3	PCC-ECE403	Electrical Measurements and Instrumentation	4	3:1:1=5
4	PCC-ECE404	Electromagnetic Field Theory	4	3:1:0=4
5	PCC-ECE405	Signals and Systems	4	3:1:0=4
6	PCC-ECE501	Digital Electronics	5	3:1:1=5
7	PCC-ECE502	Microprocessor and Microcontrollers	5	3:1:1=5
8	PCC-ECE503	Analog Electronics	5	3:1:1=5
9	PCC-ECE505	Digital System Design	5	3:1:0=4
10	PCC-ECE601	Control Systems	6	3:1:1=5
11	PCC-ECE602	Mobile Communication	6	3:1:1=5
12	PCC-ECE603	Electromagnetic Waves	6	3:1:1=5
13	PCC-ECE604	Microwave Engineering	6	3:1:0=4
1	PCC-ECE401	Network Analysis	4	3:1:1=5
2	PCC-ECE402	Electronic Devices	4	3:1:1=5
3	PCC-ECE403	Digital Communication	4	3:1:1=5
TOTAL				61

PROFESSIONAL ELECTIVE [PEC]

(Total 3 to be taken, at least one from each group)

Sl.	Code No.	Subject	Semester	Credits
		TECHNOLOGY GROUP		
1	PEC-ECEL 401	Digital Signal Processing	5 / 6	3:0:0=3
2	PEC-ECEL 402	Mechatronics	7 / 8	3:0:0=3
3	PEC-ECEL 403	Renewable Energy Sources	7 / 8	3:0:0=3
4	PEC-ECEL 404	Communications Systems	7 / 8	3:0:0=3
5	PEC-ECEL 405	VLSI Design	7 / 8	3:0:0=3
6	PEC-ECEL 406	Biosensors	7 / 8	3:0:0=3
		INDUSTRY SECTOR GROUP		
1	PEC-ECEL 411	Electric Vehicles	7 / 8	3:0:0=3
2	PEC-ECEL 412	Embedded Systems	7 / 8	3:0:0=3
3	PEC-ECEL 413	Electric Safety	7 / 8	3:0:0=3
4	PEC-ECEL 414	Biomedical Engineering	7 / 8	3:0:0=3
5	PEC-ECEL 415	Building Cyber Physical Systems	7 / 8	3:0:0=3
6	PEC-ECEL 416	Introduction to Robotics and Automation	7 / 8	3:0:0=3
			Total Credits:	**12**

ENGINEERING PROJECT (3 Stages)

Sl.	Code No.	Subject	Semester	Credits
1	BTECE608P	Engineering Project-1 (Literature Review)	6	0:0:4=2
2	BTECE705P	Engineering Project-2 (Design & Analysis)	7	0:0:10=5
3	BTINT706P	Seminar	7	0:0:2=1
4	BTECE803P	Engineering Project-3 (Prototype & Testing)	8	0:0:16=8
			Total Credits:	**16**

TOTAL = 160 credits | BSC = 18%, ESC = 17%, PCC = 36%, PEL+HSM+OEL = 9%, PROJ = 10% || LABS = 10%

NEW AND ELECTRONICS/IT-ORIENTED CORE COURSES

Sl.	Code No.	Subject	Semester	Credits
1	ESC103	Design Thinking & Idea Lab (New)	1	0:0:2=1
2	ESC103	Programming for Problem Solving	2	3:0:4=5
3	ESC301	Basic Electronics Engineering	3	3:1:2=5
4	PEC-ECEL 405	VLSI Design	6	3:0:0=3
5	PEC-ECEL 414	Biomedical Engineering	7	3:0:0=3
			Total Credits:	**25**

INDUCTION PROGRAM

The Essence and Details of Induction program can also be understood from the 'Detailed Guide on Student Induction program', as available on AICTE Portal, (Link:https://www.aicteindia.org/sites/default/files/Detailed%20Guide%20on%20Student%20Induc tion%20program.pdf).

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	• Physical activity • Creative Arts • Universal Human Values • Literary • Proficiency Modules • Lectures by Eminent People • Visits to local Areas • Familiarization to Dept./Branch & Innovations

Mandatory Visits/ Workshop/Expert Lectures:

a. It is mandatory to arrange one industrial visit every semester for the students of each branch.

b. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.

c. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from domain specific industry.

Evaluation Scheme (Suggestive only):

a. **For Theory Courses**:

(The weightage of Internal assessment is 40% and for End Semester Exam is 60%)

b. For Practical Courses:

(The weightage of Internal assessment is 60% and for End Semester Exam is 40%)

c. For Summer Internship / Projects / Seminar etc.

Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Note: The internal assessment is based on the student's performance in mid semester tests (two best out of three), quizzes, assignments, class performance, attendance, viva-voce in practical, lab record etc.

Mapping of Marks to Grades

Each course (Theory/Practical) is to be assigned 100 marks, irrespective of the number of credits, and the mapping of marks to grades may be done as per the following table:

Range of Marks	**Assigned Grade**
91-100	A^+
81-90	A
71-80	B^+
61-70	B
51-60	C^+
46-50	C
40-45	D
< 40	F (Fail due to less marks)

Semester wise Structure

SEMESTER-I

S. No.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTBSC 101	BSC	Engineering Mathematics- I	3	1	0	4	40	60	100
2	BTBSC 102	BSC	Engineering Physics-1	3	1	-	4	40	60	100
3	BTESC 103	ESC	Basics of Electrical Engineering	3	0	-	3	40	60	100
4	BTESC 104	ESC	Engineering Drawing	1	0	-	1	40	60	100
5	BTMC 105	MC	Indian Knowledge System	3	0	-	3	40	60	100
Practical										
6	BTBSC 102P	BSC	Engineering Physics Lab	-	-	2	1	30	20	50
7	BTESC 103P	ESC	Basics of Electrical Engineering Lab	-	-	2	1	30	20	50
8	BTESC 104P	ESC	Engineering Drawing & Computer Graphics Lab	-	-	4	2	30	20	50
9	BTESC 107P	ESC	Design Thinking & IDEA Lab	-	-	2	1	30	20	50
10	BTAU 106	AU	Sports/NSS/NCC/YOGA/Painting/Music/Classical dance		-	2	0	-	-	-
Total				**13**	**2**	**12**	**20**	**320**	**380**	**700**

SEMESTER-II

S. No.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTBSC 201	BSC	Engineering Mathematics -II	3	1	-	4	40	60	100
2	BTBSC 202	BSC	Engineering Chemistry	3	0	-	3	40	60	100
3	BTHSMC 203	HSMC	English for technical writing	2	0	0	2	40	60	100
4	BTESC 204	ESC	Programming for Problem Solving	2	0	-	2	40	60	100
5	BTHSMC 205	HSMC	Universal Human Values	2	1	0	3	40	60	100
Practical										
6	BTBSC 202P	BSC	Engineering Chemistry Lab	-	-	2	1	30	20	50
7	BTHSMC 203P	HSMC	English for technical writing	0	0	2	1	30	20	50
8	BTESC 204P	ESC	Programming for Problem Solving Lab	-	-	4	2	30	20	50
9	BTESC 206P	ESC	Manufacturing Practices Workshop			4	2	30	20	50
Total				**12**	**2**	**12**	**20**	**320**	**380**	**700**

SEMESTER-III

S. No.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTBSC302	BSC	Mathematics-3 (PDE, Prob/Stat)	3	1	0	4	40	60	100
2	BTBSC303	BSC	Physics-2 (Optics & Waves)	3	1	0	4	40	60	100
3	BTBSC304	BSC	Environment Science (Audit)	2	0	0	0	40	60	100
4	BTESC301	ESC	Basic Electronics Engineering	3	1	0	4	40	60	100
5	BTESC302	ESC	Network Analysis	3	1	0	4	40	60	100
6	BTESC303	ESC	Material Science	3	1	0	4	40	60	100
Practical										
7	BTESC 301P	ESC	Basic Electronics Engineering Lab	-	-	2	1	30	20	50
8	BTEE401P	PCC	Network Analysis Lab	-	-	2	1	30	20	50
Total				**17**	**5**	**4**	**22**	**250**	**450**	**700**

SEMESTER-IV

Sl. No.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTEC E401	PCC	Analog Electronics	3	1	0	4	40	60	100
2	BTEC E402	PCC	Linear Integrated Circuits	3	1	0	4	40	60	100
3	BTEC E403	PCC	Electrical Measurements and Instrumentation	3	0	0	3	40	60	100
4	BTEC E404	PCC	Electromagnetic Field Theory	3	0	0	3	40	60	100
5	BTEC E405	PCC	Signals and Systems	3	1	0	4	40	60	100
6	BTEC E406	PCC	Microwave and Antenna	3	0	0	3	40	60	100
Practical										
8	BTEC E402P	PCC	Analog Electronics and Linear Integrated Circuits Lab	-	-	2	1	30	20	50
9	BTEC E403P	PCC	Electrical Measurements and Instrumentation Lab	-	-	2	1	30	20	50
10	BTEC E407P	EEC	Summer Internship - I	-	-	4	2	30	20	50
Total				**18**	**3**	**5**	**24**	**330**	**420**	**750**

SEMESTER-V

S. NO	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTECE501	PCC	Digital Electronics	3	1	0	4	40	60	100
2	BTEE502	PCC	Microcontrollers and Microprocessor	3	1	0	4	40	60	100
3	BTECE504	PCC	Analog Communication	3	0	0	3	40	60	100
4	BTECE505	PCC	Digital Signal Processing	3	0	0	3	40	60	100
5	BTHSMC506	HSMC	HSS/ Management Elective - I	3	0	0	3	40	60	100
6	BTEEC506	EEC	Employment Enhancement Course – I	0	0	1	0	40	60	100
			Practical							
7	BTECE501P	PCC	Digital Electronics Lab	0	0	2	1	30	20	50
8	BTECE502P	PCC	Microcontrollers and Microprocessor Lab	0	0	2	1	30	20	50
9	BTECE503P	PCC	Analog Communication Lab`	0	0	2	1	30	20	50
TOTAL				**18**	**2**	**6**	**26**	**330**	**420**	**750**

SEMESTER-VI

S. NO	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTEE601	PCC	Control Systems	3	0	0	3	40	60	100
2	BTECE602	PCC	Digital Communication	3	1	0	4	40	60	100
3	BTECE603	PCC	Mobile Communication	3	0	0	3	40	60	100
4	BTECE604	PCC	Optical Fibre Communication	3	0	0	3	40	60	100
5	BTHSMC605	HSMC	HSS/ Management Elective – II	3	0	0	3	40	60	100
6	BTEEEC606	EEC	Employment Enhancement Course – II	0	0	1	0	40	60	100
			Practical							
8	BTEE602P	PCC	Control System Lab	0	0	2	1	30	20	50
9	BTECE603P	PCC	Optical Fibre Communication Lab	0	0	2	1	30	20	50
10	BTECE607P	EEC	Summer Internship – II	0	0	4	1	30	20	50
11	BTECE608P	EEC	Digital Communication Lab	0	0	4	2	30	20	50
TOTAL				**18**	**1**	**8**	**27**	**280**	**520**	**800**

SEMESTER-VII

S. NO	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTECE 701	PEL	Professional Elective – 1	3	0	0	3	40	60	100
2	BTECE 702	PEC	Professional Elective – 2	3	0	0	3	40	60	100
3	BTECE 703	OEC	Open Elective – 1	3	0	0	3	40	60	100
4	BTECE 704	OEC	Open Elective – 2	3	0	0	3	40	60	100
			Practical							
7	BTECE 705P	PROJ	Engg. Project – 1 (Literature Review, Design & Analysis)	0	0	10	5	60	40	100
10	BTINT 706P	INT	Internship /Summer Industrial Training/ Seminar (4-6 Week)	0	0	4	2	30	20	50
11	BTECE 707P	PCC	Digital Signal Processing Lab	0	0	4	2	30	20	50
TOTAL				**12**	**0**	**12**	**19**	**280**	**320**	**600**

VIII – SEMESTER

S. No.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTECE 801	PEC	Professional Elective-3	3	0	0	3	40	60	100
2	BTECE 802	OEC	Open Elective-3	3	0	0	3	40	60	100
			Practical							
3	BTECE 803P	PROJ	Engineering Project-2 (Prototype & Testing)	-	-	16	8	120	80	200
3	BTECE 804P	PEC	Microwave and Antenna Lab	0	0	4	2	30	20	50
Total				**6**	**0**	**16**	**14**	**230**	**220**	**450**

PROFESSIONAL ELECTIVE COURSES

CATEGORY	TECHNOLOGY GROUP	INDUSTRY SECTOR GROUP	CREDITS
PEC	Internet of Things	Electric Vehicles	3
PEC	Mechatronics	Embedded Systems	3
PEC	Digital Image Processing	Digital Speech Processing	3
PEC	Communications Systems	Biomedical Engineering	3
PEC	VLSI Design	Building Cyber Physical Systems	3
PEC	Biosensors	Introduction to Robotics and Automation	3

OPEN ELECTIVE COURSES

S. No.	Category	Name of the Subject	Semester	Credits
1	OEC	Optimization Techniques	7/8	3
2	OEC	Digital Control	7/8	3
3	OEC	Industrial Management	7/8	3
4	OEC	Industrial Safety	7/8	3
6	OEC	Artificial Intelligence and Machine Learning	7/8	3
7	OEC	Computer Architecture and Organization	7/8	3
8	OEC	Soft Computing and Fuzzy Systems	7/8	3
9	OEC	Information and Coding Theory	7/8	3
10	OEC	Computer Vision	7/8	3

HUMANITIES & SOCIAL SCIENCES COURSES [HS] & MANAGEMENT COURSES

Humanities & Social Sciences & Mgt. Electives (HSM): Any 2 courses from the list of those offered.

S. No	Category	Subject	Semester	Credits
1	HSMC	Communication Skills / English (Compulsory	2	3
2	HSMC	Universal Human Values-2 (Compulsory course)	2	3
3	HSMC	Industrial Psychology	5/6	3
4	HSMC	Operations Research	5/6	3
5	HSMC	Project Management	5/6	3
6	HSMC	Finance & Accounting	5/6	3

Employment Enhancement Courses

Sl.	Category	Subject	Semester	Credits
1	EEC	Employment Enhancement Course-I	5	**01**
2	EEC	Employment Enhancement Course-II	6	**01**
3	EEC	Internship / Summer Industrial Training/ Semminar (4-6 Week)	5/7	**04**
4	EEC	Engg Project – I/II/III	6/7/8	**15**

SEMESTER –I

ENGINEERING MATHEMATICS-I

Subject Code: -	**BTBSC101**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objectives:

The goal of this course is to achieve conceptual understanding and to retain the best traditions of traditional calculus. The syllabus is designed to provide the basic tools of calculus mainly for the purpose of modelling the engineering problems mathematically and obtaining solutions. This is a foundation course which mainly deals with topics such as single variable and multivariable calculus and plays an important role in the understanding of science, engineering, economics and computer science, among other disciplines.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Contents:

Module 1: Basic Calculus: (12 hours)

Curvature, 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.

Module 2: Single-variable Calculus (Differentiation): (12 hours)

Rolle's Theorem, Mean value theorems and applications; Extreme values of functions; Linear approximation; Indeterminate forms and L' Hospital's rule.

Module 3: Sequences and series: (12 hours)

Limits of sequence of numbers, Calculation of limits, Infinite series; Tests for convergence; Power series, Taylor and Maclaurin series; Taylor theorem, convergence of Taylor series, error estimates.

Module 4: Multivariable Calculus (Differentiation): (12 hours)

Limit, continuity and partial derivatives, directional derivatives, gradient, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 5: Multivariable Calculus (Integration): (12 hours)

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities); Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Gradient, curl and divergence, Theorems of Green, Gauss and Stokes.

TEXTBOOKS/REFERENCES:

1. AICTE's Prescribed Textbook: Mathematics-I (Calculus & Linear Algebra) ISBN: 9789391505172
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
4. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
5. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
7. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
8. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course outcomes: The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate differentiation and integration. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

At the end of the course, the students will learn

CO1. To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.

CO2. The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.

CO3. The tool of power series and Fourier series for learning advanced Engineering Mathematics.

CO4. To deal with functions of several variables that are essential in most branches of engineering.

CO5. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To apply differential and integral calculus to notions of curvature and to improper integrals. Apart from some other applications they will have a basic understanding of Beta and Gamma functions.	K_1
CO2	The fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.	K_2
CO3	The tool of power series and Fourier series for learning advanced Engineering Mathematics.	K_3
CO4	To deal with functions of several variables that are essential in most branches of engineering.	K_2
CO5	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.	K_2

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1									1				
CO2		2			1									
CO3			2				1				1			
CO4								2				1		
CO5				1									1	
CO(Average)	1	2	2	1	1		1	2			1	1	1	

3 –High; 2 –Medium; 1 –Low

ENGINEERING PHYSICS-I (ELECTROMAGNETISM)

SubjectCode:-	**BTBSC102**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objective:

To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Contents:

Module I: Electrostatics in vacuum (15 hours)

Calculation of electric field and electrostatic potential for a charge distribution; Divergence and curl of electrostatic field; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution and connection with steady state diffusion and thermal conduction; Practical examples like Faraday's cage and coffee-ring effect; Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and its expression in terms of electric field.

Module II: Electrostatics in a linear dielectric medium (10 hours)

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the center of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module III: Magneto statics (10 hours)

Bio-Savart law, Divergence and curl of static magnetic field; vector potential and calculating it for a given magnetic field using Stokes' theorem; the equation for the vector potential and its solution for given current densities.

Module IV: Magneto statics in a linear magnetic medium (10 hours)

Magnetization and associated bound currents; auxiliary magnetic field H; Boundary conditions on B and H. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials.

Module V: Faraday's law (15 hours)

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Text Books/Suggested References:

1. AICTE's Prescribed Textbook: Physics (Introduction to Electromagnetic Theory) with Lab Manual, ISBN: 978-93-91505-165
2. Bhattacharya & Nag, Engineering Physics
3. David Griffiths, Introduction to Electrodynamics
4. Halliday and Resnick, Physics
5. W. Saslow, Electricity, magnetism and light
6. Malik, Singh, Engineering Physics, Tata McGraw Hill

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	INTRODUCTION TO ELECTROMAGNETIC THEORY	PROF. MANOJ HARBOLA	IIT KANPUR

Course Outcomes:

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

CO1. Identify and understand the kinds of experimental results which are incompatible with classical Physics leading to the development of a quantum theory of matter and light.
CO2. Use basic concepts to analyse and design a wide range of semiconductor devices.
CO3. Understand & solve different types of wave equations.
CO4. Use the principles of optics to solve various complex engineering problems.
CO5. Use fundamental laws and relations to solve problems in electricity, electromagnetism.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Identify and understand the kinds of experimental results which are incompatible with classical Physics leading to the development of a quantum theory of matter and light.	K_1
CO2	Use basic concepts to analyse and design a wide range of semiconductor devices.	K_2

CO3	Understand & solve different types of wave equations.	K_3
CO4	Use the principles of optics to solve various complex engineering problems.	K_3
CO5	Use fundamental laws and relations to solve problems in electricity, electromagnetism.	K_4

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										3		
CO2			2		3									1
CO3				2								1		
CO4			3	2										
CO5			3							2				
CO(Average)	2	3	2.6	2	3					2		2		1

3 –High; 2 –Medium; 1 –Low

BASIC ELECTRICAL ENGINEERING

Subject Code: -	**BTESC103**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective:

The objective of this Course is to provide the students with an introductory and broad treatment of the field of Electrical Engineering.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Contents:

Module I: (10 hours)

D. C. Circuits covering, Ohm's Law and Kirchhoff's Laws; Analysis of series, parallel and series-parallel circuits excited by independent voltage sources; Power and energy; Electromagnetism covering, Faradays Laws, Lenz's Law, Fleming's Rules, Statically and dynamically induced EMF; Concepts of self-inductance, mutual inductance and coefficient of coupling; Energy stored in magnetic fields;

Module II: (10 hours)

Single Phase A.C. Circuits covering, Generation of sinusoidal voltage- definition of average value, root mean square value, form factor and peak factor of sinusoidal voltage and current and phasor representation of alternating quantities; Analysis with phasor diagrams of R, L, C, RL, RC and RLC circuits; Real power, reactive power, apparent power and power factor, series, parallel and series- parallel circuits; Three Phase A.C. Circuits covering, Necessity and Advantages of three phase systems, Generation of three phase power, definition of Phase sequence, balanced supply and balanced load; Relationship between line and phase values of balanced star and delta connections; Power in balanced three phase circuits, measurement of power by two wattmeter method;

Module III: (5 hours)

Transformers covering, Principle of operation and construction of single phase transformers (core and shell types). EMF equation, losses, efficiency and voltage regulation; Synchronous Generators covering, Principle of operation; Types and constructional features; EMF equation;

Module IV: (10 hours)

DC Machines covering, working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, relation between EMF induced and terminal voltage enumerating the brush drop and drop due to armature reaction; DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics and applications; Necessity of a starter for DC motor;

Module V: (10 hours)

Three Phase Induction Motors covering; Concept of rotating magnetic field; Principle of operation, types and constructional features; Slip and its significance; Applications of squirrel cage and slip ring motors; Necessity of a starter, star-delta starter.

TEXT/REFERENCS BOOKS:

1. AICTE's Prescribed Textbook: Basic Electrical Engineering (ISBN: 978-93-91505-158)
2. Ritu Sahdev (2022), Basic Electrical Engineering, Khanna Book Publishing.
3. Nagrath I.J. and D. P. Kothari (2001), Basic Electrical Engineering, Tata McGraw Hill.
4. Hayt and Kimberly, Engineering Circuit Analysis, Tata McGraw Hill.
5. Kulshreshtha D.C. (2009), Basic Electrical Engineering, Tata McGraw Hill.

6. Rajendra Prasad (2009), Fundamentals of Electrical Engineering, Prentice Hall, India Hughes, E. 2005)
7. Mittel & Mittal, Basic Electrical Engineering, Tata McGraw Hill.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	BASIC ELECTRIC CIRCUITS	PROF. ANKUSH SHARMA	IIT KANPUR
2	BASIC ELECTRICAL CIRCUITS	PROF. NAGENDRA KRISHNAPURA	IITM
3	FUNDAMENTALS OF ELECTRICAL ENGINEERING	PROF. DEBAPRIYA DAS	IIT KGP

COURSE OUTCOMES:

At the end of the course, the students will learn:

CO1. Understand the basic knowledge of electrical quantities such as current, voltage, power, energy and frequency
CO2. Predict the behavior of any electrical and magnetic circuits.
CO3. Formulate and solve complex AC, DC circuits.
CO4. Identify the type of electrical machine used for that particular application.
CO5. Realize the requirement of transformers in transmission and distribution of electric power and other applications.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Identify and understand the kinds of experimental results which are incompatible with classical Physics leading to the development of a quantum theory of matter and light.	K_1
CO2	Use basic concepts to analyse and design a wide range of semiconductor devices.	K_2
CO3	Understand & solve different types of wave equations.	K_3
CO4	Use the principles of optics to solve various complex engineering problems.	K_3
CO5	Use fundamental laws and relations to solve problems in electricity, electromagnetism.	K_4

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										3		
CO2			2		3									1
CO3				2								1		
CO4			3	2										
CO5			3							2				
CO(Average)	2	3	2.6	2	3					2		2		1

3 –High; 2 –Medium; 1 –Low

ENGINEERING DRAWING

Subject Code: - BTESC104	**IA Marks 40**
Number of Lecture Hours/Week: - 03	**Term End Exam Marks 60**
Total Number of Lecture Hours: - 45	**CREDITS 03**

COURSE OBJECTIVE(S):

The objective of this Course is to provide the basic knowledge about Engineering Drawing. Detailed concepts are given in projections, technical drawing, dimensioning and specifications, so useful for a student in preparing for an engineering career.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

COURSE CONTENTS:

Traditional Engineering Graphics:Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics: Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection;

Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

Module I: Introduction to Engineering Drawing (10 hours)

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Module II: Orthographic Projections (10 hours)

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Module III: Projections of Regular Solids (5 hours)

Covering those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Module IV: Sections and Sectional Views of Right Angular Solids (10 hours)

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids

- Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Module V: Isometric Projections (10 hours)

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Text/Reference Books:

1. AICTE's Prescribed Textbook: Engineering Graphics & Design (ISBN: 978-93-91505-066)
2. Jain, Maheshwari, Gautam (2021), Engineering Graphics & Design, Khanna Book Publishing.
3. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing.
4. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson.
5. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication.
6. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers.
7. (Corresponding set of) CAD Software Theory and User Manuals.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	PROF. RAJARAM LAKKARAJU	IIT KHARAGPUR	Engineering Drawing and Computer Graphics
2	PROF. NIHAR RANJAN PATRA	IIT KANPUR	Engineering Graphics

Course Outcomes:

All phases of manufacturing or construction require the conversion of new ideas and design concepts into the basic line language of graphics. Therefore, there are many areas (civil, mechanical, electrical, architectural and industrial) in which the skills of the CAD technicians play major roles in the design and development of new products or construction. Students prepare for actual work situations through practical training in a new state-of-the-art computer designed CAD laboratory using engineering software. This course is designed to address:

At the end of the course, the students will learn:

CO1. To describe engineering design and its place in society.
CO2. To discuss the visual aspects of engineering design.
CO3. To use engineering graphics standards.
CO4. To illustrate solid modelling.
CO5. To use computer-aided geometric design.
CO6. To design creating working drawings.
CO7. To inspect engineering communication.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To describe engineering design and its place in society.	K_1
CO2	To discuss the visual aspects of engineering design.	K_2
CO3	To use engineering graphics standards.	K_3
CO4	To illustrate solid modelling.	K_2
CO5	To use computer-aided geometric design.	K_3
CO6	To design creating, working, drawings.	K_6
CO7	To inspect engineering communication.	K_5

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3											
CO2				3					2					
CO3		2												
CO4						3								
CO5														
CO6		2							2			1	1	1
CO7	2													
CO(Average)	2	2	3	3		3			2			1	1	1

3 –High; 2 –Medium; 1 –Low

Indian Knowledge System

Subject Code: -	**BTMC105**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective

The course aims at imparting basic principles of thought process, reasoning and differencing. Sustainability is at the core of Indian Traditional knowledge Systems connecting society and nature. Holistic life style of yogic science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions. Part-I focuses on introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view, and basic principles of Yoga and holistic health care system.

Course Outcomes:

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

CO1. Basic principles of thought process, reasoning and differencing.
CO2. Introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care systems.
CO3. Focuses on Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

SYLLABUS

BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM: Basic structure of Indian Knowledge System.

BASIC STRUCTURE OF INDIAN KNOWLEDGE SYSTEM:

MODERN SCIENCE AND INDIAN KNOWLEDGE SYSTEM: Modern Science and Indian Knowledge System.

YOGA AND HOLISTIC HEALTH CARE LAWS: Yoga and Holistic Health care.

CASE STUDIES: Case studies.

TEXT BOOKS

1. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bhartiya.
2. Vidya Bhavan, Mumbai. 5th Edition, 2014 Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
3. Swami Jitatmanand, Holistic Science and Vedant, BharatiyaVidyaBhavan.
4. Meena Rao (2006), Fundamental concepts in Law of Contract, 3rd Edn. Professional Offset
5. Fritzof Capra, The Wave of life.

REFERENCE BOOKS

1. VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay
2. Foundation, Velliarnad, Arnakulam Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata R3. GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya
3. VidyanidhiPrakashan, Delhi 2016 RNJha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi
4. Prakashan, Delhi 2016 P B Sharma (English translation), ShodashangHridayan

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Basic principles of thought process, reasoning and differencing.	K_1
CO2	Introduction to Indian Knowledge Systems, Indian perspective of modern scientific world-view and basic principles of Yoga and holistic health care systems.	K_2
CO3	Focuses on Indian philosophical traditions, Indian linguistic tradition and Indian artistic tradition.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			3											
CO2				3					2					
CO3		2												
CO(Average)	2	2	3	3		3			2			1	1	1

3 –High; 2 –Medium; 1 –Low

ENGINEERING PHYSICS LAB

Subject Code: - BTBSC102P	**IA Marks 30**
Number of Lecture Hours/Week: - 02	**Term End Exam Marks 20**
Total Number of Lecture Hours: - 15	**CREDITS 01**

Course Objective

- To study the use of physical principles and analysis in various fields of engineering and technology.
- To supplement the theoretical knowledge gained in the lecture by hands-on experience with the equipment. This will develop scientific temper and help to apply the basic concepts and principles in solving engineering problems.
- Demonstrate an ability to make physical measurements & understand the limits of precision measurement.

Course Outcomes:

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

CO1. Understand calculation of specific resistance of wire by Carey Foster bridge
CO2. Calculate thermal conductivity of poor conductors
CO3. Measure resonance frequency and quality factor of LCR Circuit & RC circuit with AC current
CO4. Study the characteristics of transistors, photoelectric cells and determine operational parameters associated with their performance.
CO5. Work with laboratory sodium light and lasers. Understand method to measure the wavelength of the light emitted from a laser and Sodium light.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50

Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.

SYLLABUS

Sl. No.	Name of Experiments
1.	To determine the specific resistance of the material of a wire by Carey Foster bridge
2.	To determine the Planck‟s constant using LED.
3.	To determine the wavelength of sodium light by using Newton‟s ring apparatus.
4.	To find the wave length of sodium light using Fresnel‟s biprism
5.	To determine dispersive power of the material of the prism with the help of a Spectrometer
6.	To determine the number of lines per centimeter of the plane diffraction grating by using sodium light.
7.	To determine the thermal conductivity of following bad conductor (a) ebonite (b) mica sheet (c) wooden By Lee‟s disc method
8.	To determine the co-efficient of viscosity of glycerin by Stoke‟s method.
9.	To determine acceleration due to gravity by a Bar Pendulum.
10.	To determine input & output characteristics of a PNP Junction Transistor in CE and CB configuration.
11.	To determine input & output characteristics of a NPN Junction Transistor in CE and CB configuration
12.	To study resonance phenomena in LCR circuits with AC current
13.	To measure moment of inertia of Flywheel
14.	To determine the Lorentz force in a vacuum tube.
15.	To measure the numerical aperture of an optical fiber.
16.	To obtain the particle size by Laser
17.	To obtain forbidden energy gap of Semiconductor Diode.
18.	To obtain Dielectric constant.
19.	To obtain Curie temperature

20.	To determine the time constant of an RC circuit.

Text Book:

1. A Text Book of Engineering Physics Practical by Dr. Ruby Das, C.S. Robinson, Dr. Rajesh Kumar & Prashant Kumar Sahu; Pub University Science Press.
2. Fundamentals of Physics extended volume by Resnick, Halliday and Walker; Pub.:John Wiley & Sons. Inc. Asian Edition.

Reference Books:

1. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, Heinemann Educational Publishers.
2. Engineering Practical Physics, S. Panigrahi & B. Mallick,2015, Cengage Learning India Pvt. Ltd.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand calculation of specific resistance of wire by Carey Foster bridge	K_1
CO2	Calculate thermal conductivity of poor conductors	K_2
CO3	Measure resonance frequency and quality factor of LCR Circuit & RC circuit with AC current	K_3
CO4	Study the characteristics of transistors, photoelectric cells and determine operational parameters associated with their performance.	K_2
CO5	Work with laboratory sodium light and lasers. Understand method to measure the wavelength of the light emitted from a laser and Sodium light.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										3		
CO2			2		3									1
CO3				2								1		
CO4			3	2										
CO5			3							2				
CO(Average)	2	3	2.6	2	3					2		2		1

3 –High; 2 –Medium; 1 –Low

BASICS OF ELECTRICAL ENGINEERING LAB

Subject Code: -	**BTESC103P**	**IA Marks**	**30**
Number of Lecture Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Course Objective

- To impart a basic knowledge of electrical instruments voltmeter, ammeter, multi-meter, and oscilloscope. Real-life resistors, capacitors and inductors. Measurement such as current, voltage, power, energy and frequency to understand the impact of technology in a global and societal context.
- Emphasize the effects of electric shock and precautionary measures.
- Improve the ability to function on multi-disciplinary team.

Course Outcomes:

At the end of the course, students will be able

CO1. Study different meters and instruments for measurement of electrical quantities
CO2. Study the linear and nonlinear characteristics of different types of loads experimentally.
CO3. Design and experiment potential divider circuits
CO4. Experimentally verify the basic circuit theorems.
CO5. Measure power and power factor in ac circuits.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Outcome No	**Statement**	**Knowledge Level (KL)**
CO1	Study different meters and instruments for measurement of electrical quantities	K_1
CO2	Study the linear and nonlinear characteristics of different types of loads experimentally.	K_2
CO3	Design and experiment potential divider circuits	K_3

CO4	Experimentally verify the basic circuit theorems.	K_2
CO5	Measure power and power factor in ac circuits.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2		1	2											
CO3				3									1	1
CO4														
CO5														
CO(Average)	3	1	2	3									1	1

3 –High; 2 –Medium; 1 –Low

ENGINEERING DRAWING & COMPUTER GRAPHICS LAB

Subject Code: -	**BTESC104P**	**IA Marks**	**30**
Number of Lecture Hours/Week: -	**04**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**02**

Course Objective

- Increase ability to communicate with people
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic engineering drawing formats
- Prepare the student for future Engineering positions

Course Outcomes:

At the end of the course, students will be able

CO1. Perform basic sketching techniques
CO2. Understanding of architectural and engineering scales will increase.
CO3. Able to draw orthographic projections and sections.
CO4. Ability to produce engineered drawings will improve.
CO5. Become familiar with office practice and standards.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5

	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content

GENERAL INTRODUCTION: Significance of engineering drawing, Introduction to CAD, Lettering, Dimensioning, Scales, Sense of proportioning, Conic sections – General methods only, Different types of projections,

ORTHOGRAPHIC PROJECTIONS OF POINTS AND LINES: Orthographic projections, Projections of points, Projections of lines in different quadrants, traces, inclinations, and true lengths of the line's projections on auxiliary planes. shortest distance, intersecting and non-intersecting lines.

PROJECTIONS OF PLANE FIGURES: Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angles (with one or both reference planes). Obtaining true shape of the plane figure by projection.

PROJECTION OF SOLIDS &SECTION OF SOLID: Simple cases when solid are placed in different positions Axis faces and tines lying in the faces of the solid making given angles. Sectional orthographic views of geometrical solids.

DEVELOPMENT OF SURFACE & ISOMETRIC PROJECTION: Development of simple objects with and without sectioning, Concept of Isometric Projection.

TEXT BOOKS

1. Engineering Graphics, N.D Bhatt, Charotar Publishing House Pvt. Limited
2. Principle of Engineering Graphics and Drawing, R.K Dhawan, S. Chand Publishing
3. Engineering Graphics and Drafting, P.S GILL, S. K. Kataria& Sons

REFERENCE BOOKS

1. Engineering Drawing and Computer Graphics, Shah, M.B. & Rana B.C. Pearson Education
2. Engineering Graphics, Agrawal B. & Agrawal C. M, TMH Publication
3. Text book on Engineering Drawing, Narayana, K.L. & P Kannaiah, Scitech Publishers

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Perform basic sketching techniques.	K_1

CO2	Understanding of architectural and engineering scales will increase.	K_2
CO3	Able to draw orthographic projections and sections.	K_3
CO4	Ability to produce engineered drawings will improve.	K_2
CO5	Become familiar with office practice and standards.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2										
CO2	1													
CO3													2	
CO4					1				2					
CO5														
CO(Average)	2	3		2	1				2				2	

3 –High; 2 –Medium; 1 –Low

DESIGN THINKING & IDEA LAB

Subject Code: - BTESC107P	**IA Marks 30**
Number of Lecture Hours/Week: - 02	**Term End Exam Marks 20**
Total Number of Lecture Hours: - 15	**CREDITS 01**

COURSE OBJECTIVE(S):

The objective of this Course is to provide the new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.

COURSE CONTENTS:

Module 1: An Insight to Learning Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting

Module 2: Basics of Design Thinking

Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test

Module 3: Prototyping & Testing

What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing

Module 4: Design Thinking & Customer Centricity

Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design

Module 5: Feedback, Re-Design & Re-Create

Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, final product, Final Presentation – "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".

Course Outcomes (CO):

Student will able to:

CO1. Compare and classify the various learning styles and memory techniques and apply them in their engineering education.
CO2. Analyse emotional experience and inspect emotional expressions to better understand users while designing innovative products.
CO3. Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.
CO4. Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development.
CO5. Perceive individual differences and its impact on everyday decisions and further Create a better customer experience.

Text/Reference Books:

1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company.

IDEA Lab Workshop

Course Objectives:

CO1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
CO2. Learn useful mechanical and electronic fabrication processes.
CO3. Learn necessary skills to build useful and standalone system/ project with enclosures.
CO4. Learn necessary skills to create print and electronic documentation for the system/project

Course Contents:

Unit	Topics	
1.	Electronic component familiarization, Understanding electronic system design flow. Schematic design and PCB layout	Introduction to basic hand tools - Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws,

	and Gerber creation using EagleCAD. Documentation using Doxygen, Google Docs, Overleaf. Version control tools - GIT and GitHub. Basic 2D and 3D designing using CAD tools such as FreeCAD, Sketchup, Prusa Slicer, FlatCAM, Inkspace, OpenBSP and VeriCUT.	tube cutter, chisels, vice and clamps, tapping and threading. Adhesives Introduction to Power tools: Power saws, band saw, jigsaw, angle grinder, belt sander, bench grinder, rotary tools. Various types of drill bits,
2.	Familiarization and use of basic measurement instruments - DSO including various triggering modes, DSO probes, DMM, LCR bridge, Signal and function generator. Logic analyzer and MSO. Bench power supply (with 4-wire output) Circuit prototyping using (a) breadboard, (b) Zero PCB (c) 'Manhattan' style and (d) custom PCB. Single, double and multilayer PCBs. Single and double-sided PCB prototype fabrication in the lab. Soldering using soldering iron/station. Soldering using a temperature controlled reflow oven. Automated circuit assembly and soldering using pick and place machines.	Mechanical cutting processes - 3-axis CNC routing, basic turning, milling, drilling and grinding operations, Laser cutting, Laser engraving etc. Basic welding and brazing and other joining techniques for assembly. Concept of Lab aboard a Box.
3.	Electronic circuit building blocks including common sensors. Arduino and Raspberry Pi programming and use. Digital Input and output. Measuring time and events. PWM. Serial communication. Analog input. Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging	3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering. Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers. Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab
4.	Discussion and implementation of a mini project.	
5.	Documentation of the mini project (Report and video).	

Laboratory Activities:

S. No.	List of Lab activities and experiments
1.	Schematic and PCB layout design of a suitable circuit, fabrication and testing of the circuit.

2.	Machining of 3D geometry on soft material such as soft wood or modelling wax.
3.	3D scanning of computer mouse geometry surface. 3D printing of scanned geometry using FDM or SLA printer.
4.	2D profile cutting of press fit box/casing in acrylic (3- or 6-mm thickness)/cardboard, MDF (2 mm) board using laser cutter & engraver.
5.	2D profile cutting on plywood /MDF (6-12 mm) for press fit designs.
6.	Familiarity and use of welding equipment.
7.	Familiarity and use of normal and wood lathe.
8.	Embedded programming using Arduino and/or Raspberry Pi.
9.	Design and implementation of a capstone project involving embedded hardware, software and machined or 3D printed enclosure.

Reference Books:

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), ISBN: 978-9391505332
2. All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
3. Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4. 3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
5. The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6. The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7. Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8. The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
9. Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
10. Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703

11. Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
12. Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633
13. Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13: 978-1260019193.
14. Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13: 978-1484200773
15. Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
16. Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17. Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Compare and classify the various learning styles and memory techniques and apply them in their engineering education.	K_1
CO2	Analyse emotional experience and inspect emotional expressions to better understand users while designing innovative products.	K_3
CO3	Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.	K_4
CO4	Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development.	K_4
CO5	Perceive individual differences and its impact on everyday decisions and further Create a better customer experience.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2			2					2						1
CO3														
CO4	1		1							1		1		1
CO5														
CO(Average)	2		1.5					2		1		1		1

3 –High; 2 –Medium; 1 –Low

SPORTS AND YOGA

Subject Code: - BTESC107P	**IA Marks 00**
Number of Lecture Hours/Week: - 02	**Term End Exam Marks 00**
Total Number of Lecture Hours: - 15	**CREDITS 00**

Course Objective(s):

- To make the students understand the importance of sound health and fitness principles as they relate to better health.
- To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
- To create a safe, progressive, methodical and efficient activity-based plan to enhance improvement and minimize risk of injury.
- To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health.

Course Contents:

Module I: Introduction to Physical Education

- Meaning & definition of Physical Education
- Aims & Objectives of Physical Education
- Changing trends in Physical Education

Module II: Olympic Movement

- Ancient & Modern Olympics (Summer & Winter)
- Olympic Symbols, Ideals, Objectives & Values
- Awards and Honours in the field of Sports in India (Dronacharya Award, Arjuna Award, Dhayanchand Award, Rajiv Gandhi Khel Ratna Award etc.)

Module III: Physical Fitness, Wellness & Lifestyle

- Meaning & Importance of Physical Fitness & Wellness
- Components of Physical fitness
- Components of Health related fitness
- Components of wellness
- Preventing Health Threats through Lifestyle Change
- Concept of Positive Lifestyle

Module IV: Fundamentals of Anatomy & Physiology in Physical Education, Sports and Yoga

- Define Anatomy, Physiology & Its Importance

- Effect of exercise on the functioning of Various Body Systems. (Circulatory System, Respiratory System, Neuro-Muscular System etc.)

Module V: Kinesiology, Biomechanics & Sports

- Meaning & Importance of Kinesiology & Biomechanics in Physical Edu. & Sports
- Newton's Law of Motion & its application in sports.
- Friction and its effects in Sports.

Module VI: Postures

- Meaning and Concept of Postures.
- Causes of Bad Posture.
- Advantages & disadvantages of weight training.
- Concept & advantages of Correct Posture.
- Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders; Lordosis, Kyphosis, Bow Legs and Scoliosis.
- Corrective Measures for Postural Deformities

Module VII: Yoga

- Meaning & Importance of Yoga
- Elements of Yoga
- Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas
- Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana)
- Relaxation Techniques for improving concentration - Yog-nidra

Module VIII: Yoga & Lifestyle

- Asanas as preventive measures.
- Hypertension: Tadasana, Vajrasana, Pavan Muktasana, Ardha Chakrasana, Bhujangasana, Sharasana.
- Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.
- Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
- Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana.
- Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana.

Module IX: Training and Planning in Sports

- Meaning of Training
- Warming up and limbering down
- Skill, Technique & Style
- Meaning and Objectives of Planning.
- Tournament – Knock-Out, League/Round Robin & Combination.

Module X: Psychology & Sports

- Definition & Importance of Psychology in Physical Edu. & Sports
- Define & Differentiate Between Growth & Development
- Adolescent Problems & Their Management
- Emotion: Concept, Type & Controlling of emotions
- Meaning, Concept & Types of Aggressions in Sports.
- Psychological benefits of exercise.
- Anxiety & Fear and its effects on Sports Performance.
- Motivation, its type & techniques.
- Understanding Stress & Coping Strategies.

Module XI: Doping

- Meaning and Concept of Doping
- Prohibited Substances & Methods
- Side Effects of Prohibited Substances

Module XII: Sports Medicine

- First Aid – Definition, Aims & Objectives.
- Sports injuries: Classification, Causes & Prevention.
- Management of Injuries: Soft Tissue Injuries and Bone & Joint Injuries

Module XIII: Sports / Games

Following subtopics related to any one Game/Sport of choice of student out of:

Athletics, Badminton, Basketball, Chess, Cricket, Kabaddi, Lawn Tennis, Swimming, Table Tennis, Volleyball, Yoga etc.

- History of the Game/Sport.
- Latest General Rules of the Game/Sport.
- Specifications of Play Fields and Related Sports Equipment.
- Important Tournaments and Venues.
- Sports Personalities.
- Proper Sports Gear and its Importance.

Text Books/References:

1. Modern Trends and Physical Education by Prof. Ajmer Singh.
2. Light On Yoga by B.K.S. Iyengar.
3. Health and Physical Education – NCERT (11th and 12th Classes)

Course Outcomes:

On successful completion of the course the students will be able:

1. To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.
2. To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.

3. To learn breathing exercises and healthy fitness activities
4. To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.
5. To perform yoga movements in various combination and forms.
6. To assess current personal fitness levels.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To practice Physical activities and Hatha Yoga focusing on yoga for strength, flexibility, and relaxation.	K_1
CO2	To learn techniques for increasing concentration and decreasing anxiety which leads to stronger academic performance.	K_3
CO3	To learn breathing exercises and healthy fitness activities	K_4
CO4	To understand basic skills associated with yoga and physical activities including strength and flexibility, balance and coordination.	K_4
CO5	To perform yoga movements in various combination and forms.	K_3
CO6	To assess current personal fitness levels.	K_4

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3													
CO2		1	2											
CO3				3									1	1
CO4														
CO5														
CO6										1				
CO(Average)	3	1	2	3						1			1	1

3 –High; 2 –Medium; 1 –Low

SEMESTER-II

ENGINEERING MATHEMATICS- II

Subject Code: -	**BTBSC201**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**60**	**CREDITS**	**04**

Course Objective:

Mathematics fundamental necessary to formulate, solve and analyse engineering problems.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module 1: Matrices (10 hours)

Linear Systems of Equations; Linear Independence; Rank of a Matrix; Determinant, Inverse of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew-symmetric and orthogonal matrices; Determinants; Eigenvalues and eigenvectors; Orthogonal transformation; Diagonalization of matrices; Cayley-Hamilton Theorem.

Module 2: First order ordinary differential equations: (10 hours)

Exact, linear and Bernoulli's equations. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module 3: Ordinary differential equations of higher orders: (10 hours)

Second order linear differential equations with variable coefficients: Euler-Cauchy equations, solution by variation of parameters; Power series solutions: Legendre's equations and Legendre polynomials, Frobenius method, Bessel's equation and Bessel's functions of the first kind and their properties.

Module 4: Complex Variable – Differentiation: (15 hours):

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable – Integration: (15 hours):

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

TEXTBOOKS/REFERENCES:

1. AICTE's Prescribed Textbook: Mathematics-II (Calculus, Ordinary Differential Equations and Complex Variable) ISBN: 978-93-91505-28-8
2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.
3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.
4. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2006.
5. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
6. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley India, 2009.
7. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
8. S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.
9. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
10. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
11. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
12. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
13. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The modules have been prepared keeping the following from the Textbooks/References in mind:

(1) Module 1: Sections 7.3-7.5, 7.7, 7.8, 8.1-8.4 of [1].
(2) Module 2: Sections 1.4, 1.5 of [1]; Section 5.1 of [2].
(3) Module 3: Sections 2.5, 2.6, 2.10, 5.1, 5.3, 5.4, 5.5 of [1].
(4) Module 4: Sections 13.3 – 13.7, 17.1 – 17.3 of [1].
(5) Module 5: Sections 14.1 – 14.4, 15.2 – 15.4, 16.1 – 16.4 of [1].

COURSE OUTCOMES: The objective of this course is to familiarize the prospective engineers with techniques in matrices, ordinary differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

The students will learn:

CO1. The essential tool of matrices and linear algebra in a comprehensive manner.
CO2. The effective mathematical tools for the solutions of differential equations that model physical processes.
CO3. The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	The essential tool of matrices and linear algebra in a comprehensive manner.	K_1
CO2	The effective mathematical tools for the solutions of differential equations that model physical processes.	K_2
CO3	The tools of differentiation and integration of functions of a complex variable that are used in various techniques dealing engineering problems.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

ENGINEERING CHEMISTRY

Subject Code: -	**BTBSC202**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective:

The objective of the Chemistry-I is to acquaint the students with the basic phenomenon/concepts of chemistry, the student faces during course of their study in the industry and Engineering field. The student with the knowledge of the basic chemistry, will understand and explain scientifically the various chemistry related problems in the industry/engineering field. The student will able to understand the new developments and breakthroughs efficiently in engineering and technology. The introduction of the latest (R&D oriented) topics will make the engineering student upgraded with the new technologies.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I: Atomic and Molecular Structure (10 hours):

Schrodinger equation. Particle in a box solution and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module II: Spectroscopic techniques and applications (8 hours):

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterization techniques. Diffraction and scattering.

Module III: Intermolecular forces and potential energy surfaces (7 hours):

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module IV: Use of free energy in chemical equilibria (10 hours):

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and EMF. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module V: Periodic properties (10 hours):

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Chemistry – I with Lab Manual (ISBN: 978-93-91505-141)
2. Engineering Chemistry, by Manisha Agrawal.
3. University chemistry, by B. H. Mahan.
4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
6. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.
7. Physical Chemistry, by P. W. Atkins.
8. A Textbook of Engineering Chemistry, Shashi Chawla.
9. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	Experiment Name	Experiment Link(s)

1	Determination of surface tension and viscosity.	http://pcv-au.vlabs.ac.in/physical-chemistry/Determination_of_Viscosity_of_Organic_Solvents/
2	Ion exchange column for removal of hardness of water.	http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Chemical_Parameters/
3	Determination of chloride content of water.	http://vlabs.iitb.ac.in/vlabs-dev/labs/nitk_labs/Environmental_Engineering_1/experiments/determination-of-chloride-nitk/simulation.html
4	Colligative properties using freezing point depression.	http://pcv-au.vlabs.ac.in/physical-chemistry/Cryoscopy/
5	Determination of the rate constant of a reaction.	http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/
6	Determination of cell constant and conductance of solutions.	http://icv-au.vlabs.ac.in/inorganic-chemistry/Water_Analysis_Determination_of_Physical_Parameters/
7	Potentiometry - determination of redox potentials and EMFs.	http://pcv-au.vlabs.ac.in/physical-chemistry/EMF_Measurement/
8	Saponification/acid value of an oil.	http://biotech01.vlabs.ac.in/bio-chemistry/Estimation_of_Saponification_Value_of_Fats_or_Oils/

Course Outcomes: The concepts developed in this course will aid in quantification of several concepts in chemistry that have been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic, atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels. The course will enable the students:

CO1. To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
CO2. To rationalise bulk properties and processes using thermodynamic considerations.
CO3. To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques

CO4. To rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.

CO5. To list major chemical reactions that are used in the synthesis of molecules.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.	K_1
CO2	To rationalise bulk properties and processes using thermodynamic considerations.	K_2
CO3	To distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques	K_3
CO4	To rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.	K_3
CO5	To list major chemical reactions that are used in the synthesis of molecules.	K_4

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2	2	1	2											
CO3				3									1	
CO4							2							
CO5	1													
CO(Average)	2	1	2	3			1.5		1				1	

3 –High; 2 –Medium; 1 –Low

ENGLISH FOR TECHNICAL WRITING

Subject Code: - BTHSMC203	**IA Marks 40**
Number of Lecture Hours/Week:- 02	**Term End Exam Marks 60**
Total Number of Lecture Hours: - 30	**CREDITS 02**

Course Objective:

1. To provide learning environment to practice listening, speaking, reading and writing skills.

2. To assist the students to carry on the tasks and activities through guided instructions and materials.
3. To effectively integrate English language learning with employability skills and training.
4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I: Vocabulary Building

1.1. The concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4. Synonyms, antonyms, and standard abbreviations.

Module II: Basic Writing Skills

1.1. Sentence Structures
1.2. Use of phrases and clauses in sentences
1.3. Importance of proper punctuation
1.4. Creating coherence
1.5. Organizing principles of paragraphs in documents
1.6. Techniques for writing precisely

Module III: Identifying Common Errors in Writing

1.1. Subject-verb agreement
1.2. Noun-pronoun agreement
1.3. Misplaced modifiers
1.4. Articles
1.5. Prepositions
1.6. Redundancies
1.7. Clichés

Module IV: Nature and Style of sensible Writing

1.1. Describing

1.2. Defining
1.3. Classifying
1.4. Providing examples or evidence
1.5. Writing introduction and conclusion
1.6. Comprehension
1.7. Précis Writing
1.8. Essay Writing

Module V: Oral Communication

(This Module involves interactive practice sessions in Language Lab)

- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text/Reference Books:

1. AICTE's Prescribed Textbook: English (with Lab Manual), Khanna Book Publishing Co.
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	English language for competitive exams	Prof. Aysha iqbal	IIT MADRAS
2.	Technical English for engineers	Prof. Aysha iqbal	IITM

Course Outcomes:

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

CO1. Remembering the basic of the comm Represent unication process and to know the practical implementations in the work place.
CO2. Understanding verbal and non-verbal modes of communication effectively in practical situations
CO3. Analyzing vocalics and basic grammar.
CO4. Creating competence in reading and writing.
CO5. Evaluation of speaking process.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Remembering the basic of the comm Represent unication process and to know the practical implementations in the work place.	K_1
CO2	Understanding verbal and non-verbal modes of communication effectively in practical situations	K_2
CO3	Analyzing vocalics and basic grammar.	K_3
CO4	Creating competence in reading and writing.	K_6
CO5	Evaluation of speaking process.	K_5

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3	1			2									1	
CO4					2									
CO5														
CO(Average)	2	1	2	3	2		1		1				1	

3 –High; 2 –Medium; 1 –Low

PROGRAMMING FOR PROBLEM SOLVING

Subject Code: -	**BTESC204**	**IA Marks**	**40**
Number of Lecture Hours/ Week: -	**02**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**02**

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To learn the syntax and semantics of C programming language.
4. To learn the usage of structured programming approach in solving problems.
5. To understated and formulate algorithm for programming script
6. To analyze the output based on the given input variables.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30

	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Contents:

Module I: (8 hours)

Introduction to Programming; Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudocode with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Module II: (7 hours)

Arithmetic expressions and precedence. Conditional Branching and Loops. Writing and evaluation of conditionals and consequent branching. Iteration and loops. Arrays, Arrays (1-D, 2-D), Character arrays and Strings. Basic Algorithms, Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module III: **(8 hours)**

Function, Functions (including using built in libraries), Parameter passing in functions, call by value, Passing arrays to functions: idea of call by reference. Recursion, Recursion as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Module IV: (7 hours)

Structures, Defining structures and Array of Structures. Pointers, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

Module V: (5 hours)

File handling (only if time is available, otherwise should be done as part of the lab).

TEXT/REFERENCE BOOKS:

1. AICTE's Prescribed Textbook: Programming for Problem Solving (ISBN: 978-93-91505-219)
2. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
3. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

4. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Introduction to programming in c	Prof. Satyadev nandakumar	IIT KANPUR
2	Problem solving through programming in c	Prof. Anupam basu	IIT KHARAGPUR

COURSE OUTCOMES:

The student will learn following through lectures:

CO1. To formulate simple algorithms for arithmetic and logical problems.
CO2. To translate the algorithms to programs (in C language).
CO3. To test and execute the programs and correct syntax and logical errors.
CO4. To implement conditional branching, iteration and recursion.
CO5. To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
CO6. To use arrays, pointers and structures to formulate algorithms and programs.
CO7. To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
CO8. To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To formulate simple algorithms for arithmetic and logical problems.	K_1
CO2	To translate the algorithms to programs (in C language).	K_2
CO3	To test and execute the programs and correct syntax and logical errors.	K_3
CO4	To implement conditional branching, iteration and recursion.	K_4
CO5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.	K_1
CO6	To use arrays, pointers and structures to formulate algorithms and programs.	K_3
CO7	To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.	K_3
CO8	To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO5											2			
CO6	3													
CO7	1		2				1							
CO8														
CO(Average)	2	1	2	2	2		1		1				1	

3 –High; 2 –Medium; 1 –Low

UNIVERSAL HUMAN VALUES

Subject Code: -	**BTHSMC205**	**IA Marks**	**40**
Number of Lecture Hours/ Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objectives

This introductory course input is intended:

1. To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content

Module 1 – Introduction to Value Education

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)
Lecture 2: Understanding Value Education
Tutorial 1: Practice Session -Sharing about Oneself
Lecture 3: Self-exploration as the Process for Value Education
Lecture 4: Continuous Happiness and Prosperity – the Basic Human Aspirations
Tutorial 2: Practice Session-Exploring Human Consciousness
Lecture 5: Happiness and Prosperity – Current Scenario
Lecture 6: Method to Fulfil the Basic Human Aspirations
Tutorial 3: Practice Session -Exploring Natural Acceptance

Module 2 – Harmony in the Human Being

Lecture 7: Understanding Human being as the Co-existence of the Self and the Body
Lecture 8: Distinguishing between the Needs of the Self and the Body
Tutorial 4: Practice Session -Exploring the difference of Needs of Self and Body
Lecture 9: The Body as an Instrument of the Self
Lecture 10: Understanding Harmony in the Self
Tutorial 5: Practice Session -Exploring Sources of Imagination in the Self
Lecture 11: Harmony of the Self with the Body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session -Exploring Harmony of Self with the Body

Module 3 – Harmony in the Family and Society

Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session -Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session- Exploring the Feeling of Respect Lecture 16: Other Feelings, Justice in Human-to-Human Relationship Lecture 17: Understanding Harmony in the Society

Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session -Exploring Systems to fulfil Human Goal

Module 4 – Harmony in the Nature/Existence

Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session -Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session -Exploring Co-existence in Existence

Module 5 – Implications of the Holistic Understanding – a Look at Professional Ethics
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order.

The Textbook

1. A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034- 47-1
2. Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, RR Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-
3. Professional Ethics and Human Values, Premvir Kapoor, ISBN: 978-93-86173-652, Khanna Book Publishing Company, New Delhi, 2022.

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal

9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

COURSE OUTCOME:

CO1. Understand the role of values in achieving happiness and prosperity through right understanding and relationships.
CO2. Analyze harmony in self, family, society, and nature for ethical and responsible living.
CO3. Apply human values and ethics in professional and personal life for a value-based society.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the role of values in achieving happiness and prosperity through right understanding and relationships.	K_1
CO2	Analyze harmony in self, family, society, and nature for ethical and responsible living.	K_4
CO3	Apply human values and ethics in professional and personal life for a value-based society.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

ENGINEERING CHEMISTRY LAB

Subject Code: -	**BTBSC202P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks

Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Determination of surface tension and viscosity.
2. Thin layer chromatography.
3. Ion exchange column for removal of hardness of water.
4. Determination of chloride content of water.
5. Determination of the rate constant of a reaction.
6. Determination of cell constant and conductance of solutions.
7. Potentiometry - determination of redox potentials and EMFs.
8. Synthesis of a polymer/drug.
9. Saponification/acid value of an oil.
10. Chemical analysis of a salt.
11. Adsorption of acetic acid by charcoal.
12. Use of the capillary viscosimeters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Chemistry – I with Lab Manual (ISBN: 978-93-91505-141)
2. Engineering Chemistry, by Manisha Agrawal.
3. University chemistry, by B. H. Mahan.
4. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane.
5. Fundamentals of Molecular Spectroscopy, by C. N. Banwell.
6. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan.
7. Physical Chemistry, by P. W. Atkins.
8. A Textbook of Engineering Chemistry, Shashi Chawla.
9. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Laboratory Outcomes: The chemistry laboratory course will consist of experiments illustrating the principles of chemistry relevant to the study of science and engineering. The students will learn:

CO1. To estimate rate constants of reactions from concentration of reactants/products as a function of time.

CO2. To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.
CO3. To synthesize a small drug molecule and analyze a salt sample.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To estimate rate constants of reactions from concentration of reactants/products as a function of time.	K_1
CO2	To measure molecular/system properties such as surface tension, viscosity, conductance of solutions, redox potentials, chloride content of water, etc.	K_2
CO3	To synthesize a small drug molecule and analyze a salt sample.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1										1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	2		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

ENGLISH FOR TECHNICAL WRITING LAB

Subject Code: - BTHSMC202P	**IA Marks 30**
Number of Lab Hours/Week: - 02	**Term End Exam Marks 20**
Total Number of Lecture Hours: - 15	**CREDITS 01**

Course Objectives

1. To improve fluency in spoken English and to practice correct pronunciation.
2. To introduce the techniques of presentation skills
3. Help improve speaking skills through participation in activities such as role plays, discussions, and structured talks/ oral presentations

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5

Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Module- I

The sounds of English

Practicing correct Pronunciation through IPA, Stress, Intonation, Rhythm

Module –II

Group Discussions

Purpose, Different roles for participants, Etiquette in a structured GD - Practice GDs

Module –III

Interpersonal Skills

1. Introduction of self and others, making announcements
2. Getting Someone's Attention, and Interrupting Conversations
3. Making Requests and Responding to them, asking for directions

Module –IV

Listening Skills

1. Listening to unknown passages – for global understanding, identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Module –V

Presentation skills

1. Oral Presentations (JAMs) 2. Describing and analysing videos and pictures.3. Interpreting and analysing data from graphs and charts

Course Outcomes

By the end of the course, the student will be able to:

CO1. Speak English with proper pronunciation and intonation
CO2. Make effective oral presentations by interpreting and analysing data, pictures and videos and participate in Group Discussion on general topics
CO3. Make meaningful conversations and follow logical flow of thought; answer questions on key concepts after listening to extended passages.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Speak English with proper pronunciation and intonation	K_1
CO2	Make effective oral presentations by interpreting and analysing data, pictures and videos and participate in Group Discussion on general topics	K_2
CO3	Make meaningful conversations and follow logical flow of thought; answer questions on key concepts after listening to extended passages.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1													
CO2		2		1			2		2				1	
CO3			2											1
CO(Average)	1	2	2	1			2		2				1	1

3 –High; 2 –Medium; 1 –Low

PROGRAMMING FOR PROBLEM SOLVING LAB

Subject Code: - BTESC204P	**IA Marks 30**
Number of Lab Hours/Week: - 04	**Term End Exam Marks 20**
Total Number of Lecture Hours: - 30	**CREDITS 02**

Course Objectives:

1. To learn the fundamentals of computers.
2. To understand the various steps in program development.
3. To learn the syntax and semantics of C programming language.
4. To learn the usage of structured programming approach in solving problems.
5. To understated and formulate algorithm for programming script
6. To analyze the output based on the given input variables

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

PRACTICALS:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Programming for solving Numerical methods problems
9. Recursive functions
10. Pointers and structures
11. File operations

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	Experiment Name	Experiment Link(s)
1	Simple computational problems using arithmetic expressions.	http://ps-iiith.vlabs.ac.in/exp7/Introduction.html?domain=Computer%20Science&lab=Problem%20Solving%20Lab
2	Iterative problems e.g., sum of series.	http://ps-iiith.vlabs.ac.in/exp4/Introduction.html?domain=Computer%20Science&lab=Problem%20Solving%20Lab
3	1D Array manipulation.	http://cse02-iiith.vlabs.ac.in/exp4/index.html
4	Matrix problems, String operations.	http://ps-iiith.vlabs.ac.in/exp5/Introduction.html?domain=Computer%20Science&lab=Problem%20Solving%20Lab
5	Simple functions.	http://cse02-iiith.vlabs.ac.in/exp2/index.html

6	Programming for solving Numerical methods problems.	http://ps-iiith.vlabs.ac.in/exp1/Introduction.html?domain=Computer%20Science&lab=Problem%20Solving%20Lab
7	Recursive functions.	http://ps-iiith.vlabs.ac.in/exp6/Introduction.html?domain=Computer%20Science&lab=Problem%20Solving%20Lab

Course Outcomes

The student will learn following through Practicals:

1. To formulate the algorithms for simple problems.
2. To translate given algorithms to a working and correct program.
3. To be able to correct syntax errors as reported by the compilers.
4. To be able to identify and correct logical errors encountered at run time.
5. To be able to write iterative as well as recursive programs.
6. To be able to represent data in arrays, strings and structures and manipulate them through a program.
7. To be able to declare pointers of different types and use them in defining self-referential structures.
8. To be able to create, read and write to and from simple text files.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To formulate the algorithms for simple problems.	K_1
CO2	To translate given algorithms to a working and correct program.	K_2
CO3	To be able to correct syntax errors as reported by the compilers.	K_3
CO4	To be able to identify and correct logical errors encountered at run time.	K_1
CO5	To be able to write iterative as well as recursive programs.	K_1
CO6	To be able to represent data in arrays, strings and structures and manipulate them through a program.	K_2
CO7	To be able to declare pointers of different types and use them in defining self-referential structures.	K_2
CO8	To be able to create, read and write to and from simple text files.	K_6

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	3			2							1			
CO3		2						1						
CO4	1											1		
CO5				3										
CO6	3							3					3	
CO7					1									
CO8														
CO(Average)	2.3	2.5		2.5	1	2		2	2		1	1	2	1

3 –High; 2 –Medium; 1 –Low

WORKSHOP/MANUFACTURING PRACTICES LAB

Subject Code: - BTESC206P	**IA Marks 30**
Number of Lab Hours/Week: - 04	**Term End Exam Marks 20**
Total Number of Lecture Hours: - 30	**CREDITS 02**

Course Objective:

1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To have a study and hands-on-exercise on plumbing and carpentry components.
3. To have a practice on gas welding, foundry operations and fitting
4. To have a study on measurement of electrical quantities, energy and resistance to earth.
5. To have a practice on soldering.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I: Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods.
Module II: CNC machining, Additive manufacturing.
Module III: Fitting operations & power tools.
Module IV: Electrical & Electronics.
Module V: Carpentry.
Module VI: Plastic moulding, glass cutting.
Module VII: Metal casting.
Module VIII: Welding (arc welding & gas welding), brazing.

Practicals:

1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop (Arc welding + Gas welding)
6. Casting
7. Smithy
8. Plastic moulding & Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Suggested Text/Reference Books:

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual) ISBN: 978-93-91505-332
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
4. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
5. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
6. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

EXPERIMENTS THAT MAY BE PERFORMED THROUGH VIRTUAL LABS:

S. No.	Experiment Name	Experiment Link(s)

1	Welding shop (Arc welding + Gas welding).	http://mm-coep.vlabs.ac.in/LaserSpotWelding/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20Micromachining%20laboratory
2	Casting	http://fab-coep.vlabs.ac.in/exp7/Theory.html?domain=Mechanical%20Engineering&lab=Welcome%20to%20FAB%20laboratory

Laboratory Outcomes:

Upon completion of this laboratory course, students will be able:

1. To fabricate components with their own hands.
2. To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. To design small devices of their interest by assembling different components.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To fabricate components with their own hands.	K_1
CO2	To relate practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.	K_2
CO3	To design small devices of their interest by assembling different components.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

Semester-III

PHYSICS-2 (OPTICS & WAVES)

Subject Code: -	**BTBSC301**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**60**	**CREDITS**	**04**

Course Objective: To provide students with a foundational understanding of wave phenomena, including their properties, behaviour, and applications, particularly in relation to light.

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I: Simple harmonic motion, damped and forced simple harmonic oscillator Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion, damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators, electrical and mechanical impedance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator.

Module II: Non-dispersive transverse and longitudinal waves in one dimension and introduction to dispersion Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, impedance matching, standing waves and their Eigen frequencies, longitudinal waves and the wave equation for them, acoustics waves and speed of sound, standing sound waves. Waves with dispersion, water waves, superposition of waves and Fourier method, wave groups and group velocity.

Module III: The propagation of light and geometric optics Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them, transfer formula and the matrix method.

Module IV: Wave optics Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer, Mach-Zehnder interferometer. Farunhofer

diffraction from a single slit and a circular aperture, the Rayleigh criterion for limit of resolution and its application to vision; Diffraction gratings and their resolving power.

Module V: Lasers Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers (ruby, Neodymium), dye lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in science, engineering and medicine.

Laboratory - Oscillations, waves and optics

Suggested list of experiments from the following:

Diffraction and interference experiments (from ordinary light or laser pointers); measurement of speed of light on a table top using modulation; minimum deviation from a prism.

TEXTBOOKS/REFERENCES:

1. AICTE's Prescribed Textbook: Physics (Oscillations, Waves & Optics) with Lab Manual ISBN: 978-93-91505-13-4

2. Bhattacharya & Nag, Engineering Physics

3. Ian G. Main, Oscillations and waves in physics

4. H.J. Pain, The physics of vibrations and waves

5. E. Hecht, Optics

6. A. Ghatak, Optics

7. O. Svelto, Principles of Lasers

COURSE OUTCOMES : A Physics course in Waves and Optics aims to provide students with a comprehensive understanding of wave phenomena and their applications in various fields. Students will learn to analyze wave behavior, apply mathematical tools to solve problems, and develop experimental skills in related areas.

The students will learn:

CO 1. Students should be able to define and describe different types of waves (e.g., longitudinal, transverse) and understand their fundamental properties (wavelength, frequency, speed).

CO 2. Students should comprehend how waves interact with matter, including concepts like reflection, refraction, diffraction, and interference.

CO 3. Analyze the operation of lenses and prisms based on the principles of ray and wave optics.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students should be able to define and describe different types of waves (e.g., longitudinal, transverse) and understand their fundamental properties (wavelength, frequency, speed).	K_1
CO2	Students should comprehend how waves interact with matter, including concepts like reflection, refraction, diffraction, and interference	K_2
CO3	Analyze the operation of lenses and prisms based on the principles of ray and wave optics.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

MATHEMATICS-3 (PDE, PROB/STAT)

Subject Code: -	**BTBSC302**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**04**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**60**	**CREDITS**	**04**

Course Objectives: To introduce the solution methodologies for second order Partial Differential Equations with applications in engineering. To provide an overview of probability and statistics to engineers.

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Definition of Partial Differential Equations, First order partial differential equations, solutions of first order linear PDEs; Solution to homogenous and non-homogenous linear partial differential equations of second order by complimentary function and particular integral method. Second-order linear equations and their classification, Initial and boundary conditions, D'A lembert's solution of the wave equation; Duhamel's principle for one dimensional wave equation. Heat diffusion and vibration problems, Separation of variables method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates, solutions with Bessel functions and Legendre functions. One dimensional diffusion equation and its solution by separation of variables.

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. Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule

Basic Statistics, 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. 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, Tests for single mean, difference of means, and difference of standard deviations. Test for ratio of variances - Chi- square test for goodness of fit and independence of attributes

Textbooks/References:

1. AICTE Prescribed Textbook: Mathematics – II (Probability and Statistics), ISBN: 978-93-91505 41-7

2. Reena Garg, Engineering Mathematics, Khanna Book Publishing Company, 2022.

3. Reena Garg, Advanced Engineering Mathematics, Khanna Book Publishing Company, 2021.

4. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.

5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010. 81 AICTE revised Model Curriculum for UG Degree Course in Mechanical Engineering

6. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint)

7. S. Ross, A First Course in Probability, 6th Ed., Pearson Education India, 2002.

COURSE OUTCOME:

Students will be able to solve PDEs, apply probability distributions, and analyze statistical data.

The students will learn:

CO 1. Understand basic concepts of PDE, probability, and statistics
CO 2. Apply intermediate techniques in PDE, probability distributions, correlation, and regression.
CO 3. Apply advanced statistical methods and solve real-world problems using PDE.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand basic concepts of PDE, probability, and statistics	K_1
CO2	Apply intermediate techniques in PDE, probability distributions, correlation, and regression	K_2
CO3	Apply advanced statistical methods and solve real-world problems using PDE.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

ENVIRONMENT SCIENCE (AUDIT)

Subject Code: -	**BTBSC303**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**60**	**CREDITS**	**02**

Course Objectives: Develop a comprehensive understanding of environmental issues: This includes learning about pollution, resource management, and the impact of human activities on the environment.

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

MODULE – I

Natural Resources: A)Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people. Water resources - Use and over utilization of surface and ground water –Floods, drought, conflicts over water, dams - benefits and problems. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. B)Energy resources: Renewable and non-renewable resources-Natural resources and associated problems Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies. Mineral resources: Use and exploitation problems, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Organic Farming, Bio fertilizers and Bio-pesticides

MODULE – II

Ecosystems: Definition, Scope and importance, Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem -Ecological succession. - Food chains, food webs and ecological pyramids, Flow of energy, Bio-geochemical cycles, Bio-magnification, Ecosystem values, Services and

carrying capacity. B) Biodiversity and its conservation: Introduction - Definition: genetic, species and ecosystem diversity. Bio-geographical classification of India, India as a mega-diversity nation, Hot-sports of biodiversity, Value of biodiversity**,** consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service values. Threats to biodiversity: habitat loss, poaching of wildlife, man wildlife conflicts. - Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

MODULE – III

Environmental Pollution: Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards B)Solid waste Management:. - classification and characters of solid waste, factors affecting waste generation, collection and disposal of solid waste. E- waste and management. Role of an individual in prevention of pollution. – Pollution case studies.

MODULE – IV

Global Environmental problems and Global efforts: Green house effect, Green house gasses, Global warming, Climate change and their impacts on human environment, ozone layer depletion. International conventions / protocols: Earth summit, Kyoto protocol & Montreal protocol. Towards Sustainable Future: From Unsustainable to Sustainable development, Population and its explosion, Urban problems related to energy, Consumerism and waste products, Role of IT in Environment and human health. Value Education. HIV/AIDS, Environmental ethics ,Concept of green buildings and Clean Development Mechanism**.**

MODULE - V

Environmental Impact Assessment & Management plans, Environmental Law: Definition of impact, Classification of impacts, Impacts of different components such as: human health, resources, air, water, flora & fauna. Environment management plans (EMP): Technological solutions for pollution.

Text Books/ Reference Books:

1. Text of Environmnet studies by Anubha Kaushik, New age publishers, 4th Edition.

2. Erach Bharucha, 2010 “Text Book of Environmental Studies”, University Grants Commission, Universities Press (India) Pvt.Ltd., Hyderabad

3. Text Book of Environmental Studies by Deeshita Dave & P. Udaya Bhaskar, Cengage Learning.

4. Text Book of Environmental Science and Engineering by G.Tyler Miller Jr,2006 Cengage learning

5. Text Book of Environmental Sciences and Technology by M. Anji Reddy, BS Publications.

e-Learning Resources:

1. http://nptel.ac.in/courses.php

2. http://jntuk-coeerd.in/

COURSE OUTCOME:

Students will be able to solve PDEs, apply probability distributions, and analyze statistical data.

The students will learn:

CO 1. Comprehending the structure and function of ecosystems, including biogeochemical cycles and their role in maintaining environmental balance.
CO 2. Identifying and analyzing various environmental problems like air, water, and soil pollution, solid waste management, and their causes and impacts.
CO 3. Understanding the ways human activities affect the environment, including population growth, resource consumption, and pollution.
CO 4. Developing skills in monitoring and assessing pollution levels, identifying pollution sources, and implementing control measures.
CO 5. Applying environmental management techniques for various resources like water, air, and land, and for waste management.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Comprehending the structure and function of ecosystems, including biogeochemical cycles and their role in maintaining environmental balance.	K_1
CO2	Identifying and analyzing various environmental problems like air, water, and soil pollution, solid waste management, and their causes and impacts.	K_2
CO3	Understanding the ways human activities affect the environment, including population growth, resource consumption, and pollution.	K_3
CO4	Developing skills in monitoring and assessing pollution levels, identifying pollution sources, and implementing control measures.	K_2
CO5	Applying environmental management techniques for various resources like water, air, and land, and for waste management.	K_2

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1									1				
CO2		2			1									
CO3			2				1				1			
CO4								2				1		
CO5				1									1	
CO(Average)	1	2	2	1	1		1	2			1	1	1	

3 –High; 2 –Medium; 1 –Low

BASIC ELECTRONICS ENGINEERING

Subject Code: -	**BTESC304**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**60**	**CREDITS**	**04**

Course Objectives: Provide students with a foundational understanding of electronic devices, circuits, and systems. They typically cover topics like Ohm's Law, Kirchhoff's laws, diodes, transistors, amplifiers, and basic digital logic, enabling students to analyze and design simple circuits.

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I: Semiconductor Devices and Applications Introduction to P-N Junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XX

and 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a single stage CE amplifier, frequency response and bandwidth.

Module II: Operational amplifier and its applications Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.

Module III: Timing Circuits and Oscillators RC-timing circuits, IC 555 and its applications as astable and mono-stable multi-vibrators, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.

Module IV: Digital Electronics Fundamentals Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, de-multiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module V: Electronic Communication Systems The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Text /Reference Books:

1. Floyd, Electronic Devices‖ Pearson Education 9th edition, 2012.

2. R.P. Jain, ―Modern Digital Electronics‖, Tata Mc Graw Hill, 3rd Edition, 2007.

3. A.K. Maini & Nakul Maini - All-in-One Electronics Simplified, Khanna Book Publishing, 2021.

4. Frenzel, ―Communication Electronics: Principles and Applications‖, Tata Mc Graw Hill, 3rd Edition, 2001

5. Mittel, Basic Electrical Engineering, Tata McGraw Hill.

Course Outcomes:

The students will learn:

CO 1. Understand the principles of semiconductor devices and their applications.
CO 2. Design an application using Operational amplifier.
CO 3. Understand the working of timing circuits and oscillators.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the principles of semiconductor devices and their applications	K_1
CO2	Design an application using Operational amplifier.	K_2
CO3	Understand the working of timing circuits and oscillators.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

NETWORK ANALYSIS

Subject Code: -	**BTESC302**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objectives:

Mathematics fundamental necessary to formulate, solve and analyse engineering problems.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

Module–I

Overview of network analysis techniques (nodal analysis, mesh analysis). Network theorems.

Module–II

Transient and steady-state sinusoidal response. Network graphs and their applications in network analysis.

Module–III

Two-port networks, Examples of Two-Port networks. Z, Y, h, *g*, and transmission matrices. Combining two ports in various configurations.

Module– IV

Analysis of transmission lines to motivate the scattering matrix. Scattering matrix and its applications in network analysis.

Module– V

Network functions, positive real functions, and network synthesis.

Text /Reference Books:

1. M. E. Van Valkenburg, Network Analysis. Prentice-Hall of India.

2. Kuo, Franklin. Network analysis and synthesis. John Wiley & Sons, 2006.

Course outcomes:

Attending of the course, the students will learn

CO1: Apply mesh/nodal analysis and theorems to solve circuits.

CO2: Apply graph theory principles to analyze circuits.

CO3: Evaluate network transients.

CO4: Analyze resonance and frequency response.

CO5: Model and analyze two-port networks

Course Outcome No	Statement	Knowledge Level (KL)
CO1	**Analyze Electrical Circuits:** Apply basic laws (KVL, KCL, Ohm's Law) and network theorems (Superposition, Thevenin's, Norton's) to solve DC and AC circuits	K_1,K_2,K_3,K_4,K_5
CO2	**Analyze Transient Behavior:** Determine the response of RL, RC, and RLC circuits under transient conditions (first and second-order circuits) using differential equations or Laplace transforms	K_1,K_2,K_3,K_4,K_5
CO3	**Evaluate Frequency Response:** Analyze series and parallel resonance, compute Q-factors, bandwidth, and understand the frequency response of networks	K_1,K_2,K_3,K_4,K_5
CO4	**Understand Network Topology:** Analyze complex networks using graph theory concepts such as trees, links, tieset, and cutset matrices	K_1,K_2,K_3,K_4,K_5
CO5	**Analyze Two-Port Networks:** Determine parameters (Z, Y, H, ABCD) and characterize two-port networks	K_1,K_2,K_3,K_4,K_5

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix:(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1									1				
CO2		2			1									
CO3			2				1				1			
CO4								2				1		
CO5				1									1	
CO(Average)	1	2	2	1	1		1	2			1	1	1	

3 –High; 2 –Medium; 1 –Low

MATERIAL SCIENCE (BTESC305)

Subject Code	**BTESC305**	**IA Marks**	40
Number of Lecture Hours/Week	03	**Term End Exam Marks**	60
Total Number of Lecture Hours	50	**CREDITS**	04

Course Objective:

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

- To gain knowledge in applications properties strengthening mechanisms in structural steels and super alloys and stainless steels
- To develop a fundamental understanding of various electrical and electronic materials
- To be able to understand and importance of bio materials.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

Module-I

Conductivity of Metal: Introduction, factors affecting the resistivity of electrical materials, motion of an electron in an electric field, Equation of motion of an electron, current carried

by electrons, mobility, energy levels of a molecule, emission of electrons from metals, thermionic emission, photo electric emission, field emission, effect of temperature on electrical conductivity of metals, electrical conducting materials, thermal properties, thermal conductivity of metals, thermoelectric effects. **Hours-10**

Module-II

Dielectric Properties: Introduction, effect of a dielectric on the behavior of a capacitor, polarization, the dielectric constant of monatomic gases, frequency dependence of permittivity, dielectric losses, significance of the loss tangent, dipolar relaxation, frequency and temperature dependence of the dielectric constant, dielectric properties of polymeric system, ionic conductivity in insulators, insulating materials, Ferro electricity, piezoelectricity. **Hours-10**

Module-III

Magnetic properties of Materials: Introduction, Classification of magnetic materials, diamagnetism, Para magnetism, ferromagnetism, magnetization curve, the hysteresis loop, factors affecting permeability and hysteresis loss, common magnetic materials, magnetic resonance**.** **Hours-5**

Module-IV

Semiconductors: energy band in solids, conductors, semiconductors and insulators, types of semiconductors, Intrinsic semiconductors, impurity type semiconductor, diffusion, the Einstein relation, hall effect, thermal conductivity of semiconductors, electrical conductivity of doped materials. **Hours-5**

Module-V

Insulators-properties – visual – electrical – mechanical- thermal - chemical properties - Classification based on operating temperature as per IS. Properties and application of fibrous material-impregnated fibrous-bitumen-wax-insulating liquid-enamel-varnish-ceramics-mica-asbestos-glass-rubber-synthetic resin-thermoplastics resin-Polyethylene-Teflon-PVC-Gas Insulating materials- air-Nitrogen-SF6 - Dielectric materials - Polarization-applications-capacitors. **Hours-10**

Module-VI

Ceramics: properties, application to conductors, insulators & capacitors Plastics: Thermoplastics, rubber, thermostats, properties. Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, and sintered alloys for breaker and switch contacts. **Hours-10**

Textbooks/References:

1. C.S.Indulkar and S. Thiruvengadam, S., “An Introduction to Electrical Engineering
2. Kenneth G. Budinski, “Engineering Materials: Prentice Hall of India, New Delhi
3. Superalloys-II edited by C.T. SIMS, N.S. Stoloff and W.C. Hagel A Wiley-Inter science publication John Wiley and sons, New York, 1972.

Course outcomes:

Attending of the course, the students will learn

CO1: To select and design components based on their properties and requirements.

CO2: Awareness about the electrical and electronic materials

CO3: Knowledge about bio materials like, titanium and stainless steel based.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	**Describe Electrical Properties:** Analyze conductivity, resistivity, and classification (conductors, semiconductors, insulators) based on atomic structure and energy bands	K_1,K_2,K_3,K_4,K_5
CO2	**Identify Material Types & Applications:** Differentiate between low/high resistivity materials (e.g., copper vs. nichrome) and select appropriate materials for specific electrical engineering applications	K_1,K_2,K_3,K_4,K_5
CO3	**Evaluate Magnetic and Dielectric Materials:** Analyze magnetic properties (ferromagnetism, hysteresis) and dielectric materials for capacitance, polarization, and insulation strength	K_1,K_2,K_3,K_4,K_5

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix :(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1									1				
CO2		2			1									
CO3			2	1			1	2			1	1	1	
CO(Average)	1	2	2	1	1		1	2			1	1	1	

3 –High; 2 –Medium; 1 –Low

BASIC ELECTRONICS ENGINEERING LAB

Subject Code: -	**BTESC303P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Study of CRO & Measurement of Voltage Amplitude & Frequency

2. Study of Zener Diode Characteristics

3. Characteristics of BJT in Common Emitter Configuration

4. Characteristics of JFET in Common source Configuration

5. Study of Half Wave and Full Wave Rectifier without Filter

6. Study of Common Emitter BJT Amplifier.

7. To study the operation of Hartley & Colpitts oscillator circuits and to determine their frequency of oscillations.

Laboratory Outcomes:

Develop practical skills in analyzing and building electronic circuits, including diodes, transistors, and amplifiers. They learn to verify circuit characteristics, implement designs, and understand the underlying principles of electronics.

CO 1. Diode and Transistor Characteristics**:** Students learn to understand the V-I characteristics of diodes (forward and reverse bias), Zener diodes, and transistors (CB, CE, CC configurations).

CO 2. Students apply these characteristics to analyze the performance of basic circuits containing diodes and transistors, including rectifiers, amplifiers, and biasing circuits

CO 3. Students design and implement half-wave and full-wave rectifier circuits with and without filters, learning how to convert AC to DC voltage.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Diode and Transistor Characteristics**:** Students learn to understand the V-I characteristics of diodes (forward and reverse bias), Zener diodes, and transistors (CB, CE, CC configurations).	K_1
CO2	Students apply these characteristics to analyze the performance of basic circuits containing diodes and transistors, including rectifiers, amplifiers, and biasing circuits	K_2
CO3	Students design and implement half-wave and full-wave rectifier circuits with and without filters, learning how to convert AC to DC voltage.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1										1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	2		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

NETWORK ANALYSIS LAB

Subject Code: -	**BTEE401P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Verify Thevnin Theorem

2. Verify Norton Theorem

3. Verify Superposition Theorem

4. Study of Z parameters

5. Study of Transient Response of RC Circuit

6. Study of Transient Response of RL Circuit

7. Study of ACTIVE FILTERS

Laboratory Outcomes:

Develop practical skills in analyzing and testing circuits, including resistor, inductor and capacitor. They learn to verify circuit characteristics, implement designs, and understand the underlying principles of network theory.

CO 1. Analyze Linear Electrical Networks Apply fundamental circuit laws (Ohm's Law, Kirchhoff's Voltage and Current Laws) and network theorems (Thevnin, Norton, Superposition, Maximum Power Transfer) to solve for voltage, current, and power in DC and AC circuits.

CO 2. Evaluate Transient and Steady-State Responses Model and solve first-order and second-order RC, RL, and RLC circuits to determine transient behaviour (natural and step responses) and steady-state AC response using phasor and Laplace transform

CO 3. Determine Network Parameters and Functions Compute two-port network parameters (z, y, h, ABCD) and derive network functions (transfer functions, impedance, admittance) to characterize the input-output behaviour of interconnected electrical systems.

Course Outcome No	Statement	Knowledge Level (K_L)
CO1	Apply fundamental circuit laws (Ohm's Law, Kirchhoff's Voltage and Current Laws) and network theorems (Thevnin, Norton, Superposition, Maximum Power Transfer) to solve for voltage, current, and power in DC and AC circuits.	K_1
CO2	Model and solve first-order and second-order RC, RL, and RLC circuits to determine transient behaviour (natural and step responses) and steady-state AC response using phasor and Laplace transform	K_2
CO3	Compute two-port network parameters (z, y, h, ABCD) and derive network functions (transfer functions, impedance, admittance) to characterize the input-output behaviour of interconnected electrical systems.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1										1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	2		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

SEMESTER-IV

ANALOG ELECTRONICS

Subject Code: -	**BTECE401**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**04**

Course Objectives:

- To understand the concepts of analog and digital circuits.
- To impart knowledge on signal generation and measuring equipment.

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Course Contents:

MODULE I - ANALOG DEVICE **9 Hours**

Review of analog devices – Rectifier circuits - Wave shaping circuits - Clippers and Clampers – Regulators - Zener and op-amp based regulator circuits - Introduction to switched mode power supplies.

MODULE II – BIASING CIRCUIT AND MODELING **9 Hours**

Different biasing circuit of BJT and FETs. R_e model and hybrid model of BJT amplifiers

MODULE III - OSCILLATORS & SIGNAL GENERATOR CIRCUITS **9 Hours**

Function generator circuit - Pulse generator circuit - AM/FM signal generator circuit – Qualitative analysis.

MODULE IV - DISPLAY UNIT and OPAMPS **9 Hours**

Display Units - optoelectronic devices – Seven-segment displays - LCD and LED display units and applications. Basics of Opamps

MODULE V - SPECIAL ELECTRONIC CIRCUIT **9 Hours**

UJT Saw tooth generator circuit – Schmitt trigger – Analog-to-digital converter – Digital-to-analog converter circuits using Opamps

TEXT/REFERENCE BOOKS:

1. David A Bell, 'Fundamentals of Electronic Devices and Circuits', Oxford University Press, Incorporated, 25- Jun-2009.

2. Bouwens A. J., 'Digital Instrumentation', Tata McGraw Hill Publications, 16th Reprint (2008).

3. R.L.Boylested -Electronic Devices and Circuits, PHI 2007

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Analog Electronics**	Prof. S. R. M. Prasanna	IIT Madras
2	**Analog Circuits**	Prof. G. K. Bansal	IIT Roorkee

COURSE OUTCOMES:

CO1. Design cascade amplifiers and sweep circuits
CO2. Design the transistor Amplifiers using its small signal model.
CO3. Evaluate the performance analysis of large signal amplifier.
CO4. Design the feedback amplifiers and analyze frequency response.
CO5. Design oscillators for different types of signal generation

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Design cascade amplifiers and sweep circuits	K_1
CO2	Design the transistor Amplifiers using its small signal model.	K_2
CO3	Evaluate the performance analysis of large signal amplifier.	K_3
CO4	Design the feedback amplifiers and analyze frequency response	K_4
CO5	Design oscillators for different types of signal generation	K_1

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO5											2			
CO(Average)	2	1	2	2	2		1		1				1	

3–High;2–Medium;1–Low

LINEAR INTEGRATED CIRCUITS

Subject Code: - BTECE402	**IA Marks 40**
Number of Lecture Hours/Week: - 03	**Term End Exam Marks 60**
Total Number of Lecture Hours: - 30	**CREDITS 04**

Course Objectives:

- To understand the concepts of OPAMP circuits.
- To impart knowledge on signal generation and measuring equipment.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Course Contents:

MODULE I - Fundamentals of Operational Amplifiers 9 Hours

Differential amplifier stages (BJT, MOSFET), block diagram of Op-Amp (input stage, intermediate stage, level shifter, output stage), ideal Op-Amp characteristics (infinite open-loop gain, infinite input impedance, zero output impedance, infinite bandwidth, infinite CMRR), practical Op-Amp parameters (input offset voltage, input offset current, input bias current, CMRR, PSRR, slew rate, gain-bandwidth product), open-loop configuration, closed-loop configuration, inverting amplifier, non-inverting amplifier, voltage follower.

MODULE II – Linear and Nonlinear Applications of OpAmps **9 Hours**

Summing amplifier (adder), subtractor (difference amplifier), instrumentation amplifier (three Op-Amp configuration), integrator (practical with compensation resistor), differentiator, voltage-to-current converter, current-to-voltage converter, log amplifier, antilog amplifier, basic comparator (inverting, non-inverting), Schmitt trigger (inverting, non-inverting, hysteresis calculation), precision rectifiers (half-wave, full-wave), peak detector, clipper circuits, clamper circuits, square wave generator (astable multivibrator), triangular wave generator, sawtooth generator.

MODULE III – Filters **9 Hours**

First-order low-pass Butterworth filter, second-order low-pass Butterworth filter, first-order high-pass Butterworth filter, second-order high-pass Butterworth filter, wideband band-pass filter, narrowband band-pass filter, band-reject filter (notch filter), all-pass filter (phase shifter), Barkhausen criterion for oscillation, RC phase shift oscillator, Wein bridge oscillator (amplitude stabilization using lamp or JFET), LC oscillators (Hartley oscillator, Colpitts oscillator) using Op-Amp, crystal oscillator

MODULE IV - Data Converters and Noise in Linear IC **9 Hours**

Digital-to-analog converter (weighted resistor DAC, R-2R ladder DAC, resolution, settling time, accuracy), analog-to-digital converter (flash ADC, successive approximation ADC, dual-slope ADC, sigma-delta ADC, conversion time, resolution), noise in linear ICs (flicker noise, shot noise, thermal noise), signal-to-noise ratio (SNR), power supply rejection ratio (PSRR) review, noise reduction techniques (shielding, filtering, careful grounding)

MODULE V - SPECIAL ELECTRONIC CIRCUIT **9 Hours**

IC 555 timer (block diagram, monostable mode, astable mode, bistable mode, pulse-width modulation, missing pulse detector), IC 565 phase-locked loop (block diagram, phase detector, voltage-controlled oscillator, low-pass filter, capture range, lock range, frequency multiplication

TEXT/REFERENCE BOOKS:

1. *Op-Amps and Linear Integrated Circuits* by Ramakant A. Gayakwad, 4th Edition, Pearson Education.

2. *Linear Integrated Circuits* by D. Roy Choudhury & Shail B. Jain, 4th Edition, New Age International

3. R.L.Boylested -Electronic Devices and Circuits, PHI 2007

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Integrated Circuits and Applications**	Prof. S. R. Ahmed	IIT Guwahati
2	**Analog Circuits**	Prof. G. K. Bansal	IIT Roorkee

COURSE OUTCOMES:

CO1. Design cascade amplifiers and sweep circuits
CO2. Design the opamp Amplifiers using its small signal model.
CO3. Evaluate the performance analysis of large signal amplifier.
CO4. Design the feedback amplifiers and analyze frequency response.
CO5. Design oscillators for different types of signal generation

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Design cascade amplifiers and sweep circuits	K_1
CO2	Design the opamp Amplifiers using its small signal model.	K_2
CO3	Evaluate the performance analysis of large signal amplifier.	K_3
CO4	Design the feedback amplifiers and analyze frequency response	K_4
CO5	Design oscillators for different types of signal generation	K_1

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3	1			2									1	
CO4				1	2					2				
CO5				1	1						2			
CO(Average)	2	1	2	1.3	1.5		1		1				1	

3–High;2–Medium;1–Low

ELECTRICAL MEASUREMENT AND INSTRUMENTATION

Subject Code: -	**BTECE403**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objectives:

Mathematics fundamental necessary to formulate, solve and analyse engineering problems.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

Module–I **5hrs**

Basics of Measurement and Instrumentation, Instrument Examples: Galvanometer, Accelerometer etc; calibration methods.

Module–II **6hrs**

Voltage and Current Measurements; Theory, calibration, application.

Module–III **10hrs**

Errors and compensation. Power and Energy Measurement and its errors, Methods of correction, LPF wattmeter, Phantom loading.

Module– IV **10hrs**

Induction type KWH meter; Calibration of wattmeter, energy meter. Potentiometer and Instrument Transformer: DC and AC potentiometer, C.T. and V.T. construction, theory, operation, characteristics.

Module– V **5hrs**

Analog-to-Digital Conversion (ADC), Staircase Ramp Compensation, Integrator-based ADC, Delta-Pulse-Modulation-based ADC. Digital Instrumentation.

Text /Reference Books:

1. E. A. Doebelin, 'Measurement Systems - Applications and Design', Tata McGraw Hill, New York, 1990.
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurement and Instrumentation', Dhanpat Rai and Co (P) Ltd., 2004.
3. E. W. Golding and F. C. Widdis, 'Electrical Measurements & Measuring Instruments', A. H. Wheeler & Co, 1994.
4. A. J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.

Course outcomes:

Attending of the course, the students will learn

CO 1. Explain the basics of measurement systems, instruments (galvanometer, accelerometer), and calibration methods.
CO 2. Analyze the theory, calibration, and application of voltage and current measurement instruments.
CO 3. Identify errors in power and energy measurements and apply correction methods including LPF wattmeter and phantom loading.
CO 4. Evaluate the operation of induction-type KWH meters, potentiometers (DC and AC), and instrument transformers (CT and VT).
CO 5. Describe ADC techniques (staircase ramp, integrator-based, delta-pulse-modulation) and principles of digital instrumentation

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Explain measurement basics, instruments like galvanometer and accelerometer, and calibration methods.	K_1
CO2	Analyze voltage and current measurement instruments for theory, calibration, and application.	K_2, K_3
CO3	Identify errors in power/energy measurements and apply correction techniques including LPF wattmeter and phantom loading.	K_3
CO4	Evaluate induction KWH meters, DC/AC potentiometers, and CT/VT instrument transformers.	K_3, K_4
CO5	Describe ADC techniques (staircase ramp, integrator-based, delta-pulse-modulation) and digital instrumentation principles.	K_1

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix:(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				2		1		1					
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO5					2						2		1	1
CO(Average)	2	1	2	2	2		1		1				1	1

3–High;2–Medium;1–Low

ELECTROMAGNETIC FIELD THEORY

Subject Code: -	**BTECE404**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objectives:

Mathematics fundamental necessary to formulate, solve and analyse engineering problems.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

Course objective:

- To introduce the basic mathematical concepts related to electromagnetic vector fields.
- To impart knowledge on the concepts of electrostatics, electric potential, energy density and their applications.
- To impart knowledge on the concepts of magneto statics, magnetic flux density, scalar and vector potential and its applications.

- To impart knowledge on the concepts of Faraday‘s law, induced emf and Maxwell‘s equations.
- To impart knowledge on the concepts of Concepts of electromagnetic waves and Transmission lines.

Module-I

Introduction: Vector Relation in rectangular, cylindrical, spherical and general curvilinear coordinate system. Concept and physical interpretation of gradient, Divergence and curl, Green’s Stoke’s and Helmholtz theorems. Electrostatics: Electric field vectors-electric field intensity, flux density & polarization. Electric field due to various charge configurations. The potential functions and displacement vector Gauss’s law, Poisson’s and Laplace’s equation and their solution. Uniqueness theorem. Continuity equation. Capacitance and electrostatics energy. Field determination by method of images. Boundary conditions. Field mappings and concept of field cells. **10 Hours-**

Module-II

Magneto statics: Magnetic field vector: Magnetic field intensity, flux density & magnetization, Bio-Savart’s law, Ampere’s law, Magnetic scalar and vector potential, self & mutual inductance Energy stored in magnetic field, Boundary conditions, Analogy between electric and magnetic field, Field mapping and concept of field cells **15 Hour**

Module-III

Time Varying Fields: Faraday’s law, Displacement currents and equation of continuity Maxwell’s equations, Uniform plane wave in free space, dielectrics and conductors, skin effect sinusoidal time variations reflections, refraction & polarization of Upstanding wave ratio. Pointing vector and power considerations **- 15 Hours**

Module-IV

Transmission Lines: The high-frequency circuit. LCR ladder model. The transmission Line equation. Solution for loss-less lines Wave velocity and wave impedance. Reflection and Transmission coefficients at junctions. VSWR. **05 Hours**

Textbooks/References:

- Hayt: Engineering Electromagnetics, 7/e, (With CD), MGH
- Matthew N. O. Sadiku: Principles of Electromagnetics, 4th ed., Oxford
- G. S. N. Raju: Electromagnetic Field Theory and Transmission Lines, Pearson.
- J. D. Kraus: Electromagnetic. 5th edition, MGH. 1999
- S. Baskaran and K. Malathi: Electromagnetic Field and Waves, Scitech Pub.
- R. S. Kshetrimayum, Electromagnetic Field Theory, Cengage Learning.
- V.V. Sarwate: Electromagnetic Field and Waves, Willey Eastern Ltd.
- Bhag Guru: Electromagnetic Field Theory Fundamentals, Cambridge Uni. Press

Course Outcome:

CO1-Understand the basic mathematical concepts related to electromagnetic vector fields.
CO2- Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.

CO3 -Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
CO4-Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.
CO5-Apply Maxwell‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the basic mathematical concepts related to electromagnetic vector fields	K_1
CO2	Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density. .	K_2, K_3
CO3	Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.	K_3
CO4	Understand the concepts related to Faraday‘s law, induced emf and Maxwell‘s equations.	K_3, K_4
CO5	Apply Maxwell‘s equations to solutions of problems relating to transmission lines and uniform plane wave propagation.	K_1

KL-Bloom’s Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix:(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				2		1		1					
CO2		1	2											
CO3	1			2		1							1	
CO4					2					2				
CO5					2						2		1	1
CO(Average)	2	1	2	2	2	1	1		1				1	1

3–High;2–Medium;1–Low

SIGNALS AND SYSTEMS

Subject Code: - -	**BTECE405**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

Course Objectives:

To develop skills for analyzing signals and systems for any given process.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

Module–I
Signals and Systems: signal characterization: discrete and continuous, energy, power, periodicity, finite duration. system characterization: linearity, time invariance, stability, causality, memory, inevitability.

Module–II
Linear Time-Invariant systems: delta functions, unit step functions, impulse response, convolution, impulse response characterization with respect to system properties such as causality.

Module–III
Fourier Series Representation: Eigen function of the LTI system, Fourier series representation of periodic signals (continuous and discrete), properties of Fourier series: linearity, time shifting, time scaling, conjugation, multiplication, convolution. Parseval's relation.

Module– IV
Fourier Transform: convergence of Fourier transform, representation of a periodic signals (continuous and discrete) with Fourier transform, representation of periodic signals (continuous and discrete) with Fourier transform, properties of Fourier transforms: linearity, differentiation in time and frequency, convolution, multiplication, time and frequency shifting, Parseval's relation.

Module– V

Laplace Transform: Notion of complex frequency, Laplace transform, region of convergence, pole-zero (s-plane) plots, properties of Laplace transforms. Unilateral Laplace transforms,

Initial and Final value theorems, differential equations, system representations: direct, cascade, parallel forms. Z-Transform: discrete system and notion of complex frequency, z-transform, region of convergence, pole-zero plots (z-plane),

Text /Reference Books:

1. Signals and Systems, Oppenheim, Alan V.; Willsky, Alan S.; Nawab, Hamid; with S. Hamid. Pearson Education (1998).
2. Digital Signal Processing, Sanjit K Mitra, Mc Graw Hill, 2008, Third Edition
3. Digital Signal Processing (Principles, Algorithms, and Applications), John G. Proakis, Dmitri G. Manolakis, Prentice Hall International Inc., 1996, Third Edition

Course outcomes:

Attending of the course, the students will learn

CO 1. Characterize continuous and discrete signals (energy, power, and periodicity) and systems (linearity, time invariance, stability, causality, memory).
CO 2. Analyze LTI systems using impulse response, convolution, and delta/unit step functions to determine system properties like causality.
CO 3. Represent periodic signals using Fourier series and apply its properties (linearity, time shifting/scaling, convolution, Parseval's relation).
CO 4. Apply Fourier transform to periodic and periodic signals and utilize its properties (differentiation, convolution, shifting, and Parseval's relation).
CO 5. Analyze systems using Laplace transform (ROC, pole-zero plots, initial/final value theorems) and Z-transform (ROC, pole-zero plots) with various system representations.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Characterize continuous and discrete signals (energy, power, and periodicity) and systems (linearity, time invariance, stability, causality, memory).	K_1
CO2	Analyze LTI systems using impulse response, convolution, and delta/unit step functions to determine system properties like causality.	K_1, K
CO3	Represent periodic signals using Fourier series and apply its properties (linearity, time shifting/scaling, convolution, Parseval's relation	K_4,K_5
CO4	Apply Fourier transform to periodic and periodic signals and utilize its properties (differentiation, convolution, shifting, and Parseval's relation)	K_1,K_2,K_3,K_4,K_5,K_6
CO5	Analyze systems using Laplace transform (ROC, pole-zero plots, initial/final value theorems) and Z-transform (ROC, pole-zero plots) with various system representations	K_1,K_2,K_3

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix :(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				2		1		1					
CO2		1	2											
CO3	1			2		1							1	
CO4					2					2				
CO5					2						2		1	1
CO(Average)	2	1	2	2	2	1	1		1				1	1

3–High;2–Medium;1–Low

MICROWAVE AND ANTENNA

Subject Code: -	**BTECE406**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**04**

COURSE OBJECTIVES:

The main objective is to understand the fundamentals of microwave frequency range and wave propagation and to study microwave transmission lines and waveguides to analyse microwave passive and active components and to understand microwave measurement techniques and instruments and to learn applications of microwaves in communication and radar systems.

ASSENMENT PLAN:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

COURSE CONTENT:

Module 1: Electromagnetic Wave Fundamentals and Transmission Lines
Maxwell's equations in integral and differential forms, wave equations, plane wave characteristics, polarization of waves, reflection and refraction of electromagnetic waves, Poynting theorem and power flow concepts, electromagnetic wave propagation in free space and different media, transmission line theory at microwave frequencies, types of transmission lines, characteristic impedance and propagation constant, infinite line analysis, reflection coefficient, standing wave ratio (VSWR), impedance matching techniques, Smith chart and its applications in transmission line problems, rectangular and circular waveguides, dominant modes and cutoff frequency, wave propagation in waveguides.

Module 2: Antenna Fundamentals and Types
Basic antenna parameters (radiation pattern, radiation resistance, gain, directivity, bandwidth, efficiency), types of antennas and their characteristics, antenna arrays (array factor, broadside array, end-fire array), principle of antenna radiation, reciprocity theorem, dipole antennas, monopole antennas, loop antennas, Yagi-Uda antenna, horn antenna, parabolic reflector antenna, antenna design principles and applications in communication systems, microstrip patch antennas, modern antenna technologies.

Module 3: Microwave Devices and Components
Microwave frequency spectrum and applications, advantages and limitations of microwaves, microwave tubes (klystron, magnetron, travelling wave tube - TWT), semiconductor microwave devices (Gunn diode, IMPATT diode, PIN diode), scattering parameters (S-parameters), microwave network analysis, waveguide components (tees, couplers, attenuators, isolators, circulators, directional couplers), resonant cavities and applications, microwave filters, impedance matching techniques.

Module 4: Wave Propagation and Microwave Measurements
Ground wave propagation, sky wave propagation, space wave propagation, effects of ionosphere on radio wave propagation, fading, diffraction, scattering, absorption, propagation in different frequency bands (VHF, UHF, microwave), applications in wireless communication systems, microwave measurement techniques (frequency, power, impedance, VSWR), microwave test instruments (network analyzer, spectrum analyzer, signal generator), calibration and error analysis in microwave measurements.

Module 5: Microwave and Antenna Applications
Microwave applications in radar systems, satellite communication, wireless communication, medical applications, radar principles (range equation, types of radar systems), modern microwave technologies in 5G and IoT systems, integration of antennas with microwave systems for communication.

REFERENCE BOOKS/ TEXTBOOKS:

1. *Antennas and Wave Propagation* by John D. Kraus, 4th Edition, McGraw-Hill;

2. *Microwave Engineering* by David M. Pozar, 4th Edition, Wiley

3 *Antenna Theory: Analysis and Design* by Constantine A. Balanis, 3rd Edition, Wiley

COURSE OUTCOME

CO1 Explain microwave frequency concepts and waveguide theory.

CO2 Understand microwave devices and their working principles.

CO3 Analyse microwave passive components and S-parameters.

CO4 Apply microwave measurement techniques and instruments.

CO5 Understand microwave applications in communication systems.

CO6 Evaluate modern microwave technologies and systems.

COURSE OUTCOME		**Bloom's Knowledge Level**
CO1	Explain microwave frequency concepts and waveguide theory.	K2
CO2	Understand microwave devices and their working principles.	K2
CO3	Analyze microwave passive components and S-parameters.	K4
CO4	Apply microwave measurement techniques and instruments.	K3
CO5	Understand microwave applications in communication systems.	K2

KL-Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)
K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Course Articulation Matrix :(Mapping of Cos with POs & PSOs)

CO	**CORRELATION WITH PROGRAM OUTCOMES**												**CORRELATION WITH PSOs**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				2		1		1					
CO2		1	2											
CO3	1			2		1							1	
CO4					2					2				
CO5					2						2		1	1
CO(Average)	2	1	2	2	2	1	1		1				1	1

ANALOG ELECTRONICS AND LINEAR INTEGRATED CIRCUIT LAB

Subject Code: - **BTECE402P**	**IA Marks** **30**
Number of Lab Hours/Week: - **02**	**Term End Exam Marks** **20**
Total Number of Lecture Hours: - **15**	**CREDITS** **01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Study BAISING CIRCUIT OF BJT

2. Study Summing Amplifier

3. Study of inverting and non inverting amplifier

4. Study of square wave generator

5. Study JFET biasing circuits

6. Study of ADC converter

7. tudy instrumentation amplifier using MULTISIM software

Laboratory Outcomes:

Develop practical skills in analyzing and building electrical circuits, using machines. They learn to verify machine characteristics, implement designs, and understand the underlying principles of electrical machines.

CO 1. Analyze design of amplifiers.
CO 2. Generate and evaluate nonlinear waveform.
CO 3. Simulate and Analyze the instrumentation amplifier

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Analyze design of amplifiers.	K_1
CO2	Generate and evaluate nonlinear waveform.	K_2
CO3	Simulate and Analyze the instrumentation amplifier	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1		1								1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	1.5		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

ELECTRICAL MEASUREMENTS AND INSTRUMENTATION LAB

Subject Code: -	**BTECE403P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves includingmedical leaves.	

LABORATORY

1. Familiarization of lab instruments (Oscilloscope, Function Generator, DMM, DC Power Supply)

2. Energy measurement using watt-hour meter for household wiring

3. Measurement of low resistance using Kelvin's double bridge

4. Design of temperature transmitter using RTD

5. Characteristics of LVDT (Linear Variable Differential Transformer)

Laboratory Outcomes:

Develop practical skills in analyzing and measure electrical quantities, using instruments. They learn to verify instrument characteristics, implement designs, and understand the underlying principles of electrical instruments.

CO 1. Demonstrate proficiency in using basic lab instruments (oscilloscope, function generator, DMM, DC power supply) and measure energy consumption using a watt-hour meter.
CO 2. Measure low resistance accurately using Kelvin's double bridge.
CO 3. Design a temperature transmitter using RTD and analyze the characteristics of an LVDT.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Demonstrate proficiency in using basic lab instruments (oscilloscope, function generator, DMM, DC power supply) and measure energy consumption using a watt-hour meter.	K_1
CO2	Measure low resistance accurately using Kelvin's double bridge.	K_2
CO3	Design a temperature transmitter using RTD and analyze the characteristics of an LVDT.	K_3, K_4, K_5, K_6

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1		1								1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Avg)	1	2	1.5		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

Semester V

DIGITAL ELECTRONICS

Subject Code: - BTECE501	**IA Marks 40**
Number of Lecture Hours/Week: - 03	**Term End Exam Marks 60**
Total Number of Lecture Hours: - 30	**CREDITS 04**

Course Objectives:

- To understand the concepts of analog and digital circuits.
- To impart knowledge on signal generation and measuring equipment.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Course Contents:

MODULE I - NUMBER SYSTEM AND LOGIC FAMILIES 9 Hours

Review of number systems, binary codes, error detection and correction codes. Digital Logic Families – Introduction to RTL, DTL, TTL, ECL and MOSL families – wired and operation, characteristics of digital logic family – comparison of different logic families.

MODULE II - COMBINATIONAL LOGIC 9 Hours

Representation of logic functions – SOP and POS forms, K-map representations – minimization using K-maps- simplification and implementation of combinational logic – multiplexers and demultiplexers – code converters, adders, subtractors.

MODULE III - SEQUENTIAL LOGIC 9 Hours

SR, JK, D and T flip-flops – level triggering and edge triggering – counters – Pulse forming circuits - asynchronous and synchronous type – Modulo counters – Shift registers – Ring counters.

MODULE IV - SYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS 9 Hours

State table and excitation tables - state diagrams - Moore and Mealy models - design of counters - analysis of synchronous sequential logic circuits - state reduction and state assignment.

MODULE V - ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUITS **9 Hours**

Transition table, flow table – race conditions – circuits with latches, analysis of asynchronous sequential logic circuits – implication table – hazards.

TEXT/REFERENCE BOOKS:

1. Ciletti, Michael D., and M. Morris Mano. Digital design. Hoboken: Prentice-Hall, 2007.
2. Floyd, Thomas L. Digital fundamentals, 10/e. Pearson Education India, 2011.
3. Jain, R. P. Modern digital electronics. Vol. 1. No. 10. Tata McGraw-Hill Education, New Delhi, 2003.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Digital Circuits and Systems**	Prof. B. S. Rajan	Indian Institute of Technology (IIT) Madras
2	**Digital Electronics** :	Prof. K. A. S. Kumar	IIT Kharagpur

COURSE OUTCOMES:

The student will learn following through lectures:

CO1- Interpret, convert and represent different number systems.
CO2 - Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplification.
CO3- Design and analyze combinational and sequential logic circuits.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Interpret, convert and represent different number systems	K_1
CO2	Manipulate and examine Boolean algebra, logic operations, Boolean functions and their simplification.	K_2
CO3	Design and analyze combinational and sequential logic circuits	K_3

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					1
CO2		1	2											
CO3	1			2									1	
CO(Average)	2	1	2	2	2		1		1				1	1

MICROPROCESSORS & MICROCONTROLLER

Subject Code	**BTEEE502**	**IA Marks**	40
Number of Lecture Hours/Week	04	**Term End Exam Marks**	60
Total Number of Lecture Hours	45	**CREDITS**	03

Course Objective:

To understand the concepts of Architecture of 8086 microprocessor, and understand the design aspects of I/O and Memory Interfacing circuits also understand the architecture and programming of ARM processor

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Module-I

THE 8086 MICROPROCESSOR - Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation. **-8 Hours**

Module-II

8086 SYSTEM BUS STRUCTURE - 8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure - Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors. **-8 Hours**

Module-III

MICROCONTROLLER - Architecture of 8051 – Special Function Registers(SFRs) - I/O Pins Ports and Circuits - Instruction set - Addressing modes - Programming 8051 Timers – Interfacing Microcontroller - Serial Port Programming - Interrupts Programming – LCD & Keyboard - External Memory Interface- Stepper Motor **9 Hours**

Module-IV

INTRODUCTION TO EMBEDDED SYSTEMS - Complex systems and microprocessors– Embedded system design process – Instruction sets preliminaries - ARM Processor – CPU: programming input and output supervisor mode, exceptions and traps – Co-processors- Memory system mechanisms – CPU performance. **-10 Hours**

Module-V

EMBEDDED COMPUTING PLATFORM DESIGN AND OPTIMIZATION The CPU - Bus-Memory devices and systems–Designing with computing platforms – platform level performance analysis - Components for embedded programs-Models of programs Assembly, linking and loading – compilation techniques- Program level performance analysis – Software performance optimization – Analysis and optimization of program size- Program validation and testing. **10 Hours**

Course outcome:

CO1-Ability to design and implement programs on 8086 microprocessor

CO2-Ability to design I/O circuits and Memory Interfacing circuits

CO3-Ability to design and develop components of ARM processor

Textbooks/References:

- Yu-Cheng Liu, Glenn A. Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007
- Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinley, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, 2 nd Edition, Pearson Education, 2011

- Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 3rd Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2012

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Microprocessors And Microcontroller	Prof. Santanu Chattopadhyay	IIT Kharagpur
2	Microprocessors And Microcontrollers	Prof. Chandramouleeswaran Sankaran	RV University

Course Outcome

CO1- Ability to design and implement programs on 8086 microprocessor

CO2- Ability to design I/O circuits and Memory Interfacing circuits

CO3- Ability to design and develop components of ARM processor

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Ability to design and implement programs on 8086 microprocessor	K_1
CO2	Ability to design I/O circuits and Memory Interfacing circuits	K_2, K_3
CO3	Ability to design and develop components of ARM processor	K_3

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix: (Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				2		1		1					
CO2		1	2											
CO3	1			2		1							1	
CO(Average)	2	1	2	2	2	1	1		1				1	1

3–High; 2–Medium; 1–Low

Analog Communication

Subject Code: -	**BTECE504**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**04**

Course Objectives:

To impart knowledge on communication engineering, and overview of Analog communication method

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Course Contents:

Module 1 (9 hours):

Introduction to Communication Systems, Electromagnetic spectrum, Need for modulation, Amplitude Modulation (AM): Time domain and frequency domain description, Modulation index, Transmission bandwidth, Generation of AM (Collector modulation, Base modulation), Demodulation of AM (Envelope detector, Square law detector), Double Sideband Suppressed Carrier (DSB-SC): Generation (Balanced modulator, Ring modulator), Coherent detection, Single Sideband Suppressed Carrier (SSB-SC): Generation (Filter method, Phase shift method), Vestigial Sideband (VSB) modulation.

Module 2 (9 hours):

Angle Modulation: Basic concepts, Frequency Modulation (FM) and Phase Modulation (PM), Relationship between FM and PM, Single-tone frequency modulation, Narrowband FM and Wideband FM, Modulation index and deviation ratio, Transmission bandwidth of FM (Carson's rule), Bessel function analysis of FM spectrum, Phasor diagram of FM, Generation of FM (Direct method: Varactor diode modulator, Indirect method: Armstrong method), Demodulation of FM

(Slope detector, Foster-Seely discriminator, Ratio detector), Pre-emphasis and De-emphasis.

Module 3 (9 hours):
Noise in Analog Communication Systems: Types of noise (External noise, Internal noise – Thermal noise, Shot noise, Flicker noise), Noise figure and Noise temperature, Noise bandwidth, Signal-to-Noise Ratio (SNR), Figure of merit, Noise in AM systems (DSB-SC, SSB-SC, AM with envelope detector), Noise in FM systems (Threshold effect, Capture effect), Comparison of noise performance of AM, DSB-SC, SSB-SC, and FM systems.

Module 4 (9 hours):
Radio Receivers and Transmitters: Super heterodyne receiver (Block diagram, RF amplifier, Mixer, Local oscillator, IF amplifier, Demodulator, AGC), Receiver characteristics (Selectivity, Sensitivity, Fidelity, Image frequency rejection, Tracking), AM transmitter architecture (Low-level and High-level modulation), FM transmitter architecture (Direct and Indirect), Diversity reception, Adjacent channel interference, Crosstalk.

Module 5 (9 hours):
Special Topics and Analog Pulse Modulation: Sampling theorem (Low-pass and Band-pass signals), Aliasing, Pulse Amplitude Modulation (PAM): Generation and detection, Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM): Generation and detection, Time Division Multiplexing (TDM), Frequency Division Multiplexing (FDM), Introduction to Phase Locked Loop (PLL): Basic block diagram, Applications of PLL in FM demodulation, Frequency synthesizer, Comparison of analog and digital communication basics.

Text /Reference Books:

1. Communication Systems, S. Haykin and M. Moher, Wiley Press, 2009, Fifth Edition
2. Modern Digital and Analog Communication Systems, B. P. Lathi, Z. Ding and H. M. Gupta, Oxford University Press, 2017, Fourth Edition.
3. Fundamentals of Digital Communication, U. Madhow, Cambridge University Press, 2008, First Edition.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Analog Communication	Prof. Goutam Das	IIT Kharagpur

Course Outcomes:

CO1: Explain the principles of amplitude modulation and its variants (AM, DSB-SC, SSB-SC, VSB), including generation, demodulation techniques, and frequency domain representation.

CO2: Analyze frequency and phase modulation (FM/PM), compute modulation index, bandwidth using Carson's rule, and describe FM generation and demodulation methods along with pre-emphasis/de-emphasis.

CO3: Evaluate the effect of various noises (thermal, shot, flicker) on analog communication systems, compute signal-to-noise ratio (SNR) and figure of merit, and compare noise performance of AM, DSB-SC, SSB-SC, and FM systems.

CO4: Describe the architecture of super heterodyne receivers and AM/FM transmitters, and analyze receiver characteristics such as selectivity, sensitivity, fidelity, and image frequency rejection.

CO5: Apply sampling theorem to analog pulse modulation techniques (PAM, PWM, PPM), explain TDM/FDM, and illustrate the working of Phase Locked Loop (PLL) for FM demodulation and frequency synthesis.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Explain the principles, generation, and demodulation of AM, DSB-SC, SSB-SC, and VSB systems.	K_1
CO2	Analyze FM and PM, including modulation index, bandwidth, generation, demodulation, and pre-emphasis/de-emphasis.	K_2
CO3	Evaluate noise performance (SNR, figure of merit) of AM, DSB-SC, SSB-SC, and FM systems	K_3, K_4, K_5, K_6
CO4	Describe superheterodyne receivers, AM/FM transmitters, and key receiver characteristics	K_3
CO5	Apply sampling theorem to PAM, PWM, PPM, explain TDM/FDM, and illustrate PLL applications	K_2

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix:(Mapping of Cos with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	2	2	1	0	0	0	1	0	1	3	2
CO2	3	3	3	2	2	1	0	0	0	2	1	1	3	2
CO3	3	3	3	2	2	1	0	0	0	2	1	1	3	2
CO4	3	3	3	2	2	1	0	0	0	2	1	1	3	2
CO5	3	2	1	2	2	1	0	0	0	1	0	1	3	2
CO(Average)														

3–High;2–Medium;1–Low

Digital Signal Processing

Subject Code: - BTECE505	**IA Marks 40**
Number of Lecture Hours/Week: - 03	**Term End Exam Marks 60**
Total Number of Lecture Hours: - 30	**CREDITS 04**

Course Objective: This course introduces the basics concepts of Discrete fourier transform, digital filter design and application of digital signal processing. The design of IIR and FIR filter, their structure and implementation is also addressed in this course. DSP processor is also discussed in this course.

Course Outcomes: On completion this course, students will be able to

CO1: Analyze and study discrete fourier transform (DFT) and their implementation.
CO2: Analyze and implementation of IIR and FIR filters and their implementation.
CO3: Application and introduction to digital signal processors.

Module -I **12hrs**

Discrete Fourier Transforms (DFT): Frequency domain sampling and Reconstruction of Discrete Time Signals, The Discrete Fourier Transform, DFT as a linear transformation Properties of the DFT: Periodicity, Linearity and Symmetry properties, Multiplication of two DFTs and Circular Convolution, Additional DFT properties. Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long data Sequences, Fast-Fourier-Transform (FFT) algorithms, Efficient Computation of the DFT: Radix- 2 FFT algorithms for the computation of DFT and IDFT decimation in-time and decimation-in-frequency algorithms.

Module-II **12 hrs**

Aperture and Reflector Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas, Monopole antenna

Module-III **2 hrs**

IIR Filter Design: Infinite Impulse response Filter Format, Bilinear Transformation Design Method, Analog Filters using Low pass prototype transformation. Normalized Butterwor th Functions, Bilinear Transformation and Frequency Warping, Bilinear Transformation Design Procedure, Digital Butterworth Filter Design using BLT. Realization of IIR Filters in Direct form I and II.

Module-IV **10 hrs**

Digital Signal Processors: DSP Architecture, DSP Hardware Modules, Fixed point format, Floating point Format, Fixed Point digital signal processors, Floating point processors. Application of Digital Signal Processors.

Text/Reference Books:

1.Proakis & Manolakis, "Digital Signal Processing- Principles Algorithms &Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317- 1000-9.
2. Oppenheim & Schaffer, "Discrete Time Signal Processing, PHI, 2003.
3. Sanjit K Mitra, "Digital Signal Processing, A Computer Based Approach", 4th Edition. McGraw Hill Education, 2013.
4. D.Ganesh Rao and Vineeth P Gejji, "Digital Signal Processing" Cengage India Private Limited, 2017, ISBN: 9386858231

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											1
CO3	1			2									1	
CO4					2					2				
CO5											2			
CO(Average)	2	1	2	2	2		1		1				1	1

EMPLOYMENT ENHANCEMENT COURSE – I

Subject Code: -	**BTEEC 506**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**02**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**01**

Course objectives:

1. Employment Enhancement Course-I is aimed to developing key employability skills.
2. It develops the leadership, planning, and organizational skills.
3. The course aims to bridge the gap between skills possessed by individuals and those sought by employers.

Assessment plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Contents:

MODULE 1: EMPLOYABILITY SKILLS

Communication Skills: This module focuses on enhancing verbal and non-verbal communication, including effective listening, clear expression, and adapting communication styles.

Corporate Etiquette and Soft Skills: Students learn professional conduct, workplace manners, teamwork, and time management.

Resume Building and Interview Skills: This module equips students to craft resumes and develop confidence for interviews, including body language and mock interview practice.

MODULE 2: APTITUDE AND REASONING SKILLS

Analytical Skills: logical reasoning, quantitative aptitude, data interpretation, and problem-solving, which are frequently tested in job applications and interviews.

Reasoning Skills: Similar to analytical skills, this module focuses on developing critical thinking, pattern recognition, and deductive reasoning abilities,

MODULE 3: COMPUTER AND TECHNICAL SKILLS

Basic Computer Knowledge: This module often covers essential computer skills, including working with MS Office applications (like Word, Excel, and PowerPoint) and navigating the internet.

Technical Skill Building: Some programs may include modules offering basic technical skills relevant to the students' fields of study (e.g., programming, networking, content writing)

MODULE 4: DEVELOPING KEY TRAITS

Leadership and Management: Understanding different leadership styles, motivating teams, delegating tasks, and taking initiative.

Time Management: Prioritizing tasks, setting goals, managing time effectively, and meeting deadlines.

Adaptability: Adjusting to changing circumstances, embracing new challenges, and remaining flexible in the workplace.

Work Ethics: Understanding professional conduct, demonstrating responsibility, and maintaining a positive attitude.

MODULE 5: PRACTICAL APPLICATIONS AND CAREER PLANNING

Resume and Cover Letter Writing: Crafting compelling resumes and cover letters that highlight relevant skills and experience.

Interview Skills: Practicing interview techniques, preparing for different types of interviews, and effectively showcasing qualifications.

Networking: Building professional connections, attending industry events, and leveraging social media for career advancement.

Career Planning: Setting career goals, identifying career paths, and developing a plan for achieving career aspirations.

Course outcomes:

CO1. Upon completing the course, students are expected to possess improved communication skills.
CO2. It enhanced analytical and reasoning abilities.
CO3. It builds self-confidence, better teamwork skills.
CO4. It creates a stronger foundation for entering the workforce.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Upon completing the course, students are expected to possess improved communication skills.	K_1
CO2	It enhanced analytical and reasoning abilities.	K_2
CO3	It builds self-confidence, better teamwork skills.	K_3
CO4	It creates a stronger foundation for entering the workforce.	K_6

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO(Average)	1.3	2.5		2		2			2		1		1	1

DIGITAL ELECTRONICS LAB

Subject Code: -	**BTEEE501P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Study of different gates and its corresponding ICs

2. Study of Boolean operation

3. Characteristics of BJT in Common Emitter Configuration

4. Characteristics of JFET in Common source Configuration

5. Study of Half Wave and Full Wave Rectifier without Filter

6. Study of Common Emitter BJT Amplifier.

7. To study the operation of Hartley & Colpitts oscillator circuits and to determine their frequency of oscillations.

Laboratory Outcomes:

Develop practical skills in analyzing and building electronic circuits, including diodes, transistors, and amplifiers. They learn to verify circuit characteristics, implement designs, and understand the underlying principles of electronics.

CO 1. Diode and Transistor Characteristics**:** Students learn to understand the V-I characteristics of diodes (forward and reverse bias), Zener diodes, and transistors (CB, CE, CC configurations).

CO 2. Students apply these characteristics to anal yze the performance of basic circuits containing diodes and transistors, including rectifiers, amplifiers, and biasing circuits

CO 3. Students design and implement half-wave and full-wave rectifier circuits with and without filters, learning how to convert AC to DC voltage.

Course Outcome No	**Statement**	**Knowledge Level (KL)**
CO1	Diode and Transistor Characteristics**:** Students learn to understand the V-I characteristics of diodes (forward and reverse bias), Zener diodes, and transistors (CB, CE, CC configurations).	K_1
CO2	Students apply these characteristics to analyze the performance of basic circuits containing diodes and transistors, including rectifiers, amplifiers, and biasing circuits	K_2
CO3	Students design and implement half-wave and full-wave rectifier circuits with and without filters, learning how to convert AC to DC voltage.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1										1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	2		1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

MICROPROCESSOR AND MICROCONTROLLER LAB

Subject Code: -	**BTECE502P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Familiarization of with 8085 training KIT

2. Addition of two numbers in 8085

3. Multiplication of two numbers in 8085

4. Find grater in between two numbers in 8085

5. Find 1's and 2's complement of 8-bit/16-bit numbers.

Laboratory Outcomes:

After completing these experiments, students will be able to confidently operate the 8085 training kit for memory navigation, code entry, and program execution, while writing assembly programs to perform addition with carry handling, multiplication by repeated addition, comparison to find the greater number, and calculation of 1's and 2's complements for both 8-bit and 16-bit numbers. They will also learn to analyze flag register status, verify results in memory and registers, and troubleshoot common programming errors. These foundational microprocessor programming skills prepare students for more advanced embedded system design and low-level computing applications.

CO 1. Understand and navigate the 8085 microprocessor training kit, including memory operations, register examination, code entry, and program execution using function keys.

CO 2. Develop and execute assembly language programs for arithmetic operations (addition and multiplication) and logical operations (comparison for greater number, 1's and 2's complement) on 8-bit and 16-bit data.

CO 3. Analyze flag register status (Carry, Zero, Sign, Parity) and verify program results by examining memory and register contents, while debugging basic programming errors.

Course Outcome No	**Statement**	**Knowledge Level (K_L)**
CO1	Understand and navigate the 8085 microprocessor training kit, including memory operations, register examination, code entry, and program execution using function keys	K_1
CO2	Develop and execute assembly language programs for arithmetic operations (addition and multiplication) and logical operations (comparison for greater number, 1's and 2's complement) on 8-bit and 16-bit data.	K_2
CO3	Analyze flag register status (Carry, Zero, Sign, Parity) and verify program results by examining memory and register contents, while debugging basic programming errors	K_3, K_4, K_5, K_6

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	1		1	1							1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	1.5	1	1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

ANALOG COMMUNICATION LAB

Subject Code: -	**BTECE503P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Laboratory Experiments list

1.DSB-SC, SSB-SC Modulator & Detector
2.Analog amplitude, frequency and phase modulation and demodulation with spectrum analysis
3.Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Delta Modulation, Pulse Coded Modulation & their Demodulation
4.Study of effect of channel on system with various modulation
5.Study of Frequency/Time division multiplexed schemes
6.Understand various signal processing tools like Fourier series, Fourier transform, Power spectral density etc. for analyzing the signal

7.Study the statistical properties of the output response of a system when the input is wide sense stationary
8.Measurement of modulation index of an AM signal
9.Measurement of output power with varying modulation index (DSB-SC & SSB)
10. Design a PLL using VCO & measure the lock frequency

Laboratory Outcomes

Upon completion of the lab, students will be able to generate, modulate, and demodulate analog signals (AM, FM, DSB-SC, SSB-SC, PAM, PWM, PPM, Delta Modulation), analyze them in time/frequency domains, measure all communication parameters

Course Objective Statements

CO1: Generate and analyze AM, FM, PM, DSB-SC, and SSB-SC signals using modulation techniques, and perform their demodulation while measuring parameters like modulation index and output power.
CO2: Implement and evaluate analog pulse modulation techniques including PAM, PWM, PPM, Delta Modulation, and PCM, along with their demodulation and spectral analysis.
CO3: Investigate channel effects on modulated systems, analyze FDM/TDM schemes, apply signal processing tools (Fourier series, transform, PSD), and study system response to random inputs.

Course Outcome Table

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Generate and analyze AM, FM, PM, DSB-SC, and SSB-SC signals using modulation techniques, and perform their demodulation while measuring parameters like modulation index and output power	K1
CO2	Implement and evaluate analog pulse modulation techniques including PAM, PWM, PPM, Delta Modulation, and PCM, along with their demodulation and spectral analysis.	K2
CO3	Investigate channel effects on modulated systems, analyze FDM/TDM schemes, apply signal processing tools (Fourier series, transform, PSD), and study system response to random inputs.	K3

Access These Experiments virtually

These experiments are also available on **Virtual Lab**s project by IIT Delhi and IIT Kharagpur. To perform them:

[1] Visit the official Virtual Labs website: **https://vlab.co.in**
[2] Navigate to the **"Electronics & Communications"** discipline group.
[3] Look for the **"Analog and Digital Communication Lab" (IIT Delhi)** or similar labs under IIT Kharagpur.
[4] Click on an experiment name to run the simulation directly in your browser.

Semester VI

CONTROL SYSTEM

Subject Code: -	**BTEE601**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**04**

Course Objective:

1. To introduce the elements of control system and their modeling using various techniques.
2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. To understand the compensation technique that can be used to stabilize the control system.
To introduce the state variable analysis method.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Module -I **10 hrs**

Control Systems and Components: Systems and their representation: Basic elements in control systems, open and closed loop systems, Electrical analogy of mechanical Systems, Transfer function, Block diagram reduction techniques, Signal flow graphs- AC and DC servomotor, synchro-, stepper motor.

Module-II **12 hours**

Time Response Analysis and Design Specifications:

Time response: Time domain specifications, Types of test input, I and II order system response, Error coefficients, Generalized error series, Steady state error, P, PI, PD and PID compensation.

Module-III **12 hours**

Frequency Response Analysis: Frequency response: Bode plot, Polar plot, frequency domain specifications, Correlation between frequency domain and time domain specifications, Introduction to the design of lead, lag and lag-lead compensators.

Module-IV **10 hours**

Concepts of Stability:

Stability Analysis: Characteristics equation, Location of roots in S plane for stability, Routh Hurwitz criterion, Root locus diagram and its application, Dominant poles-Nyquist stability criterion, relative stability.

Text/Reference Books:

1. Norman S. Nise, "Control Systems Engineering", 4th Ed, John Wiley, New Delhi, 2007.
2. K. Ogata, "Modern Control Engineering", 4th Ed, PHI, New Delhi, 2002.
3. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003.
4. Benjamin C. Kuo, "Automatic Control Systems", Pearson Education, New Delhi, 2003.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Control System	Prof. M. Gopal	IIT Delhi
2	Control System	Prof. Ramakrishna Pasumarthy	IIT Madras

Course Outcomes: On completion this course, students will be able to

CO1: Perform time domain and frequency domain analysis of control systems required for stability analysis.
CO2: Design of compensators that can be used to stabilize the control systems.
CO3: Demonstrate the ability to apply Laplace transform, transfer functions, and block diagrams for simulation and control.
CO4: Identify, evaluate and solve control engineering problems

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Perform time domain and frequency domain analysis of control systems required for stability analysis.	K_1
CO2	Design of compensators that can be used to stabilize the control systems.	K_2, K_3
CO3	Demonstrate the ability to apply Laplace transform, transfer functions, and block diagrams for simulation and control.	K_3
CO4	Identify, evaluate and solve control engineering problems	K_3, K_4

KL-Bloom's Knowledge Level(K_1,K_2,K_3,K_4,K_5,K_6)

K_1-Remember,K_2-Understand,K_3-Apply,K_4-Analyze,K_5-Evaluate,K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					1
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO(Average)	2	1	2	2	2		1		1				1	1

DIGITAL COMMUNICATION

Subject Code: -	**BTECE602**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**04**

Course Objectives:

To introduce fundamental concepts of digital communication systems including signal representation, modulation techniques, optimum receiver design, information theory, and coding schemes. To enable students to analyze system performance under noise and understand modern transmission methods.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Module 1 (9 hours)
Introduction to digital communication system, block diagram of digital communication system, advantages and disadvantages, sampling theorem – low-pass and band-pass signals, aliasing, quantization – uniform and non-uniform quantization (μ-law, A-law), companding, Pulse Code Modulation (PCM) – generation and reconstruction, PCM bit rate and bandwidth, differential PCM (DPCM), Delta Modulation (DM) – slope overload and granular noise, Adaptive Delta Modulation (ADM), comparison of PCM, DPCM, DM, and ADM.

Module 2 (9 hours)
Waveform coding techniques, line coding – Unipolar NRZ, Polar NRZ, Bipolar RZ, AMI, Manchester coding, power spectral density of line codes, inter-symbol interference (ISI), Nyquist pulse shaping criterion, raised cosine filter and roll-off factor, eye diagram – interpretation and applications, matched filter receiver – derivation and properties, correlation receiver, probability of error for matched filter.

Module 3 (9 hours)
Geometric representation of signals, Gram-Schmidt orthogonalization procedure, signal space concepts, constellation diagrams, optimum receiver using correlation and matched filter, maximum likelihood decoding, decision regions, probability of bit error for binary modulation schemes – BASK, BFSK (coherent and non-coherent), BPSK, Differential BPSK (DPSK), QPSK – generation and detection, offset QPSK, comparison of error probabilities.

Module 4 (9 hours)
Advanced digital modulation techniques – M-ary signaling, M-ary ASK, M-ary PSK (MPSK), M-ary FSK (MFSK), quadrature amplitude modulation (QAM) – 16 QAM, 64 QAM, transmitter and receiver block diagrams, bandwidth and power efficiency of M-ary systems, probability of error for M-ary schemes, carrier and symbol synchronization – phase locked loop (PLL), Costas loop, symbol timing recovery, eye pattern for synchronization.

Module 5 (9 hours)
Information theory – entropy, joint entropy, conditional entropy, mutual information, source coding theorem, Huffman coding, Shannon-Fano coding, Lempel-Ziv coding, channel capacity – Shannon-Hartley theorem, capacity of bandlimited AWGN channel, error control coding – block codes, linear block codes, syndrome decoding, Hamming codes, cyclic codes – CRC, convolutional codes – encoding using state diagram and trellis, Viterbi decoding algorithm, comparison of coding gain

TEXT REFERENCE BOOKS

J. S. Chitode, *Digital Communications*, 1st ed. Pune, India: Technical Publications, 2018.

S. Sharma, *Digital Communications*, 7th ed. New Delhi, India: S.K. Kataria & Sons, 2019.

M. Sathish Kumar, *Digital Communication*, 1st ed. New Delhi, India: PHI Learning, 2016.

R. P. Singh and S. D. Sapre, *Communication Systems: Analog and Digital*, 2nd ed. New Delhi, India: McGraw-Hill Education, 2010.

B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 5th ed. New York, NY, USA: Oxford University Press, 2019

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Digital Communication	**Prof. Bikash Kumar Dey**	IIT Bombay
2	Modern Digital Communication Techniques	**Prof. Suvra Sekhar Das**	IIT KGP

Course Outcome

CO1: Explain sampling, quantization, PCM, DPCM, DM, and ADM, and compare their performance parameters.
CO2: Analyze line coding techniques, inter-symbol interference (ISI), Nyquist pulse shaping, eye diagram, and matched filter receiver for baseband transmission.
CO3: Evaluate probability of error for binary modulation schemes (BASK, BFSK, BPSK, DPSK) and describe QPSK and offset QPSK using signal space concepts.
CO4: Design and analyze M-ary modulation schemes (MPSK, MFSK, QAM) and explain carrier and symbol synchronization techniques including PLL and Costas loop.
CO5: Apply information theory concepts (entropy, mutual information, channel capacity) and implement source coding (Huffman, Shannon-Fano) and error control coding (block codes, cyclic codes, convolution codes with Viterbi decoding).

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Explain sampling, quantization, PCM, DPCM, DM, and ADM, and compare their performance parameters	K_1
CO2	Analyze line coding techniques, inter-symbol interference (ISI), Nyquist pulse shaping, eye diagram, and matched filter receiver for baseband transmission	K_2
CO3	Evaluate probability of error for binary modulation schemes (BASK, BFSK, BPSK, DPSK) and describe QPSK and offset QPSK using signal space concepts	K_3
CO4	Design and analyze M-ary modulation schemes (MPSK, MFSK, QAM) and explain carrier and symbol synchronization techniques including PLL and Costas loop.	K_6

CO5	Apply information theory concepts (entropy, mutual information, channel capacity) and implement source coding (Huffman, Shannon-Fano) and error control coding (block codes, cyclic codes, convolutional codes with Viterbi decoding).	K_1, K_2, K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					1
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO5											2			
CO(Average)	2	1	2	2	2		1		1				1	1

Mobile Communication

Subject Code: -	**BTCEE603**	**IA Marks**	**40**
Number of Lecture Hours/Week: -	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objectives:

To introduce the fundamental concepts of mobile communication systems including cellular architecture, propagation mechanisms, multiple access techniques, and fading countermeasures. To enable students to analyze system capacity, evaluate handoff strategies, and understand the evolution from 2G to 4G/LTE technologies.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all Types of leaves including Medical leaves.	

Course contents:

Module 1 (9 hours)

Introduction to mobile communication, evolution of mobile radio systems (1G to 5G overview), cellular concept, frequency reuse, cluster size, co-channel interference, adjacent channel interference, carrier-to-interference ratio (C/I), cell splitting, sectoring, segmentation and dualization, cell coverage for signal and traffic, determination of cell size and shape, spectral efficiency, umbrella cell pattern, traffic engineering – Erlang B and Erlang C formulas, grade of service (GoS), blocking probability, channel assignment strategies – fixed and dynamic.

Module 2 (9 hours)

Handoff strategies – intersystem and intrasystem handoff, soft handoff and hard handoff, mobile assisted handoff (MAHO), priority handoff, dwell time, handoff initiation, locating and call setup, interference reduction techniques – power control (open loop and closed loop), diversity techniques – space diversity, polarization diversity, frequency diversity, time diversity, RAKE receiver, equalization – linear and nonlinear equalizers, adaptive equalizers, speech coding – characteristics of speech signals, vocoders, linear predictive coding (LPC).

Module 3 (9 hours)

Propagation mechanisms – free space propagation model, two-ray ground reflection model, log-distance path loss model, log-normal shadowing, outdoor propagation models – Okumura model, Hata model (Okumura-Hata), COST-231 Hata model, indoor propagation models – partition losses, log-distance path loss model for indoors, fading – slow fading and fast fading, Rayleigh fading, Rician fading, Doppler shift, multipath propagation, delay spread, coherence bandwidth, coherence time, flat fading, frequency selective fading.

Module 4 (9 hours)

Multiple access techniques – FDMA, TDMA (frame structure, guard time, synchronization), CDMA (PN sequences, Walsh codes, spreading and despreading, processing gain, near-far problem), SDMA, OFDMA, comparison of multiple access schemes, GSM architecture and specifications – mobile station (MS), base station subsystem (BSS), network switching subsystem (NSS), GSM channels – traffic channels (TCH) and control channels (CCH), GSM

frame structure (hyper frame, super frame, multiframe, TDMA frame, time slot), GSM call setup and handoff, IS-95 CDMA architecture and specifications.

Module 5 (9 hours)
Wireless local loop (WLL) architecture and applications, cellular CDMA (IS-95) forward and reverse link, spread spectrum techniques – direct sequence spread spectrum (DSSS), frequency hopping spread spectrum (FHSS), time hopping spread spectrum (THSS), GPRS (General Packet Radio Service) – architecture, packet data transmission, EDGE (Enhanced Data Rates for GSM Evolution), 3G systems – UMTS (Universal Mobile Telecommunications System), WCDMA, 3G architecture, 4G/LTE – OFDM, MIMO (Multiple Input Multiple Output), LTE architecture (eNodeB, EPC), LTE frame structure, comparison of 2G, 3G, 4G, and 5G characteristics (data rate, bandwidth, multiple access, core network).

TEXT/REFERENCE BOOKS:

1. T. L. Singal, *Wireless Communications*, 1st ed. New Delhi, India: McGraw-Hill Education, 2010.

2. S. K. Sarkar, T. G. Pal, and S. K. De, *Wireless and Mobile Communications*, 1st ed. New Delhi, India: Oxford University Press, 2018.

3. T. S. Rappaport, *Wireless Communications: Principles and Practice*, 2nd ed. New Delhi, India: Pearson Education, 2010 (Indian reprint).

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Introduction to Wireless and Cellular Communications	**Prof. David Koilpillai**	IIT Madras
2	Advanced 3G and 4G Wireless Mobile Communications	**Prof. Aditya K. Jagannatham**	IIT Kanpur

Course Outcome

CO1: Explain cellular concepts including frequency reuse, cluster size, interference, cell splitting, sectoring, and traffic engineering (Erlang B/C, GoS, blocking probability).

CO2: Analyze handoff strategies (soft/hard/MAHO), diversity techniques (space/frequency/time), RAKE receiver, equalization, and speech coding (LPC, vocoders).

CO3: Evaluate propagation mechanisms (free space, two-ray, Okumura-Hata, COST-231), fading types (Rayleigh/Rician, slow/fast,flat/frequency selective), and Doppler shift.

CO4: Compare multiple access techniques (FDMA, TDMA, CDMA, OFDMA) and describe GSM architecture, channels, frame structure, and IS-95 CDMA specifications.

CO5: Explain WLL, spread spectrum techniques (DSSS, FHSS), GPRS, EDGE, UMTS, WCDMA, LTE (OFDM, MIMO), and compare 2G, 3G, 4G, and 5G characteristics.

.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Explain cellular concepts including frequency reuse, cluster size, interference, cell splitting, sectoring, and traffic engineering (Erlang B/C, GoS, blocking probability).	K_1
CO2	Analyze handoff strategies (soft/hard/MAHO), diversity techniques (space/frequency/time), RAKE receiver, equalization, and speech coding (LPC, vocoders)	K_2
CO3	Evaluate propagation mechanisms (free space, two-ray, Okumura-Hata, COST-231), fading types (Rayleigh/Rician, slow/fast,flat/frequency selective), and Doppler shift.	K_3
CO4	Compare multiple access techniques (FDMA, TDMA, CDMA, OFDMA) and describe GSM architecture, channels, frame structure, and IS-95 CDMA specifications.	K_6
CO5	Explain WLL, spread spectrum techniques (DSSS, FHSS), GPRS, EDGE, UMTS, WCDMA, LTE (OFDM, MIMO), and compare 2G, 3G, 4G, and 5G characteristics.	K_1, K_2, K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of Cos with Pos & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					1
CO2		1	2											
CO3	1			2									1	
CO4					2					2				
CO5											2			
CO(Average)	2	1	2	2	2		1		1				1	1

OPITICAL FIBRE COMMUNICATION

Subject Code: -	**BTECE604**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective:

To introduce the fundamental principles of optical fibre communication systems including fibre optic components, transmission characteristics, sources, detectors, and system design. To enable students to analyze signal degradation mechanisms, evaluate link performance, and understand modern optical networks and DWDM technology.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module 1 (9 hours)
Historical development of optical communication, optical frequency range, electromagnetic spectrum, advantages of optical fibre communication over metallic cables, basic block diagram of optical fibre communication system, optical fibre construction – core, cladding, coating, buffer, fibre geometry, total internal reflection (TIR), acceptance angle, acceptance cone, numerical aperture (NA), refractive index profile, step index fibre, graded index fibre, single mode fibre (SMF), multimode fibre (MMF), cutoff wavelength, mode theory – modes in planar waveguide, modes in cylindrical waveguide, V-number (normalized frequency), mode field diameter (MFD), propagation constant, group index, group delay, fibre materials – glass, plastic, photonic crystal fibres.

Module 2 (9 hours)
Transmission characteristics of optical fibres – attenuation (absorption, scattering, bending losses – macro bending and micro bending), signal attenuation in dB/km, attenuation windows (850 nm, 1310 nm, 1550 nm), dispersion – intramodal dispersion (chromatic dispersion – material dispersion, waveguide dispersion), intermodal dispersion, polarization mode dispersion (PMD), dispersion shifted fibres (DSF), dispersion flattened fibres (DFF), non-zero dispersion shifted fibres (NZ-DSF), dispersion compensation techniques (DCF, FBG), nonlinear effects – stimulated Brillouin scattering (SBS), stimulated Raman scattering (SRS), self phase modulation (SPM), cross phase modulation (XPM), four wave mixing (FWM), soliton propagation.

Module 3 (9 hours)
Optical sources – light emitting diode (LED) – working principle, structure (surface emitting LED, edge emitting LED), characteristics (spectral width, output power, modulation bandwidth, far field pattern), LED drive circuits, semiconductor laser diode (LD) – working principle, population inversion, optical feedback, Fabry-Perot laser, distributed feedback (DFB) laser, distributed Bragg reflector (DBR) laser, single mode laser, laser characteristics (threshold current, linewidth, quantum efficiency, relative intensity noise), laser drive circuits, laser modulation (direct modulation, external modulation using electro-optic modulator), comparison of LED and LD.

Module 4 (9 hours)
Optical detectors – photodetector characteristics (responsivity, quantum efficiency, dark current, rise time, bandwidth, noise equivalent power), p-n photodiode, p-i-n photodiode (PIN), avalanche photodiode (APD) – working principle, multiplication gain, excess noise factor, APD bias circuits, comparison of PIN and APD, optical receiver – front end (low impedance, high impedance, transimpedance amplifier), line coding schemes in optical communication (NRZ, RZ, Manchester), receiver noise (shot noise, thermal noise), receiver sensitivity, eye diagram, bit error rate (BER), optical amplification – EDFA (erbium doped fibre amplifier) – working principle, gain spectrum, pump sources, amplification bands (C-band, L-band), SOA (semiconductor optical amplifier), Raman amplifier.

Module 5 (9 hours)
Optical fibre system design – power budget calculation, rise time budget calculation, link budget analysis, connector types (FC, SC, ST, LC, MU, MTRJ), connector losses, splicing – fusion splicing, mechanical splicing, splicing loss, optical couplers (star coupler, tee coupler), isolators, circulators, filters, wavelength division multiplexing (WDM), dense WDM

(DWDM), coarse WDM (CWDM), optical add drop multiplexer (OADM), optical cross connect (OXC), optical time domain reflectometer (OTDR) – working principle and applications, optical fibre measurement techniques – cutback method, insertion loss method, introduction to fibre optic sensors (temperature, strain, pressure sensors), applications of optical fibre communication – internet backbone, FTTX (FTTH, FTTB, FTTC), cable TV, undersea cables.

Text /Reference Books:

1. M. Sathish Kumar, *Fundamentals of Optical Fibre Communication*, 1st ed. New Delhi, India: PHI Learning, 2005.
2. S. K. Sarkar, *Optical Fibres and Fibre Optic Communication Systems for B.E./B.Tech. & M.E./M.Tech of all Indian Universities*, 1st ed. New Delhi, India: S. Chand & Company, 2006..
3. G. Keiser, *Optical Fiber Communications*, 5th ed. New Delhi, India: McGraw-Hill Education, 2013 (Indian reprint)
4. J. M. Senior, *Optical Fiber Communications: Principles and Practice*, 3rd ed. New Delhi, India: Pearson Education, 2006.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Fiber Optic Communication Technology	Prof. Deepa Venkitesh,	Department of Electrical Engineering, IIT Madras
2	Fiber Optics	Dr. Vipul Rastogi,	Department of Physics, IIT Roorkee

Course Outcomes:

At the end of this course students will demonstrate the ability

CO1: Explain optical fibre construction, TIR, numerical aperture, step index and graded index fibres, single mode and multimode fibres, and V-number.

CO2: Analyze transmission characteristics including attenuation mechanisms, dispersion types (intramodal, intermodal, PMD), dispersion compensation techniques, and nonlinear effects (SBS, SRS, SPM, XPM, FWM).

CO3: Compare optical sources (LED and laser diode) based on working principles, characteristics, modulation techniques, and drive circuits.

CO4: Evaluate optical detectors (PIN and APD), receiver structures, noise sources, sensitivity, BER, and optical amplifiers (EDFA, SOA, Raman amplifier).

CO5: Design optical fibre systems using power budget and rise time budget, describe components (connectors, couplers, isolators, circulators, filters), explain DWDM/CWDM, OTDR, and applications including FTTX.

Course Outcome No	Statement	Knowledge Level (K_L)
CO1	Explain optical fibre construction, TIR, numerical aperture, step index and graded index fibres, single mode and multimode fibres, and V-number.	K_1
CO2	Analyze transmission characteristics including attenuation mechanisms, dispersion types (intramodal, intermodal, PMD), dispersion compensation techniques, and nonlinear effects (SBS, SRS, SPM, XPM, FWM).	K_2
CO3	Compare optical sources (LED and laser diode) based on working principles, characteristics, modulation techniques, and drive circuits	K_3
CO4	Evaluate optical detectors (PIN and APD), receiver structures, noise sources, sensitivity, BER, and optical amplifiers (EDFA, SOA, Raman amplifier).	K_3
CO5	Design optical fibre systems using power budget and rise time budget, describe components (connectors, couplers, isolators, circulators, filters), explain DWDM/CWDM, OTDR, and applications including FTTX.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

EMPLOYMENT ENHANCEMENT COURSE – II

Subject Code: -	**BTEEC 606**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**02**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**30**	**CREDITS**	**01**

Course objectives:

1. The Employment Enhancement Course - II (EEC-II) is designed to equip students with crucial skills for securing employment or pursuing entrepreneurship.
2. The course is structured around various modules, each focusing on specific skill development.

CONTENTS

MODULE 1: COMMUNICATION AND SOFT SKILLS

Learn good communication and soft skills. Practicing formal introductions and understanding the importance of communication. Interpersonal communication, including giving and receiving feedback effectively. Developing verbal and non-verbal communication skills. Enhancing listening skills and practicing gender sensitivity. Workplace communication with peers, superiors, and juniors.

MODULE 2: COMPUTER BASICS AND DIGITAL LITERACY

Understanding and recalling essential elements of computer basics and technology. Basic computer operations, including MS-Word and Excel basics. Web browsing and using search engines efficiently. Creating and using email accounts, including attaching documents and professional email etiquette. Exploring mobile applications relevant to the workplace. Understanding concepts like file conversion, cloud computing, and language translation.

MODULE 3: EMPLOYMENT AND SELF-EMPLOYMENT ENHANCEMENT

Resume writing and preparation for interviews. Practicing technical evaluations and aptitude tests. Developing interview etiquette, including communication, body language, and answering questions confidently. Understanding and applying for apprenticeships and internships. Registering on government job portals and exploring job search strategies. Learning about career planning, exploring career pathways within a chosen sector, and anticipating challenges.

MODULE 4: ENTREPRENEURSHIP SKILLS

Introducing students to the basics of entrepreneurship and fostering an entrepreneurial mindset.

COURSE OUTCOMES:

CO1. Developing an entrepreneurial mindset and identifying opportunities.

CO2. Learning about market research, developing a Unique Value Proposition (UVP), and being resourceful.

CO3. Understanding the ease of doing business, including statutory compliances and government schemes.

CO4. Managing resources, including human resources, finance, and infrastructure.

CO5. Importance of mentorship and continuous learning in entrepreneurship.

Course Outcome No	Statement	Knowledge Level (K_L)
CO1	Developing an entrepreneurial mindset and identifying opportunities.	K_1
CO2	Learning about market research, developing a Unique Value Proposition (UVP), and being resourceful.	K_2
CO3	Understanding the ease of doing business, including statutory compliances and government schemes.	K_3
CO4	Managing resources, including human resources, finance, and infrastructure.	K_5
CO5	Importance of mentorship and continuous learning in entrepreneurship.	K_2

K_L- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
C05														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

CONTROL SYSTEM LABORATORY

Subject Code: -	**BTEEE602P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

CONTROL SYSTEM LABORATORY

Laboratory Experiments

1. Study of open loop and closed loop control systems.
2. Determination of transfer function of DC motor.
3. Time response analysis of first order and second order systems.
4. Study of stability analysis using Routh-Hurwitz criterion.
5. Study of root locus technique for control systems.
6. Frequency response analysis using Bode plot.
7. Frequency response analysis using Nyquist plot.
8. Study of PID controller characteristics and tuning methods.
9. Simulation of control systems using MATLAB/Simulink.
10. Study of servo motor and synchro system characteristics.

Laboratory Outcomes

Students develop practical skills in analyzing, designing, and simulating control systems using hardware setups and software tools. They learn system modelling, stability analysis, time and frequency response analysis, and controller design techniques for engineering applications.

CO Statements

- CO1. Students understand the fundamentals of control systems, transfer functions, stability concepts, and system response characteristics.
- CO2. Students analyze the performance of control systems using time response, frequency response, and stability analysis techniques.
- CO3. Students design and simulate control systems and PID controllers using modern software tools for practical engineering applications**.**

Course Outcome Table		
Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students understand the fundamentals of control systems, transfer functions, stability concepts, and system response characteristics.	K1
CO2	Students analyze the performance of control systems using time response, frequency response, and stability analysis techniques.	K2
CO3	Students design and simulate control systems and PID controllers using modern software tools for practical engineering applications.	K3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	**CORRELATION WITH PROGRAM OUTCOMES**												**CORRELATION WITH PSOs**	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO (Avg)	3	1	2	3			1		1				1	

Online Resources

The official **Virtual Labs** project by the Ministry of Education (IIT Delhi, IIT Kharagpur) hosts many of these simulations. You can find them by following these steps:

[1] Go to the official website: **https://vlab.co.in**
[2] Click on the **"Electronics & Communications"** discipline group.
[3] Look for labs titled **"Optical Fibre Communication Lab"** (often from IIT Kharagpur or IIT Delhi).

[4] Select any experiment to run the simulation directly in your browser.

For design-oriented simulations (like Experiment 5), some experiments may use **OptiSystem** software, which is sometimes accessible via virtual lab interfaces

DIGITAL COMMUNICATION LAB

Subject Code: -	**BTEEE608P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Laboratory Experiments

1. Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK), Binary Phase Shift Keying (BPSK): Generation and Detection
2.Pass band implementation of ASK, FSK, BPSK: Generation and Detection
3.Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM), Delta Modulation, Pulse Coded Modulation (PCM) & their Demodulation
4.Study of Modulation schemes with Memory (MSK, GMSK)
5.Study of effect of channel on system with various modulation
6.Study of Frequency/Time Division Multiplexed schemes (FDM/TDM)
7.Understand various signal processing tools like Fourier series, Fourier transform, Power Spectral Density (PSD) for analyzing the signal

Laboratory Outcomes

Upon completion of these 7 experiments, students will be able to generate and detect digital modulation schemes including ASK, FSK, BPSK, MSK, and GMSK, analyze the effect of channel impairments on modulated signals, implement analog pulse modulation techniques (PAM, PWM, PPM, Delta Modulation, PCM) and their demodulation, demonstrate frequency and time division multiplexing schemes, and apply signal processing tools such as Fourier series, Fourier transform, and power spectral density for signal analysis.

Course Outcomes

CO1: Generate and detect digital modulation schemes (ASK, FSK, BPSK, MSK, GMSK) and analyze their performance under different channel conditions.

CO2: Implement and demodulate analog pulse modulation techniques including PAM, PWM, PPM, Delta Modulation, and PCM.

CO3: Demonstrate FDM/TDM multiplexing schemes and apply Fourier series, Fourier transform, and PSD for signal analysis.

.

Course Outcome Table		
Course Outcome No	Statement	Knowledge Level (KL)
CO1	Generate and detect digital modulation schemes (ASK, FSK, BPSK, MSK, GMSK) and analyze their performance under different channel conditions.	K1
CO2	Implement and demodulate analog pulse modulation techniques including PAM, PWM, PPM, Delta Modulation, and PCM.	K2
CO3	Demonstrate FDM/TDM multiplexing schemes and apply Fourier series, Fourier transform, and PSD for signal analysis.	K3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	**CORRELATION WITH PROGRAM OUTCOMES**												**CORRELATION WITH PSOs**	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

Online Resources

The official **Virtual Labs** project by the Ministry of Education (IIT Delh) hosts many of these simulations. You can find them by following these steps:

[1] Go to the official website: **https://vlab.co.in**
[2] Click on the **"Electronics & Communications"** discipline group.

[3] Look for labs titled **" Analog and Digital Communication Lab (IIT Delhi)"**
[4] Select any experiment to run the simulation directly in your browser.

SEMESTER VII

VLSI DESIGN (BTEEE704)

Subject Code	**BTECE701**	**IA Marks**	30
Number of Lecture Hours/Week	04	**Term End Exam Marks**	70
Total Number of Lecture Hours	50	**CREDITS**	04

Assessment

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Objective:

- To learn basic CMOS Circuits.
- To learn CMOS process technology.
- To learn techniques of chip design using programmable devices.
- To learn the concepts of designing VLSI Subsystems.

MODULE-1

Introduction: Review of MOSFET characteristics, scaling and small-geometry effects, and MOSFET capacitances. MOS resistor, MOS current source, current mirror circuits. MOS voltage source, linear voltage and current converters. **Hours-10**

MODULE-2

CMOS operational amplifier (OPAMP) design: Differential amplifier, level shifter, source follower, output stage voltage and power amplifiers. Cascade OP-AMP. Compensation techniques. Analog Filters: Switched capacitor (SC) fundamentals, first order SC circuits, second-order SC circuits and cascade design. Analog to digital and digital to analog converters, speed of conversion and over sampling issues. VLSI Interconnects: Distributed RC model, transmission line model. Future interconnect technologies. **Hours-15**

MODULE-3

Digital VLSI Circuit Design: MOS inverters, CMOS inverter, state characteristics, switching characteristics, power dissipation issues. CMOS logic gates: NAND, NOR, XOR, CMOS logic

design of half and full adders. CMOS transmission gates, pseudo-nMOS, domino logic gates. **Hours-15**

MODULE-4

Sequential MOS Logic Circuits: The SR latch circuit, clocked latch and flip-flop, CMOS D-latch and edge-triggered circuits, Schmitt trigger circuit, Comparator. Dynamic Logic Circuits: Pass transistor logic, synchronous dynamic circuit techniques. **Hours-05**

MODULE-5

Semiconductor Memories: ROM circuits, SRAM circuits, DRAM circuits, drivers and buffers, Buffer scaling and design issues. **Hours-05**

Textbook/References:

1. Sung-Mo Kang, Yusuf Leblebici Charl wood Kim, Digital Integrated Circuits: Analysis and Design, 4th Edition, McGraw Hill Education, 2016.

2. Behzad Razavi, Design of Analog CMOS Integrated Circuits, 2nd Edition, McGraw Hill Education, 2016.

3. Jan M RABAEY, Digital Integrated Circuits, 2nd Edition, Pearson Education, 2003.

4. Neil H.E. Weste and David Harris, CMOS VLSI Design: A circuits and systems perspective, 4th Edition, Pearson Education, 2015.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**CMOS Digital VLSI Design**,	Prof. Sudeb Dasgupta	IIT Roorkee
2	**VLSI Physical Design**	Prof. Indranil Sengupta	IIT Kharagpur

Course Outcome:

CO1: Explain MOSFET characteristics, scaling effects, capacitances, and design MOS resistors, current sources, current mirrors, voltage sources, and linear voltage/current converters.

CO2: Design CMOS operational amplifiers including differential amplifiers, level shifters, source followers, output stages, cascade OP-AMPs, compensation techniques, analog filters (switched capacitor circuits), and understand ADC/DAC converters with interconnect modeling.

CO3: Analyze digital VLSI circuits including MOS and CMOS inverters (static and switching characteristics, power dissipation), and design CMOS logic gates (NAND, NOR, XOR, half/full adders, transmission gates, pseudo-nMOS, domino logic).

CO4: Explain sequential MOS logic circuits (SR latch, clocked latch, flip-flops, CMOS D-latch, edge-triggered circuits, Schmitt trigger, comparator) and dynamic logic circuits (pass transistor logic, synchronous dynamic circuit techniques).

CO5: Describe semiconductor memory circuits including ROM, SRAM, DRAM, drivers, buffers, and analyze buffer scaling and design issues.

Course Outcome No	Statement	Knowledge Level (K_L)
CO1	Analyze MOSFET characteristics, scaling effects, and design MOS resistors, current sources, mirrors, and voltage converters.	K_1
CO2	Describe semiconductor memory circuits (ROM, SRAM, DRAM) along with drivers, buffers, and buffer scaling issues.	K_2
CO3	Analyze CMOS inverters (static/switching characteristics, power dissipation) and design CMOS logic gates including NAND, NOR, XOR, half/full adders, transmission gates, pseudo-nMOS, and domino logic.	K_3
CO4	Explain sequential MOS logic circuits (SR latch, clocked latch, D-latch, flip-flops, Schmitt trigger, comparator) and dynamic logic circuits (pass transistor logic, synchronous dynamic techniques).	K_2
CO5	Design CMOS OP-AMPs, differential amplifiers, level shifters, cascade OP-AMPs, switched capacitor filters, ADC/DAC converters, and VLSI interconnects.	K_3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				1		1		1					
CO2		1	2											
CO3				3									1	
CO4														
CO5	2	3		3	1									
CO(Average)	2.5	2	2	3	1		1		1				1	

3 –High; 2 –Medium; 1 –Low

BIOMEDICAL ENGINEERING

Subject Code: -	**BTECE702**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**03**

COURSE OBJECTIVE:

The main objective of this course is to understand the fundamentals of biomedical engineering and human physiology. To study medical instrumentation and biological signal measurement and to analyse biomedical sensors and transducers. To understand medical imaging systems and diagnostic techniques and to learn applications of engineering in healthcare and biomedical systems.

ASSENMENT PLAN:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

COURSE CONTENT:

Module 1: Introduction to Biomedical Engineering

Study of biomedical engineering concepts, scope and applications. Basic human physiology and anatomy relevant to engineering. Biomedical signals and their characteristics. Interaction between engineering and biological systems.

Module 2: Biomedical Sensors and Transducers

Study of biomedical sensors for measurement of physiological parameters. Working principles of electrodes and transducers used in biomedical applications. Measurement of temperature, pressure, blood flow, heart rate and respiration rate. Bio-potential electrodes and their types.

Module 3: Biomedical Instrumentation Systems

Study of biomedical instruments such as ECG, EEG, EMG and blood pressure monitoring systems. Signal acquisition, conditioning and processing in biomedical systems. Amplifiers and filters used in biomedical instrumentation. Patient monitoring systems and medical safety standards.

Module 4: Medical Imaging Systems

Study of medical imaging techniques including X-ray, CT scan, MRI and ultrasound imaging. Principles of image formation and reconstruction. Advantages and limitations of different imaging modalities. Introduction to digital image processing in medical applications.

Module 5: Advanced Biomedical Systems and Applications

Study of advanced biomedical systems such as artificial organs, pacemakers, ventilators and prosthetic devices. Telemedicine and remote health monitoring systems. Biomedical signal processing applications. Ethical issues and safety regulations in biomedical engineering.

REFERENCE BOOKS/ TEXTBOOKS:

1. Introduction to Biomedical Engineering
2. Biomedical Engineering Fundamentals
3. Medical Imaging Systems
4. Biomedical Sensors and Instruments

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Biomedical Instrumentation**	Prof. Varadhan SKM	IIT Madras
2	**Biomedical Ultrasound**	Prof. K. Mercado-Shekhar, Prof. H. Shekhar, Prof. H. J. Pandya	IIT Gandhinagar & IISc Bangalore

COURSE OUTCOME (CO) STATEMENTS

At the end of the course, students will able to

CO1 Understand fundamentals of biomedical engineering and physiology.

CO2 Explain biomedical sensors and measurement techniques.

CO3 Analyse biomedical instrumentation systems.

CO4 Understand medical imaging technologies and applications.

CO5 Apply biomedical engineering concepts in healthcare systems.

COURSE OUTCOME		Bloom's Knowledge Level
CO1	Understand fundamentals of biomedical engineering and physiology.	K2
CO2	Explain biomedical sensors and measurement techniques.	K2
CO3	Analyse biomedical instrumentation systems.	K4
CO4	Understand medical imaging technologies and applications.	K2
CO5	Apply biomedical engineering concepts in healthcare systems.	K3

KL-Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)
K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				1		1		1					
CO2		1	2											
CO3				3									1	
CO4														
CO5	2	3		3	1									1
CO(Average)	2.5	2	2	3	1		1		1				1	1

3 –High; 2 –Medium; 1 –Low

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Subject Code: -	**BTECE703**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours:-	**60**	**CREDITS**	**03**

Course Objective
To introduce fundamental concepts of Artificial Intelligence and Machine Learning, including problem-solving techniques, supervised and unsupervised learning algorithms, neural networks, and deep learning architectures. To enable students to apply AI/ML techniques to solve engineering problems in the field of electronics and communication.

Module 1 (9 hours)
Introduction to AI – AI applications – Problem solving agents – Search algorithms – Uninformed search strategies – Heuristic search strategies – Local search and optimization

problems – Adversarial search – Constraint satisfaction problems (CSP) – Definition of learning systems – Goals and applications of machine learning – Types of machine learning – Machine learning process – Terminology and weight space – The curse of dimensionality – Testing machine learning algorithms .

Module 2 (9 hours)
Introduction to supervised learning – Linear regression models – Least squares, single and multiple variables – Bayesian linear regression – Gradient descent – Linear classification models – Discriminant function – Probabilistic discriminative model – Logistic regression – Probabilistic generative model – Naive Bayes – Maximum margin classifier – Support vector machine (SVM) – Decision tree – Random forests – K-nearest neighbor (KNN) classifier – Ensemble methods .

Module 3 (9 hours)
Introduction to unsupervised learning – Clustering – K-means clustering – Expectation-maximization (EM) algorithm – Hierarchical clustering – Dimensionality reduction – Principal component analysis (PCA) – Probabilistic PCA – Introduction to association rule mining – Applications of unsupervised learning .

Module 4 (9 hours)
The brain and the neuron – Perceptron – Training the perceptron – Perceptron learning algorithm – Multilayer perceptron – Activation functions – Network training – Gradient descent optimization – Stochastic gradient descent – Error backpropagation – From shallow networks to deep networks – Vanishing gradient problem – ReLU activation – Hyperparameter tuning – Batch normalization – Regularization – Dropout .

Module 5 (9 hours)
Convolutional neural networks – Convolution and pooling layers – Variants of CNNs – Transfer learning – Recurrent neural networks (RNN) – Bidirectional RNNs – Deep recurrent networks – Long short-term memory (LSTM) – Recursive neural networks – Applications – Speech recognition – Computer vision – Natural language processing

Textbook/References:

1. S.Haykin, *Neural Networks and Learning Machines*, 3rd ed. New Delhi, India: Pearson Education, 2010 (Indian reprint).
2. V. K. Jain, *Artificial Intelligence and Expert Systems*, 1st ed. Pune, India: Technical Publications, 2018.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Neural Networks for Signal Processing - I**	Prof. Shayan Srinivasa Garani,	IISc Bangalore
2	**Deep Learning for Computer Vision**	Prof. Vineeth N. Balasubramanian	, IIT Hyderabad

Course Outcomes

CO1: Explain fundamental AI concepts, search strategies, and the machine learning process including types of learning and the curse of dimensionality.

CO2: Apply supervised learning algorithms including linear regression, logistic regression, SVM, decision trees, random forests, KNN, and ensemble methods for classification and regression tasks.

CO3: Analyze unsupervised learning techniques including K-means clustering, EM algorithm, hierarchical clustering, PCA, and association rule mining for dimensionality reduction and pattern discovery.

CO4: Design and train neural networks using perceptron, multilayer perceptron, backpropagation, activation functions, gradient descent optimization, and regularization techniques including batch normalization and dropout.

CO5: Implement deep learning architectures including CNNs with convolutional and pooling layers, RNNs, LSTMs, and apply them to applications such as speech recognition, computer vision, and natural language processing.

COURSE OUTCOME		**Bloom's Knowledge Level**
CO1	Explain fundamental AI concepts, search strategies, and the machine learning process including types of learning and the curse of dimensionality	K2
CO2	Apply supervised learning algorithms including linear regression, logistic regression, SVM, decision trees, random forests, KNN, and ensemble methods for classification and regression tasks	K2
CO3	Analyze unsupervised learning techniques including K-means clustering, EM algorithm, hierarchical clustering, PCA, and association rule mining for dimensionality reduction and pattern discovery	K4
CO4	Design and train neural networks using perceptron, multilayer perceptron, backpropagation, activation functions, gradient descent optimization, and regularization techniques including batch normalization and dropout	K2
CO5	Implement deep learning architectures including CNNs with convolutional and pooling layers, RNNs, LSTMs, and apply them to applications such as speech recognition, computer vision, and natural language processing	K3

KL-Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)
K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				1		1		1					
CO2		1	2											
CO3				3									1	
CO4													1	
CO5	2	3		3	1									1
CO(Average)	2.5	2	2	3	1		1		1				1	1

3 –High; 2 –Medium; 1 –Low

INDUSTRIAL MANAGEMENT

Subject Code: -	**BTECE704**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective

To introduce fundamental concepts of industrial management including principles of management, organizational behavior, production planning, financial management, and modern management techniques. To enable students to understand managerial functions, decision-making processes, and apply management principles in industrial and organizational contexts.

Module 1 (9 hours)

Introduction to management – definition, functions of management (planning, organizing, staffing, directing, coordinating, controlling) – evolution of scientific management and industrial engineering – Taylor's scientific management theory – Fayol's principles of management – Mintzberg's ten managerial roles – Maslow's hierarchy of human needs – Douglas McGregor's Theory X and Theory Y – Herzberg's two-factor theory of motivation – systems approach to management – forms of business organization – sole proprietorship, partnership, joint stock company (private and public limited), cooperative and government owned companies – merits and demerits of each type – public sector vs private sector organizations – business environment – economic, social, political, legal factors .

Module 2 (9 hours)

Organization – importance and principles of organization – types of organization structures (line, line and staff, functional, matrix, project) – span of control – authority delegation – centralization vs decentralization – groups, committees and task forces – coordination – departmentation – personal management – objectives and functions – human resource planning – recruitment, selection, placement, training and development – induction –

performance appraisal methods – job evaluation and merit rating – motivation – factors, characteristics and methods – incentives, pay, promotion, rewards – job satisfaction and job enrichment – leadership – need for leadership, functions of a leader, leadership styles and traits – managerial grids (Blake-Mouton, Reddin) .

Module 3 (9 hours)
Communication – purpose, model, types (formal/informal, verbal/non-verbal, upward/downward/horizontal) – barriers to communication and remedies – directing (leading) – morale – controlling – process, types, levels, guidelines – audit (external, internal, merits) – preventive control – decision making – elements, characteristics, nature, process, classifications – cost concepts – elements of cost – types of costs – cost functions – break-even analysis – problems – depreciation – methods of calculating depreciation (straight line, declining balance, sum of years digits) – introduction to reliability – reliability of electronic components .

Module 4 (9 hours)
Operations management – objectives – product design process – process selection – types of production systems (job, batch, mass production) – plant location – factors affecting location decisions – urban vs rural sites comparison – types of plant layouts – design of product layout – line balancing – value analysis – definition, types of values, objectives, phases, FAST diagram – work study – definition, objectives, steps – method study – definition, objectives, steps – work measurement – purpose, types of study, stopwatch methods, rating, allowances, standard time calculations – work sampling – statistical quality control – variables and attributes – Shewart control charts for variables (X-bar chart, R chart) – charts for attributes (p-chart, c-chart) – acceptance sampling – single sampling and double sampling plans – OC curves – inventory control – relevant costs, EOQ, deterministic single item model with static demand – ABC, VED and FSN analysis – introduction to MRP .

Module 5 (9 hours)
Marketing management – functions of marketing – concepts of selling and marketing – difference – market research – product pricing – distribution channels – marketing mix (4 Ps) – advertising and sales promotion – product life cycle – financial management – concept of time value of money – interest formulae – present and future worth amounts – evaluation of alternative investment proposals (capital budgeting) – types of capital – fixed and working capital – working capital management – factors and principles – productivity – concept, measurements, affecting factors, methods to improve – modern topics – business process reengineering (BPR) – benchmarking – SWOT/SWOC analysis – total productive maintenance – enterprise resource planning (ERP) – management information systems (MIS) – entrepreneurship – concept, qualities, functions – small scale industries – procedure of starting SSI unit – social responsibilities of management – professional ethics – industrial relations – trade unions – functions, merits and demerits – labour welfare schemes – industrial disputes – strikes, lockouts, picketing, gherao – labour legislation acts – Factory Act, Workmen's Compensation Act, Industrial Dispute Act, PF Act, ESI Act

Text /Reference Books:

1. M. Govindarajan and S. Natarajan, *Principles of Management*, Prentice Hall of India, New Delhi, 2009
2. O.P. Khanna, *Industrial Engineering and Management*, Khanna Publishers

3. Koontz. H. and Weihrich. H., *Essentials of Management: An International Perspective*, 8th Edition, Tata McGrawhill, New Delhi, 2010

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	**Industrial Engineering and Management**	Prof. G. K. Sahu,	Department of Industrial and Management Engineering, IIT Kanpur
2	**AI/ML applications in Industrial Management**	Prof. Prithwis Kumar Dey,	IIT Kharagpur

Course Outcomes

CO1: Explain the functions of management, evolution of management theories, motivation theories (Maslow, McGregor, Herzberg), and various forms of business organizations.

CO2: Analyze organization structures, human resource functions (recruitment, training, performance appraisal), leadership styles, and managerial grids for effective management.

CO3: Apply communication models, decision-making processes, cost concepts, break-even analysis, and depreciation methods to industrial management problems.

CO4: Evaluate production systems, plant location and layout, work study (method study and work measurement), statistical quality control (control charts, acceptance sampling), and inventory control (EOQ, ABC analysis).

CO5: Integrate marketing mix, financial management (time value of money, capital budgeting), productivity measurement, modern management techniques (BPR, ERP, MIS, TPM), and industrial relations concepts including labour legislation.

COURSE OUTCOME		Bloom's Knowledge Level
CO1	Explain the functions of management, evolution of management theories, motivation theories (Maslow, McGregor, Herzberg), and various forms of business organizations.	K2
CO2	Analyze organization structures, human resource functions (recruitment, training, performance appraisal), leadership styles, and managerial grids for effective management.	K2
CO3	Apply communication models, decision-making processes, cost concepts, break-even analysis, and depreciation methods to industrial management problems.	K4
CO4	Evaluate production systems, plant location and layout, work study (method study and work measurement), statistical quality control (control charts, acceptance sampling), and inventory control (EOQ, ABC analysis).	K2
CO5	Integrate marketing mix, financial management (time value of money, capital budgeting), productivity measurement, modern management techniques (BPR, ERP, MIS, TPM), and industrial relations concepts including labour legislation	K3

KL-Bloom's Knowledge Level (K1, K2, K3, K4, K5, K6)
K1-Remember, K2-Understand, K3-Apply, K4-Analyze, K5-Evaluate, K6-Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3				1		1		1					
CO2		1	2											
CO3				3									1	
CO4													1	
CO5	2	3		3	1		1							1
CO(Average)	2.5	2	2	3	1		1		1				1	1

3 –High; 2 –Medium; 1 –Low

ENGINEERING PROJECT-1

Subject Code: -	**BTEEE705P**	**IA Marks**	**40**
Number of Lecture Hours/Week:-		**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -		**CREDITS**	**03**

Course Objective:

Following are the intended objectives of the Project work:

1. To prepare students to use applications of the theory and practical learned during the course.
2. To help students to develop an industry or research oriented project.
3. To help students how to carry out project/studies in the field of interest of the student or as given by the industry

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	40
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

GUIDELINES FOR PROJECT WORK

The Project work should be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup and this project to be carried over to next semester.

SUMMER INDUSTRIAL TRAINING

Subject Code: -	**BTEEE706P**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective:

Following are the intended objectives of the Project work:

1. Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
2. Provide possible opportunities to learn understand and sharpen the real time technical / managerial skills required at the job.
3. Exposure to the current technological developments relevant to the subject area of training.
4. Experience gained from the „Industrial Internship" in classroom will be use in classroom discussions.
5. Create conditions conducive to quest for knowledge and its applicability on the job

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	40
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including Medical leaves.	

GUIDELINES FOR INTERNSHIP

Summer Internship –II should be undertaken in an industry only

S.No.	Suggested Schedule	Suggested Duration (In weeks)	Activities
1	Summer/winter vacation after 4th Semester	4-6	Inter/Intra Institutional Activities

DIGITAL SIGNAL PROCESSING LAB

Subject Code: -	**BTEEE707P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	**Description**	**Maximum Marks**
Internal Assessment (IA)	Internal Examination	20
	Attendance/Discipline	5
	Assignment/ Seminar	5

Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

LABORATORY

1. Familiarization of with MATLAB

2. Sample programming in MATLAB

3. Plot 5 different discrete signals using STEM

4. Find convolution of two signals

5. Find DFT of two discrete signals

6. Find FFT of discrete signal.

Laboratory Outcomes:

This laboratory course introduces students to the fundamentals of digital signal processing using MATLAB as a computational and visualization tool. Students will learn to generate and manipulate discrete signals, perform time-domain and frequency-domain analysis, and implement core signal processing algorithms. Upon completion of this course, students will be equipped with practical programming skills essential for analyzing and designing digital signal processing systems.

CO 1. Familiarize with the MATLAB environment, write and execute sample programs, and generate and plot five different discrete signals (unit impulse, step, ramp, exponential, and sinusoidal) using the STEM function.

CO 2. Compute and plot the linear convolution of two discrete signals to understand time-domain analysis of LTI systems.

CO 3. Compute and plot the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) of discrete signals to perform frequency-domain analysis.

Course Outcome No	Statement	Knowledge Level (K_L)
CO1	Familiarize with MATLAB environment, write sample programs, and generate/plot five different discrete signals (impulse, step, ramp, exponential, sinusoidal) using the STEM function.	K_1
CO2	Compute and plot the linear convolution of two discrete signals for time-domain analysis of LTI systems.	K_2
CO3	Compute and plot DFT and FFT of discrete signals for frequency-domain analysis.	K_3, K_4, K_5, K_6

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		1	1							1		1	
CO2		2			1									
CO3			2				1				1			1
CO(Average)	1	2	1.5	1	1		1				1		1	1

3 –High; 2 –Medium; 1 –Low

SEMESTER VIII

INTERNET OF THINGS

Subject Code: -	**BTECE801**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective:

Students will understand the concepts of Internet of Things and can able to build IoT applications.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Course Content:

Module I
INTRODUCTION TO IOT: Defining IoT, Characteristics of IoT, and Physical design of IoT. Logical design of IoT, Functional blocks of IoT, Communication models &APIs.

Module II
IOT & M2M: Machine to Machine, Difference between IoT and M2M.Software define Network

Module III
NETWORK & COMMUNICATION ASPECTS: Wireless medium access issues, MAC protocol survey. Survey routing protocols, Sensor deployment & Node discovery. Data aggregation & dissemination.

Module IV
CHALLENGES IN IOT: Design challenges, Development challenges. Security challenges, other challenges.

Module V
DOMAIN SPECIFIC APPLICATIONS OF IOT: Home automation, Industry applications. Surveillance applications, Other IoT applications.

Textbook/References:

1. A. Bahga and V. Madisetti, *Internet of Things: A Hands-On Approach*, 1st ed. Hyderabad, India: Universities Press, 2015.

2. I. A. Dhotre, *Internet of Things for SPPU 19 Course (Semester VII - Information Technology)*, 1st ed. Pune, India: Technical Publications, 2021.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Introduction To Internet Of Things	Prof. Sudip Misra	IIT Kharagpur
2	Design for Internet of Things	Prof. T V Prabhakar	IISc Bangalore

Course Outcomes:

At the end of this course students will demonstrate the ability

CO1. Understand the concepts of Internet of Things
CO2. Analyze basic protocols in wireless sensor network.
CO3. Design IoT applications in different domain and be able to analyze their performance.
CO4. Implement basic IoT applications on embedded platform.
CO5. Application of IoT in automation of Commercial and Real world examples

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the concepts of Internet of Things	K_1
CO2	Analyze basic protocols in wireless sensor network.	K_2
CO3	Design IoT applications in different domain and be able to analyze their performance.	K_3
CO4	Implement basic IoT applications on embedded platform	K3
CO5	Application of IoT in automation of Commercial and Real world examples	K3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO4		2												
CO5											2	2		
CO(Average)	3	1.5	2	3			1		1		2	2	1	

3 –High; 2 –Medium; 1 –Low

INDUSTRIAL SAFETY

Subject Code: -	**BTECE802**	**IA Marks**	**40**
Number of Lecture Hours/Week:-	**03**	**Term End Exam Marks**	**60**
Total Number of Lecture Hours: -	**45**	**CREDITS**	**03**

Course Objective

To introduce the fundamental principles of industrial safety including hazard identification, risk assessment, safety standards, and emergency procedures relevant to electronics and electrical engineering environments. To enable students to apply safety practices, comply with regulatory requirements (OSHA, NFPA, NEC), and prevent workplace accidents and occupational illnesses.

Module 1 (9 hours)

Introduction to industrial safety – definition and scope – need for industrial safety – accident prevention – safety and health in electronics industry – general industry safety training (OSHA 10 overview) – safety, health and environmental rules and regulations – federal and state requirements – Occupational Safety and Health Administration (OSHA) – National Institute for Occupational Safety and Health (NIOSH) – Environmental Protection Agency (EPA) – common industrial hazards per OSHA standards – ergonomics – laser safety – National Fire Protection Association (NFPA) arc flash – confined space hazards and safety practices – Safety Data Sheet (SDS) – locating and interpreting information – hazardous situation procedures – job safety analysis – fire safety – fuel sources – fire extinguisher class selection – oil hazards – storage and disposal – lubricants – maintenance chemicals .

Module 2 (9 hours)

Electrical safety standards and procedures – lockout, tagout, test out (LOTO) program – LOTO process – zero energy state testing – National Electrical Code (NEC) safety regulations – NFPA 70E arc flash guidelines – safety procedures for tightening, disconnecting, and connecting electrical conductors and components – hazards of contact with live electrical systems – safe approach distances – disconnecting and connecting

electronic components – grounding safety standards and procedures – electrostatic discharge (ESD) control – definition and causes – ESD sensitive components – handling and packaging procedures – ESD prevention equipment (wrist straps, mats, ionizers) – testing and verification – electrical shock – mechanisms of electric shock – effects of electrical shock on human body – factors affecting shock severity – treatment for electrical shock – how to prevent electrical shocks – electrocution hazards .

Module 3 (9 hours)

Mechanical and fluid-controlled system safety practices – machine guarding for mechanical power transmission systems – required machine guarding for fluid power systems – safe removal procedures – stored hydraulic or pneumatic energy – systems with accumulators and compressed air reservoirs – dangers of pressurized hydraulic and pneumatic streams – hot surfaces in fluid power systems – proper fall protection – working at heights – sling ladders, scaffolding and lifts – unguarded leading edges – open holes – improper guardrails – damaged equipment – slippery conditions – fire safety in industrial environments – classes of fire (A, B, C, D, K) – fire extinguisher selection and use – fire suppression for electrical fires – emergency response procedures – hazardous materials (HAZMAT) – flammable and combustible liquids – chemical hazards – biological hazards – physical hazards – reporting procedures – workplace hazard signs and labels – standard hazard warning signs – safety colors and their meanings – personal protective equipment (PPE) – types and selection – head, eye, face, hand, and foot protection – hearing protection – respiratory protection .

Module 4 (9 hours)

Industrial hygiene and occupational health – recognition, evaluation and control of health hazards – permissible exposure limits – workplace monitoring – ventilation – noise exposure and hearing conservation – radiation safety in electronics – laser safety classification – safety interlocks – warning labels – RF radiation hazards – product safety testing and certification – Underwriters Laboratories (UL) – Canadian Standards Association (CSA) – Verband Deutscher Elektrotechniker (VDE) – product design for electrical safety – isolation requirements for biomedical equipment – grounding requirements – creepage and clearance distances – electrical/electronic product safety standards – safety in testing and measurement – safe instrument usage – multimeters and oscilloscopes – current measurement safety – voltage measurement safety – working with energized equipment – safe approach boundaries – limited approach boundary – restricted approach boundary – arc flash boundary – qualified vs unqualified personnel .

Module 5 (9 hours)

Safety management and safety culture – safety policy and organization – safety training programs – safety audits and inspections – accident investigation – root cause analysis – documentation and reporting – first aid and emergency response – bloodborne pathogens – CPR and AED basics – emergency action plans – evacuation procedures – safety in manufacturing environment – safe handling of electronic components – soldering safety – chemical safety in PCB assembly – solvent handling – lead exposure – fume extraction – environmental health and safety (EHS) – waste disposal – electronic waste (e-waste) – RoHS compliance – safety in research and development laboratories – safe work practices for engineering students – internship safety requirements – professional ethics and safety responsibility – case studies of industrial accidents in electronics and electrical industries – lessons learned – continuous improvement in safety performance

Textbook/References:

1 L. M. Deshmukh, *Industrial Safety Management*, 1st ed. New Delhi, India: Tata McGraw Hill Education, 2005.

2. R. K. Jain and S. S. Rao, *Industrial Safety, Health and Environment*, 1st ed. New Delhi, India: Khanna Publishers, 2018

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Industrial Safety Engineering	Prof. Jhareswar Maiti	IIT Kharagpur
2	Safety and Risk Analytics	Prof. Jhareswar Maiti	IIT Kharagpur

Course Outcomes:

CO1: Explain industrial safety principles, OSHA standards, fire safety, hazardous situations, and interpretation of Safety Data Sheets (SDS).

CO2: Apply electrical safety procedures including LOTO, NFPA 70E arc flash guidelines, grounding standards, and ESD control measures to prevent electrical shock hazards.

CO3: Analyze mechanical and fluid system safety practices, fall protection methods, fire extinguisher selection, hazard communication, and proper selection of personal protective equipment (PPE).

CO4: Evaluate industrial hygiene hazards, radiation safety (laser/RF), product safety standards (UL, CSA, VDE), electrical safety boundaries, and testing instrument safety protocols.

CO5: Integrate safety management principles including safety audits, accident investigation, root cause analysis, first aid/CPR, e-waste management, environmental health and safety (EHS), and professional ethics in safety responsibility.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Explain industrial safety principles, OSHA standards, fire safety, hazardous situations, and interpretation of Safety Data Sheets (SDS).	K_1
CO2	Apply electrical safety procedures including LOTO, NFPA 70E arc flash guidelines, grounding standards, and ESD control measures to prevent electrical shock hazards.	K_2
CO3	Analyze mechanical and fluid system safety practices, fall protection methods, fire extinguisher selection, hazard communication, and proper selection of personal protective equipment (PPE).	K_3
CO4	Evaluate industrial hygiene hazards, radiation safety (laser/RF), product safety standards (UL, CSA, VDE), electrical safety boundaries, and testing instrument safety protocols.	K3
CO5	Integrate safety management principles including safety audits, accident investigation, root cause analysis, first aid/CPR, e-waste management, environmental health and safety (EHS), and professional ethics in safety responsibility.	K3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PSOs	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3						1		1					1
CO2		1	2											
CO3				3									1	
CO4		2												
CO5							1				2	2		1
CO(Average)	3	1.5	2	3			1		1		2	2	1	1

3 –High; 2 –Medium; 1 –Low

Microwave and Antenna Lab

Subject Code: -	**BTEEE801P**	**IA Marks**	**30**
Number of Lab Hours/Week: -	**02**	**Term End Exam Marks**	**20**
Total Number of Lecture Hours: -	**15**	**CREDITS**	**01**

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	30
	Attendance/Discipline	5
	Assignment/ Seminar	5
Terminal Examination (TE)	Terminal Examination	20
Total		50
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

Laboratory Experiments

1. Radiation Pattern and Gain of a Pyramidal Horn Antenna
2. Study of E-plane Tee, H-plane Tee, and Magic Tee
3. Measurement of VSWR (High and Low) on a Transmission Line
4. Determination of Unknown Impedance Using Shift in Minima Technique
5. Frequency and Wavelength Measurement of a Microwave Source
6. Characteristics of a Gunn Diode Oscillator
7. Study of a Directional Coupler

Laboratory Outcome

Upon completion of these 7 experiments, students will be able to measure the radiation pattern and gain of a pyramidal horn antenna, analyze the S-parameter characteristics of E-plane Tee, H-plane Tee, and Magic Tee, determine VSWR for various load conditions, measure unknown impedance using the shift in minima technique, calculate frequency and guide wavelength of a microwave source, evaluate the V-I and power characteristics of a Gunn diode oscillator, and measure coupling factor, directivity, and isolation of a directional coupler.

Course Outcomes

CO1: Measure radiation pattern and gain of horn antennas, analyze waveguide Tee junctions (E-plane, H-plane, Magic Tee), and characterize directional coupler parameters including coupling factor, directivity, and isolation.

CO2: Determine VSWR (high and low) on transmission lines, measure unknown impedance using shift in minima technique, and calculate frequency, guide wavelength, and wavelength of microwave sources.

CO3: Evaluate the V-I characteristics and power output versus bias voltage relationship of a Gunn diode oscillator in a waveguide test bench.

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Course Outcome Table		
Course Outcome No	Statement	Knowledge Level (KL)
CO1	Measure radiation pattern and gain of horn antennas, analyze waveguide Tee junctions (E-plane, H-plane, Magic Tee), and characterize directional coupler parameters including coupling factor, directivity, and isolation.	K1
CO2	Determine VSWR (high and low) on transmission lines, measure unknown impedance using shift in minima technique, and calculate frequency, guide wavelength, and wavelength of microwave sources	K2
CO3	Evaluate the V-I characteristics and power output versus bias voltage relationship of a Gunn diode oscillator in a waveguide test bench.	K3

KL- Bloom's Knowledge Level (K_1, K_2, K_3, K_4, K_5, K_6)

K_1-Remember, K_2- Understand, K_3- Apply, K_4- Analyze, K_5- Evaluate, K_6- Create

Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	**CORRELATION WITH PROGRAM OUTCOMES**												**CORRELATION WITH PSOs**	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3					1				1	1
CO(Average)	3	1	2	3			1		1				1	1

Online Resources

The official **Virtual Labs** project by the Ministry of Education (IIT Delh) hosts many of these simulations. You can find them by following these steps:

[1] Go to the official website: **https://vlab.co.in**
[2] Click on the **"Electronics & Communications"** discipline group.
[3] Look for labs titled **" Microwave Engineering Lab (IIT Roorkeei)"** Select any experiment to run the simulation directly in your browser
[4]

PROJECT-2

Subject Code: - BTEEE802P	**IA Marks 80**
Number of Lecture Hours/Week:-	**Term End Exam Marks 120**
Total Number of Lecture Hours: -	**CREDITS 08**

Course Objective:

Following are the intended objectives of the Project work:

The object of Project Work & Dissertation is to enable the student to extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In-depth study of the topic assigned in the light of the Report;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modeling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar Presentation before a Departmental Committee.

Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	80
Terminal Examination (TE)	Terminal Examination	120
Total		200
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	

GUIDELINES FOR PROJECT WORK

The Project work should be based on real/ live problems of the Industry/Govt./NGO/ MSME/Rural Sector or an innovative idea having the potential of a Startup