



NETAJI SUBHAS UNIVERSITY

JAMSHEDPUR, JHARKHAND

Established under the Jharkhand State Private University Act, 2018

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

COURSE STRUCTURE & DETAILED SYLLABUS

OF

MECHANICAL ENGINEERING



FOR

B.TECH. FOUR YEAR DEGREE COURSE

(Applicable for the batches admitted from 2025-2026)

DEPARTMENT OF MECHANICAL ENGINEERING

NETAJI SUBHAS UNIVERSITY, JAMSHEDPUR

Pokhari, Near Bhilai Pahadi, Jamshedpur, Jharkhand

PREAMBLE

Mechanical engineering involves scientific analysis, problem-solving and knowledge integration using appropriate tools to model, design, produce and maintains products or systems containing mechanical 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	Plan, design, construct, maintain and improve mechanical engineering systems that are technically sound, economically feasible and socially acceptable.
PEO-2	Apply analytical, computational and experimental techniques to address the challenges faced in mechanical and allied engineering streams.
PEO-3	Communicate effectively using conventional platforms as well as innovative / online tools and demonstrate collaboration, networking & entrepreneurial skills.
PEO-4	Exhibit professionalism, ethical attitude, team spirit and pursue lifelong learning to achieve career, organizational and societal goals.

PROGRAM OUTCOMES (POs)

PO-1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering and technology to the solution of complex mechanical 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 mechanical 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 mechanical 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 mechanical and interdisciplinary knowledge to analyze, design and manufacture products to address the needs of the society.
PSO-2	Apply state of the art tools and techniques to conceptualize, design and introduce new products, processes, systems and services.

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B. TECH IN MECHANICAL 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 Mechanical Engineering (Engineering & Technology) is kept as 160.

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

Sl.	Category	Suggested Breakup of Credits (Total 168)
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	61*
5	Professional Elective courses relevant to chosen specialization/branch	9*
6	Open subjects – Electives from other technical and /or emerging subjects	9*
7	Employment Enhancement Courses (Project work, seminar and internship in industry or elsewhere.)	21*
8	Mandatory Courses [Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition]	(non-credit)
Total		168*

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

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
EEC	Employment Enhancement Courses (Project/Summer Internship/Seminar)

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- ME 201	Heat Transfer & Thermal Machines	4	3:1:0=4
2	PCC- ME 202	Fluid Mechanics & Hydraulic Machines	4	3:1:0=4
3	PCC- ME 203	Mechanics of Deformable Solids	4	3:1:0=4
4	PCC- ME 204	Kinematics & Dynamics of Machines	4	3:1:0=4
5	PCC- ME 205	Engineering Materials & Applications	4	3:1:0=4
6	PCC- ME 206	Mechanical Engineering Lab-1 (Thermal & Fluid)	4	0:1:2=2
7	PCC- ME 301	Machine Element & System Design	5	3:1:0=4
8	PCC- ME 302	Mechatronics, Robotics & Control	5	3:0:2=4
9	PCC- ME 303	Manufacturing Processes	5	3:1:0=4
10	PCC- ME 304	Measurements & Metrology	5	3:0:2=4
11	PCC- ME 305	Mechanical Engineering Lab-2 (Design)	5	0:1:2=2
12	PCC- ME 306	Computer Aided Design & Analysis	6	3:0:2=4
13	PCC- ME 307	Manufacturing Automation	6	3:0:2=4
14	PCC- ME 308	Production & Operation Management	6	3:1:0=4
15	PCC- ME 309	Product Innovation & Entrepreneurship	6	3:1:0=4
16	PCC- ME 310	Mechanical Engineering Lab-3 (Manufacturing)	6	0:1:2=2
			Total Credits:	58

PROFESSIONAL ELECTIVE [PEC]**(Total 3 to be taken, at least one from each group)**

Sl.	Code No.	Subject	Semester	Credits
<i>TECHNOLOGY GROUP</i>				
1	PEC -MEL 401	Refrigeration & Air Conditioning	7 / 8	3:0:0=3
2	PEC -MEL 402	Power Plant Engineering	7 / 8	3:0:0=3
3	PEC -MEL 403	Renewable Energy Engineering	7 / 8	3:0:0=3
4	PEC -MEL 404	Finite Element Analysis	7 / 8	3:0:0=3
5	PEC -MEL 405	Computational Fluid Dynamics	7 / 8	3:0:0=3
6	PEC -MEL 406	Design for Manufacturing & Assembly	7 / 8	3:0:0=3
7	PEC -MEL 407	Additive Manufacturing	7 / 8	3:0:0=3
8	PEC -MEL 408	Die, Mould and Tool Engineering	7 / 8	3:0:0=3
<i>INDUSTRY SECTOR GROUP</i>				
1	PEC -MEL 411	Automobile Engineering	7 / 8	3:0:0=3
2	PEC -MEL 412	Aerospace Engineering	7 / 8	3:0:0=3
3	PEC -MEL 413	Agricultural Engineering	7 / 8	3:0:0=3
4	PEC -MEL 414	Biomedical Engineering	7 / 8	3:0:0=3
5	PEC -MEL 415	Food Technology	7 / 8	3:0:0=3
6	PEC -MEL 416	Marine Engineering	7 / 8	3:0:0=3
7	PEC -MEL 417	Nuclear Engineering	7 / 8	3:0:0=3
8	PEC -MEL 418	Textile Engineering	7 / 8	3:0:0=3
Total Credits:				9

ENGINEERING PROJECT (3 Stages)

Sl.	Code No.	Subject	Semester	Credits
1	PROJ- ME 311	Engineering Project-1 (Literature Review)	6	0:0:4=2
2	PROJ- ME 401	Engineering Project-2 (Design & Analysis)	7	0:0:10=5
3	SEM- ME 402	Seminar	7	0:0:2=1
4	PROJ- ME 403	Engineering Project-3 (Prototype & Testing)	8	0:0:16=8
Total Credits:				16

TOTAL = 168 credits | BSC = 18%, ESC = 15%, PCC = 36%, PEL+HSM+OEL = 9%,
PROJ = 12% || LABS = 10%

NEW AND ELECTRONICS/IT-ORIENTED CORE COURSES

Sl.	Code No.	Subject	Semester	Credits
1	ESC 103	Design Thinking & Idea Lab (New)	1	0:0:2=1
2	ESC 103	Programming for Problem Solving	2	3:0:4=5
3	ESC 201	Basic Electronics Engineering	3	3:1:2=5
4	PCC ME 302	Mechatronics, Robotics and Control (New)	5	3:1:0=4
5	PCC ME 306	Computer-Aided Design and Analysis (New)	6	3:1:0=4
6	PCC ME 307	Manufacturing Automation (Updated)	6	3:1:0=4
7	PCC ME 309	Product Innovation and Entrepreneurship (New)	7	3:1:0=4
Total Credits:				27

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%20Induction%20program.pdf>).

Induction program (mandatory)	Three-week duration
Induction program for students to be offered right at the start of the first year.	<ul style="list-style-type: none"> • 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

Sl.	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

Sl.	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

Sl.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTBSC301	BSC	Physics-2 (Optics & Waves)	3	1	0	4	40	60	100
2	BTBSC302	BSC	Mathematics-3 (PDE, Prob/Stat)	3	1	0	4	40	60	100
3	BTBSC303	BSC	Environment Science (Audit)	2	0	0	0	40	60	100
4	BTESC304	ESC	Basic Electronics Engineering	3	1	0	4	40	60	100
5	BTESC305	ESC	Engineering Mechanics	3	1	0	4	40	60	100
6	BTESC306	ESC	Applied Thermodynamics	3	1	0	4	40	60	100
Practical										
7	BTBSC 301P	BSC	Physics-2 (Optics & Waves) Lab	-	-	2	1	30	20	50
8	BTESC 303P	ESC	Basic Electronics Engineering Lab	-	-	2	1	30	20	50
Total				17	5	4	22	250	450	700

SEMESTER-IV

Sl.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTM E401	PCC	Heat Transfer & Thermal Machines	3	1	0	4	40	60	100
2	BTM E402	PCC	Fluid Mechanics & Hydraulic Machines	3	1	0	4	40	60	100
3	BTM E403	PCC	Mechanics of Deformable Solids	3	1	0	4	40	60	100
4	BTM E404	PCC	Kinematics & Dynamics of Machines	3	1	0	4	40	60	100
5	BTM E405	PCC	Engineering Materials & Applications	3	1	0	4	40	60	100
6	BTM E406	PCC	Strength of Material	3	0	0	3	40	60	100
Practical										
7	BTME 407P	PCC	Mechanical Engg. Lab-1 (Thermal & Fluid)	-	0	2	1	30	20	50
8	BTME 406P	PCC	Strength of Material Lab	0	0	2	1	30	20	50
Total				15	5	4	25	300	400	700

SEMESTER-V

Sl.	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTME501	PCC	Machine elements & system design	3	1	0	4	40	60	100
2	BTME502	PCC	Mechatronics Robotics & Controls	3	0	0	3	40	60	100
3	BTME503	PCC	Manufacturing Processes	3	1	0	4	40	60	100
4	BTME504	PCC	Measurements & Metrology	3	0	0	3	40	60	100
5	BTHSMC 505	HSMC	HSS/ Management Elective - I	3	0	0	3	40	60	100
6	BTEEC506	EEC	Employment Enhancement Course – I	0	0	2	1	40	60	100
Practical										
7	BTME502 P	PCC	Mechatronics Robotics & Controls Lab	0	0	2	1	30	20	50
8	BTME504 P	PCC	Measurements & Metrology lab	0	0	2	1	30	20	50
9	BTME505 P	PCC	Mechanical Engg. Lab-2 (Design)	0	1	2	2	30	20	50

10	BTEEC50 7P	EEC	Internship / Summer Industrial Training/ Semminar (4-6 Week)	0	0	4	2	30	20	50
TOTAL				15	3	6	24	360	440	800

SEMESTER-VI

Sl.	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	T M
1	BTME 601	PCC	Computer Aided Design & Analysis	3	0	0	3	40	60	100
2	BTME 602	PCC	Manufacturing Automation	3	0	0	3	40	60	100
3	BTME 603	PCC	Production & Operation Management	3	1	0	4	40	60	100
4	BTME 604	PCC	Product innovation & Entrepreneurship	3	1	0	4	40	60	100
5	BTME 605	HSMC	HSS/ Management Elective - II	3	0	0	3	40	60	100
6	BTEE C606	EEC	Employment Enhancement Course – II	0	0	2	1	40	60	100
Practical										
7	BTME 601P	PCC	Computer Aided Design & Analysis	0	0	2	1	30	20	50
8	BTME 602P	PCC	Manufacturing Automation	0	0	2	1	30	20	50
9	BTME 605P	PCC	Mechanical Engg Lab – 3 (Manufacturing)	0	1	2	2	30	20	50
10	BTME 607P	EEC	Engg Project – I (Literature Review)	0	0	4	2	30	20	50
TOTAL				15	3	12	24	360	440	800

SEMESTER-VII

Sl.	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTME 701	PEL	Professional Elective – 1	3	0	0	3	40	60	100
2	BTME 702	PEC	Professional Elective – 2	3	0	0	3	40	60	100
3	BTME 703	OEC	Open Elective – 1	3	0	0	3	40	60	100
4	BTME 704	OEC	Open Elective - 2	3	0	0	3	40	60	100
Practical										
7	BTME 705P	EEC	Engg. Project – 2 (Design & Analysis)	0	0	10	5	40	60	100
10	BTEE C706P	EEC	Internship /Summer Industrial Training/ Seminar (4-6 Week)	0	0	4	2	30	20	50
TOTAL				12	0	14	19	230	320	550

SEMESTER -VIII

Sl.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTME 801	PEC	Professional Elective-3	3	0	0	3	40	60	100
2	BTME 802	OEC	Open Elective-3	3	0	0	3	40	60	100
Practical										
3	BTME 803P	EEC	Engineering Project-3 (Prototype & Testing)	-	-	16	8	80	120	200
Total				6	0	16	14	160	240	400

PROFESSIONAL ELECTIVE COURSES

CATEGORY	TECHNOLOGY GROUP	INDUSTRY SECTOR GROUP	CEDITS
PEC	Refrigeration & Air Conditioning	Automobile Engineering	3
PEC	Power Plant Engineering	Aerospace Engineering	3
PEC	Renewable Energy Engineering	Agricultural Engineering	3
PEC	Finite Element Analysis	Biomedical Engineering	3
PEC	Computational Fluid Dynamics	Food Technology	3
PEC	Design for Manufacturing & Assembly	Marine Engineering	3
PEC	Additive Manufacturing	Nuclear Engineering	3
PEC	Die, Mould and Tool Engineering	Textile Engineering	3

OPEN ELECTIVE COURSES

Sl.	Category	Name of the Subject	Semester	Credits
1	OEC	Optimization Techniques	7/8	3
2	OEC	Theory Of Elasticity	7/8	3
3	OEC	Industrial Management	7/8	3
4	OEC	Non-Traditional Machine	7/8	3
6	OEC	Computational Fluid Dynamics	7/8	3
7	OEC	Industrial Safety	7/8	3
8	OEC	Metal Forming	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.

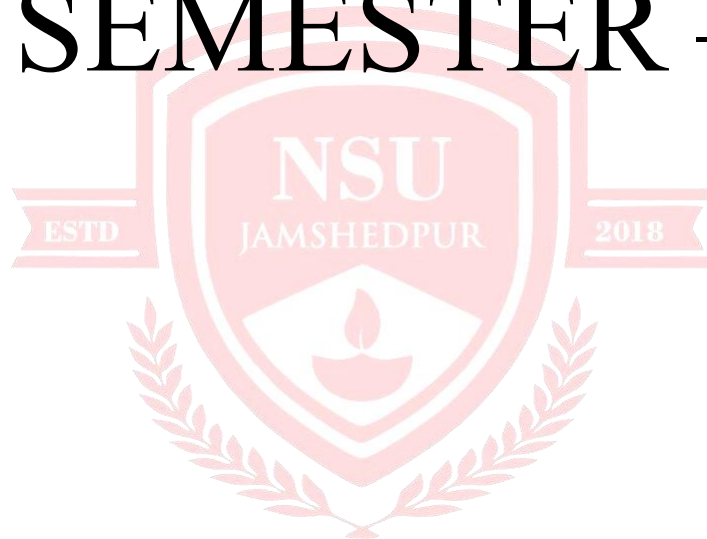
Sl.	Category	Subject	Semester	Credits
1	HSMC	Communication Skills / English (Compulsory)	2	3
2	HSMC	Universal Human Values-2 (Compulsory course)	2	3
3	HSMC	Industrial Psychology	5/6	3
4	HSMC	Operations Research	5/6	3
5	HSMC	Project Management	5/6	3
6	HSMC	Finance & Accounting	5/6	3

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/ Seminar (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 (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	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 braking 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 (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	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 behaviour 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 (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)

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										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: Projection of Points and Lines (10 hours)

Introduction and Principles of the Projection of Points, Introduction to the quadrant systems, and 2D and 3D plane systems. Introduction to the first angle, second angle, third angle, and fourth angle projections. Point projection located in various quadrants. Projections of lines (First angle projection only), line parallel to both the planes, line parallel to one plane, and inclined to another plane. Projections of straight lines inclined to both planes;

Module III: Projections of Planes (10 hours)

Introduction, Definitions — Projections of right regular polygons (First angle Projection only), Regular planes perpendicular and parallel to one reference plane and inclined to the other reference plane; inclined to both the reference planes (HP & VP);

Module IV: Orthographic Projections (10 hours)

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

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 Kanniah (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 (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)

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											
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.

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 (10 Hours)

Basics of Ancient Indian Knowledge and Diverse Fields from Health (Yoga), Agriculture, Performing Arts etc.

Yoga - Patanjali and Panini, Yoga Sutras & Mahabhashya, Yoga from Ancient Rishis, Munies, Sages and Seers, Different types of Yogas, Asanas & Pranayamas, Vagbhata Samhita for Health Benefits.

Agriculture - Ancient Agricultural Trends, Practices & means of Transportation in Agriculture. Performing Arts – Different types of Ancient Arts, i.e; Murtikala, Embossing in Jewellery, Different School of Arts in Ancient India : Mathura, Gandhara and Amravati School, Pottery & Utensil making from Mud.

Module -2 (10 Hours)

Ancient Indian Knowledge in Various Science Streams like Physics, Chemistry, Biology, Forestry, Mathematics etc.

Gravitational Laws, Concept of Pendulum, Ancient knowledge of Space & Astronomy related to Outer Space and different Celestial Bodies, i.e; Planetary System, Stars and their Movement.

Chemistry – Ancient Knowledge of Rasayanas, Preservative Methods using Oil and Salt etc.

Biology & Forestry – Rich Cultural Heritage of Ayurveda, Different types of Medicinal uses of Plants, Fauna, Flora. Study of Animal and Plant Fossils, Interaction/ Inter-relation of Mankind and Nature on Mutually Beneficial Basis. Traditional methods for conservation of Forests, Trees and Preventing Soil Erosion.

Mathematics – Present Day Decimal System traces its History to Ancient India, Giving the concept of Zero as a number to the World, Negative Numbers, basic Arithmetic and Algebraic concept, Knowledge of Advance Trigonometry in Ancient India.

Module -3 (8 Hours)

Ancient Indian Knowledge in Civil Engineering, Metallurgy, Mechanical Sciences, Textile Technology etc

Civil Engineering Concept and Familiarity with Sthapaty Kala, the Art of Construction in Ancient India, Civil Engineering Knowledge in Architecture in Making a Well Planned City by the Harappan Civilization Remains Undisputed. World Heritage Sites of Ajanta, Ellora, Khajuraho, Sanchi, Mahabalipuram are the Testaments of Excellent Civil Engineering Craftsmanship and Architecture, Well Developed Architecture During Cholas, Pal Dynasty is Evident in Various Ancient Temples in Present India. Concept of Canals and Wells for Irrigation & Human Needs in Ancient India is Well Documented

Metallurgy – Concept Well Mentioned in Vedic Age Texts Using the Term Ayas for Metals, Minting/ Metal Casting Of Gold, Silver, Bronze, Copper for Utensils and Jewellery During Ancient India.

Module -4 (7 Hours)

Mechanical Sciences – Agriculture and Military Equipments like Hammer, Tongs, Idea of Basic Mechanical Concept for Transportation Using Bullock-Carts, Handpulled Carts Using Wheels, Chariots, Boats Using Patwar (Rudder) During Vedic Age ss Well Known, Use of Ploughing Tools Made of Metals and Wood etc.

Textile Technology – Archaeological Evidence of Cotton Textile at Mohenjo Daro in the Indus Valley, Use of Charkhas and Traditional Yarns like Khadi, Silk Fabric from Silk Worm and export of quality Silk to West and European Countries is well established.

Module -5 (10 Hours)

Ancient Indian Knowledge in Electrical, Electronics, Computational Studies, Instrumentation etc.

Ancient India Knowledge in Generation of Electricity from Water, Silk and Clouds, Agastya Samhita Speaks about Electroplating, Basic knowledge of Computations and Instrumentation during Vedic Period, Musical Instruments like Seven-Holed Flute and other Stringed Instruments like Ravanahatha, Cymbals, Dhol (Drum) found by Archaeologists from Indus Valley Civilization Sites.

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.

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 (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	PO1 0	PO1 1	PO1 2	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
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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	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: -	ESTD	BTESC103P	IA Marks	2018	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 (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													
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 times 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 (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	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
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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 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.	Introduction to basic hand tools - Tape measure, combination square, Vernier caliper, hammers, fasteners, wrenches, pliers, saws, 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	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.

	using pick and place machines.	
3.	<p>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.</p> <p>Interrupts programming. Power Supply design (Linear and Switching types), Wireless power supply, USB PD, Solar panels, Battery types and charging</p>	<p>3D printing and prototyping technology – 3D printing using FDM, SLS and SLA. Basics of 3D scanning, point cloud data generation for reverse engineering.</p> <p>Prototyping using subtractive cutting processes. 2D and 3D Structures for prototype building using Laser cutter and CNC routers.</p> <p>Basics of IPR and patents; Accessing and utilizing patent information in IDEA Lab</p>
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 (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	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, Dhyanchand 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, Pawanuktasana, Ardha Chakrasana, Bhujangasana, Shavasana.
- Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardha Matsyendrasana.
- Back Pain: Tadasana, Ardha Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana.
- Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pawanuktasana, Ardha Matsyendrasana.
- Asthma: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, Gomuktasana, 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 (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													
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 Examination	30

Internal Assessment (IA)	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., McGraw 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
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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					
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 be 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://iev-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
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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	PO1 0	PO1 1	PO1 2	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:

- To provide learning environment to practice listening, speaking, reading and writing skills.
- To assist the students to carry on the tasks and activities through guided instructions and materials.
- To effectively integrate English language learning with employability skills and training.
- 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.
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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 Heasley. 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 (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	CORRELATIO N WITH PSOs

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	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 root 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 root finding of function, differentiation of function and simple integration.	K ₃

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					
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 complementarity 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 (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	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 demonstrate 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 (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 0	PO 1	PO 2	PSO1	PSO2
CO1	1										1		1	
CO2		2			1									
CO3			2				1				1			1

CO(Average)	1	2	2		1		1				1		1	1
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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 (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	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 (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 0	PO 1	PO 2	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 (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
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	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



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: monochromaticity, 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 (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					
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
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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'Alembert'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 (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 0	PO 1	PO 2	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-spots 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-coerd.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 (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	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, demultiplexers, 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 (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
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	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	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 MECHANICS

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

Course Objectives: Aim to equip students with the ability to analyze and solve problems involving forces, motion, and equilibrium of rigid bodies. This includes understanding concepts like force systems, free body diagrams, friction, and kinematics. Students should also be able to compute centroids, moments of inertia, and apply work-energy principles.

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: Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

Module II: Potential energy function; $F = - \text{Grad } V$, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

Module III: Non-inertial frames of reference; Rotating coordinate system: Five-term acceleration formula. Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

Module IV: Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Forced oscillations and resonance.

Module V: Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler’s laws of motion, their independence from Newton’s laws, and their necessity in describing rigid body motion; Examples.

Module VI : Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

TEXTBOOKS/REFERENCES:

1. AICTE’s Prescribed Textbook: Physics (Introduction to Mechanics) with Lab Manual ISBN: 978-93-91505-059
2. Engineering Physics, Bhattacharya & Nag
3. Engineering Mechanics, DS Bedi & MP Poonia
4. Engineering Mechanics, 2nd edition — MK Harbola
5. Introduction to Mechanics — MK Verma
6. An Introduction to Mechanics — D Kleppner & R Kolenkow
7. Principles of Mechanics — JL Synge & BA Griffiths
8. Mechanics — JP Den Hartog
9. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
10. Mechanical Vibrations — JP Den Hartog
11. Theory of Vibrations with Applications — WT Thomson

COURSE OUTCOME:

The students will learn:

- CO 1.** Students should be able to resolve and compose forces, understand different types of forces, and draw free body diagrams.
- CO 2.** Students should be able to use their knowledge to analyze real-world mechanical systems and solve design problems.
- CO 3.** Students should be able to break down complex problems, identify key parameters, and develop appropriate solutions.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students should be able to resolve and compose forces, understand different types of forces, and draw free body diagrams.	K ₁
CO2	Students should be able to use their knowledge to analyze real-world mechanical systems and solve design problems.	K ₂
CO3	Students should be able to break down complex problems, identify key parameters, and develop appropriate solutions	K ₃

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					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

APPLIED THERMODYNAMICS

Subject Code: -	BTESC306	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	04

Course Objectives: Aim to equip students with the knowledge and skills to understand and apply thermodynamic principles in practical engineering contexts. This includes analyzing energy conversion processes, power generation, and various thermodynamic cycles. Students learn to apply the first and second laws of thermodynamics to various systems and processes, including power plants, refrigeration systems, and internal combustion engines.

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:

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super- critical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

Properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Analysis of steam turbines, velocity and pressure compounding of steam turbines

TEXTBOOKS/REFERENCES:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

COURSE OUTCOME:

The students will learn:

- CO 1.** Students will learn to model and analyze energy conversion processes, including identifying and formulating power production based on thermal engineering fundamentals.
- CO 2.** Students will be able to analyze and compare different thermodynamic cycles, such as Otto, Diesel, Rankine, and Brayton cycles.
- CO 3.** Students will understand the principles of steam power cycles and gas turbine cycles.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will learn to model and analyze energy conversion processes, including identifying and formulating power production based on thermal engineering fundamentals	K ₁
CO2	Students will be able to analyze and compare different thermodynamic cycles, such as Otto, Diesel, Rankine, and Brayton cycles.	K ₂
CO3	Students will understand the principles of steam power cycles and gas turbine cycles.	K ₃

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

K₁-Remember, K₂- Understand, K₃- Apply, K₄- Analyze, K₅- Evaluate, K₆- Create

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



PHYSICS-2 (OPTICS & WAVES) LAB

Subject Code: -	BTBSC301P	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 (List of Experiments)

1. Reflection and Refraction: Investigating the laws of reflection and refraction using mirrors and lenses
2. Optical Instruments: Studying the properties and applications of lenses, prisms, and other optical devices
3. Interference: Observing interference patterns (e.g., Newton's rings, Fresnel's mirrors, Young's double-slit experiment) to understand wave superposition.
4. Diffraction: Examining diffraction patterns produced by single slits, double slits, and diffraction gratings, demonstrating the wave nature of light.
5. Polarization: Exploring polarization of light and its properties.
6. Spectrometer: Using a spectrometer to analyze the spectrum of light sources

Laboratory Outcomes:

Developing practical skills in using optical instruments and experimental techniques. Students gain hands-on experience, apply theoretical concepts to real-world situations, and learn to analyze data accurately. Specific outcomes include mastering techniques like using spectrometers, polarimeters, and measuring the refractive index of liquids.

- CO 1.** Students will learn to operate and utilize various optical instruments like spectrometers, polarimeters, and other lab equipment.
- CO 2.** Students will become proficient in using instruments like tuning forks, electric vibrations, and optical devices like prisms, gratings, and spectrometers.
- CO 3.** Students will gain practical knowledge of interference patterns (like those from thin films, Newton's rings, and Michelson interferometers) and diffraction patterns from single slits and diffraction gratings.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will learn to operate and utilize various optical instruments like spectrometers, polarimeters, and other lab equipment.	K ₁
CO2	Students will become proficient in using instruments like tuning forks, electric vibrations, and optical devices like prisms, gratings, and spectrometers.	K ₂
CO3	Students will gain practical knowledge of interference patterns (like those from thin films, Newton's rings, and Michelson interferometers) and diffraction patterns from single slits and diffraction gratings.	K ₃

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	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

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	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

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 (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	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



HEAT TRANSFER & THERMAL MACHINES

Subject Code: -	BTME401	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours:-	60	CREDITS	04

Course Objectives:

Build a solid foundation in heat transfer, exposing students to the three basic modes namely conduction, convection and radiation. Rigorous treatment of governing equations and solution procedures for the three modes, along with solution of practical problems using empirical correlations. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

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: Introduction Three modes of heat transfer; Examples of equipment (like air conditioner and air cooler) involving heat transfer; Derivation of heat balance equation.

Module II: Conduction Heat Transfer Steady 1D solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry; Concept of conduction and film resistances; Critical insulation thickness; Lumped system approximation and Biot number; Heat transfer through pin fins; 2D conduction solutions for steady and unsteady heat transfer.

Module III: Convection Heat Transfer Basic equations; Boundary layers; Forced convection; External and internal flows; Natural convective heat transfer; Dimensionless parameters for forced and free convection heat transfer; Correlations for forced and free convection; Approximate solutions to laminar boundary layer equations for internal and external flow; Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Module IV: Radiation Heat Transfer Interaction of radiation with materials; Definitions of radiative properties; Stefan Boltzmann's law; Black and grey body radiation; Calculation of radiation heat transfer between surfaces using radiative properties; View factors and the radiosity method; Examples for two-body enclosures; Radiation shield.

Module V: Heat Exchanger Design Function, classification and configuration of heat exchangers; Evaluation of mean temperature difference; Heat exchanger effectiveness; Analysis, design and selection of heat exchangers.

Module VI: Boiling and Condensation heat transfer Pool boiling; Flow boiling; Film and drop wise condensation.

Module VII: Introduction to mass transfer Analogy between heat and mass transfer; Mass diffusion; Fick's Law; Steady and transient mass diffusion; Simultaneous heat and mass transfer.

Text /Reference Books:

1. A. Bejan, "Heat Transfer," John Wiley, 1993.
2. J.P. Holman and S. Bhattacharyya, "Heat Transfer," McGraw Hill, 2017.
3. F.P. Incropera, and D.P. Dewitt, "Fundamentals of Heat and Mass Transfer," John Wiley, 2019.
4. Massoud Kaviany, "Principles of Heat Transfer," John Wiley, 2002.
5. Yunus A Cengel, "Heat Transfer: A Practical Approach," McGraw Hill, 2002.

Course outcomes:

Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
Design heat exchangers and estimate the insulation needed to reduce heat losses where necessary.

At the end of the course, the students will learn

- CO 1.** Students should be able to differentiate between conduction, convection, and radiation and understand the mechanisms behind each.
- CO 2.** Students should be able to apply fundamental equations for steady-state and transient heat conduction, including those with and without heat generation
- CO 3.** Students should be able to analyze both natural and forced convection heat transfer and calculate heat transfer rates.
- CO 4.** Students should be able to analyze the performance characteristics of various turbo machines

CO 5. Students should be able to predict the performance of turbo machines using model analysis.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students should be able to differentiate between conduction, convection, and radiation and understand the mechanisms behind each.	K ₁
CO2	Students should be able to apply fundamental equations for steady-state and transient heat conduction, including those with and without heat generation	K ₂
CO3	Students should be able to analyze both natural and forced convection heat transfer and calculate heat transfer rates.	K ₃
CO4	Students should be able to analyze the performance characteristics of various turbo machines	K ₂
CO5	Students should be able to predict the performance of turbo machines using model analysis.	K ₂

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	PO1 0	PO1 1	PO1 2	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

FLUID MECHANICS & HYDRAULIC MACHINES

Subject Code: -	BTME402	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 learn about the application of mass and momentum conservation laws for fluid flows. To understand the importance of dimensional analysis. To obtain the velocity and pressure variations in various types of simple flows. To analyse the flow in water pumps and turbines.

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:

Properties of Fluid: Definition of fluid; Newton's law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Continuity equation and momentum equation; Incompressible flow; Bernoulli's equation and its applications. (5)

Dimensional Analysis: Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis. (7)

Fluid Kinematics: Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function. (6)

Momentum Equation: Momentum equation; Navier Stoke equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube. (4)

Laminar and Turbulent Flow: Viscous/Laminar flow – Plane Poiseuille flow and Couette flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe. (5)

Rotodynamic Machines: Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle. (7)

Hydraulic Turbines: Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles. (6)

Text /Reference Books:

1. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2019.
2. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2012.
3. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011. 95
4. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.
5. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005.
6. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988

Course outcomes:

The course outcomes for Fluid Mechanics and Hydraulic Machines generally include understanding fluid properties, applying principles of fluid statics and dynamics,

analyzing flow characteristics, and understanding the operation and performance of hydraulic turbines and pumps. Students should be able to calculate forces on submerged surfaces, analyze pipe flows, and select appropriate turbines and pumps for specific applications

At the end of the course, the students will learn

- CO 1.** Students will be able to identify and explain the importance of various fluid properties (density, viscosity, etc.) at rest and in motion
- CO 2.** They will be able to calculate hydrostatic forces on submerged surfaces and understand pressure variations in static fluids.
- CO 3.** Students will apply principles of mass, momentum, and energy conservation to analyze fluid flow, including concepts like Bernoulli's equation and boundary layer theory.
- CO 4.** Students will understand the working principles of different types of pumps (centrifugal, reciprocating) and be able to analyze their performance characteristics
- CO 5.** Students will be able to select appropriate hydraulic turbines and pumps for specific applications based on given requirements.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to identify and explain the importance of various fluid properties (density, viscosity, etc.) at rest and in motion	K ₁
CO2	They will be able to calculate hydrostatic forces on submerged surfaces and understand pressure variations in static fluids.	K ₂
CO3	Students will apply principles of mass, momentum, and energy conservation to analyze fluid flow, including concepts like Bernoulli's equation and boundary layer theory.	K ₃
CO4	Students will understand the working principles of different types of pumps (centrifugal, reciprocating) and be able to analyze their performance characteristics	K ₂
CO5	Students will be able to select appropriate hydraulic turbines and pumps for specific applications based on given requirements.	K ₂

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	PO1 0	PO1 1	PO1 2	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

MECHANICS OF DEFORMABLE SOLIDS

Subject Code: -	BTME403	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 understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Course Contents:

Module I: Concept of Stress and Strain Deformation of bars: Hooke's law, stress, strain, and elongation; Tensile, compressive and shear stresses in 2D solids; Elastic constants and their relations; Volumetric, linear and shear strains; Principal stresses and strain; Principal planes; Mohr's circle. (8)

Module II: Mechanics of Beams Transverse loading on beams, point and distributed loads; Shear force and bend moment diagrams; Types of beam supports – simply supported, over-hanging, cantilevers, fixed and guided beams; Static determinacy and indeterminacy; Theory of bending of beams, pure bending stress distribution and neutral plane, second moment of area; Different cross-sections of beams; Shear stress distribution. (8)

Module III: Deflection of Beams Deflection of a beam using the double integration method; Computation of slopes and deflection in beams; Myosotis method for computing deflections and slopes. (8)

Module IV: Column Buckling Critical loads using Euler's theory; Different boundary conditions; Eccentric columns. (2)

Module V: Torsion and Twist Torsion stresses and deformation of circular and hollow shafts; Polar moment of area, stepped shafts; Deflection of shafts fixed at both ends; Stresses and deflection of helical springs. (5)

Module VI: Energy Theorem Principle of virtual work; Minimum potential energy theorem; Castigliano's theorems; Maxwell reciprocity theorem. (3)

Module VII: Pressure Vessels Axial and hoop stresses in cylinders subjected to internal pressure; Deformation of thin and thick cylinders; Deformation in spherical shells subjected to internal pressure; Combined thermomechanical stress; Examples and case studies (boilers). (6)

Text /Reference Books:

1. E. P. Popov, "Engineering Mechanics of Solids," Pearson, 2015.
2. Timoshenko and Gere, "Mechanics of Materials", CBS Publishers, 2011.
3. R. Subramanian, "Strength of Materials," Oxford University Press, 2007.
4. D.S. Bedi, "Strength of Materials", Khanna Book Publishing. 2022.
5. D.S. Bedi, "Engineering Mechanics", Khanna Book Publishing. 2021.
6. F. P. Beer, R. Johnson Jr and J. J. Dewole, "Mechanics of Materials," Tata Mc Graw Hill, Delhi 2005.
7. L.S Srinath, Advanced Mechanics of Solids, McGraw Hill, 2017.

Course outcomes:

The Mechanics of Deformable Solids course aims to equip students with the ability to analyze the behavior of solid objects under various loads, understand stress and strain, and apply these concepts to engineering design problems. Key outcomes include applying equilibrium principles, calculating stress and strain in different scenarios (axial, bending, shear, torsion, thermal), determining centroid and moment of inertia, and understanding material behavior under load.

At the end of the course, the students will learn

- CO 1.** Students will be able to analyze structures and components to determine internal forces and moments using free body diagrams and equilibrium equations.
- CO 2.** Students will be able to define and calculate normal stress, shear stress, normal strain, and shear strain in various loading scenarios.
- CO 3.** Students will learn about the mechanical properties of materials, such as elasticity, yield strength, and ultimate tensile strength, and how these properties influence a material's response to stress.

CO 4. Students will understand the difference between stress (internal force per unit area) and strain (deformation per unit length) and their relationship.

CO 5. Students will be able to relate material properties to stress and strain calculations to ensure structural integrity and prevent failure.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to analyze structures and components to determine internal forces and moments using free body diagrams and equilibrium equations.	K ₁
CO2	Students will be able to define and calculate normal stress, shear stress, normal strain, and shear strain in various loading scenarios.	K ₂
CO3	Students will learn about the mechanical properties of materials, such as elasticity, yield strength, and ultimate tensile strength, and how these properties influence a material's response to stress.	K ₃
CO4	Students will understand the difference between stress (internal force per unit area) and strain (deformation per unit length) and their relationship.	K ₂
CO5	Students will be able to relate material properties to stress and strain calculations to ensure structural integrity and prevent failure.	K ₂

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	PO1 0	PO1 1	PO1 2	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

KINEMATICS & DYNAMICS OF MACHINES

Subject Code: -	BTME404	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 understand the kinematics and rigid- body dynamics of kinematically driven machine components. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link. To be able to design linkage mechanisms and cam systems to generate specified output motion. To understand the kinematics of gear train.

Course Contents:

Module I: Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc.

Module II: Basic Kinematic Concepts and Definitions Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage; Transmission angle; Limit positions.

Module III: Geometric Design of Mechanisms Graphical synthesis of dyads and crank-rocker for two- and three-position synthesis for path and motion generation.

Module IV: Kinematic Analysis of Simple Mechanisms Displacement, velocity, and acceleration analysis; Velocity analysis using instantaneous centers; Position, velocity and acceleration analysis using loop closure equations; Coincident points; Coriolis component of acceleration. Static & Dynamic Force analysis of Simple Mechanisms Two & three force members; Force & moment equilibrium; Inertial forces; Equations of motion for force-bar and slider-crank mechanisms.

Module V: Cams and Followers Classification and terminology; Displacement, velocity, acceleration and jerk diagrams; Uniform velocity, parabolic, simple harmonic and cycloidal motions; Derivatives of follower motions; Circular and tangent cams; Pressure angle and undercutting; Graphical and analytical disc cam profile synthesis for roller and flat face followers.

Module VI: Gears Involute and cycloidal profiles; gear parameters; Fundamental law of gearing and conjugate action; Spur gear contact ratio and interference; Helical, bevel, worm, rack & pinion gears; Epicyclic and regular gear train kinematics; Force analysis of spur, helical, bevel and worm gearing. Computer-aided simulation of simple mechanisms.

Text /Reference Books:

1. Thomas Bevan, "Theory of Machines," CBS Publishers & Distributors, 2005.

2. W. L. Cleghorn, “Mechanisms of Machines,” Oxford University Press, 2005.
3. R. L. Norton, “Kinematics and Dynamics of Machinery,” Tata McGraw Hill, 2009.

Course outcomes:

Design various types of linkage mechanisms for obtaining specific motion and analyze them for optimal functioning.

At the end of the course, the students will learn

- CO 1.** Students will learn to identify different types of mechanisms, their components, and their motions (e.g., linkages, cams, gears, and gear trains).
- CO 2.** They will be able to analyze the position, velocity, and acceleration of machine components using graphical and analytical methods
- CO 3.** Students will gain skills in designing basic mechanisms to achieve specific motions, including understanding concepts like straight-line motion mechanisms and steering gear mechanisms.
- CO 4.** Students will learn to analyze simple vibration systems (single and two degrees of freedom) under free and forced conditions.
- CO 5.** Students will learn about different types of governors and cam mechanisms, including their design and analysis.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will learn to identify different types of mechanisms, their components, and their motions (e.g., linkages, cams, gears, and gear trains).	K ₁
CO2	They will be able to analyze the position, velocity, and acceleration of machine components using graphical and analytical methods	K ₂
CO3	Students will gain skills in designing basic mechanisms to achieve specific motions, including understanding concepts like straight-line motion mechanisms and steering gear mechanisms.	K ₃
CO4	Students will learn to analyze simple vibration systems (single and two degrees of freedom) under free and forced conditions.	K ₂
CO5	Students will learn about different types of governors and cam mechanisms, including their design and analysis.	K ₂

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 0	PO 1	PO 2	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 MATERIALS & APPLICATIONS

Subject Code: -	BTME405	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours:-	60	CREDITS	04

Course Objectives:

Broad understanding of different types of engineering materials and their applications
 Correlation between the internal structure of materials and their mechanical properties
 Various methods to quantify the mechanical integrity of materials and their failure criteria
 Interpretation of equilibrium phase diagrams of alloys
 Different heat treatment methods to tailor the properties of Fe-C alloys.

Course Contents:

Module I: Engineering Materials and Classification Metals, plastics, ceramics and composites; Relevant properties (physical, mechanical, thermal, electrical, chemical), cost; Range of applications; Material designation and standards; Ashby diagrams; Selection criteria and process

Module II: Mechanical Properties and Testing Tensile, compression, torsion, fatigue, fracture and wear tests; Young's modulus; Relations between true and engineering stress-strain curves; Generalized Hooke's law; Yielding and yield strength; ductility, resilience, toughness and elastic recovery; Hardness measurement their relation to strength; SN curve, endurance and fatigue limits; Introduction to non-destructive testing (NDT).

Module III: Metal and Alloys: Iron and steel; Stainless steel and tool steels; Copper & its alloys – brass, bronze & cupro-nickel; Aluminium & Al-Cu-Mg alloys; Nickel based superalloys & Titanium alloys; Phase diagrams and interpretation of microstructure; Iron Iron-carbide phase diagram and cooling (TTT) diagrams.

Module IV: Heat Treatment: Heat treatment of Steel; Annealing, tempering, normalizing, spheroidising, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening

Module V: Polymers, Ceramics and Composites: Polymers – Classification and applications; Polymerization techniques; Ceramics – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses; Composites – Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites; Other advanced materials – biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials.

Module VI: Electrical and Magnetic Materials: Conducting and resisting materials – types, properties and applications; Semiconducting materials – properties and applications; Magnetic materials – Soft and hard magnetic materials and applications; Superconductors and dielectric materials – properties and applications; Smart materials; Sensors and actuators; Piezoelectric, magnetostrictive and electrostrictive materials

Text /Reference Books:

1. W. D. Callister, “Materials Science & Engineering,” Wiley India, 2014.
2. K. G. Budinski and M.K. Budinski, “Engineering Materials”, PHI India, 2002.
3. V. Raghavan, “Material Science and Engineering’, PHI India, 2015.
4. U. C. Jindal, “Engineering Materials and Metallurgy”, Pearson, 2011.

Course outcomes:

Know the range of engineering materials, their mechanical properties and applications Know various methods to measure the mechanical properties of materials .Learn how to improve the properties of ferrous alloys through various heat treatments. At the end of the course, the students will learn

- CO 1.** Students will learn to describe and interpret phenomena like strength, deformation, ductility, fracture, and fatigue in materials
- CO 2.** They will understand how atomic and molecular structures, as well as crystalline and microscopic structures, influence material properties.
- CO 3.** They will gain knowledge of the applications of various materials, including metals, polymers, ceramics, and composites, in different industries like aerospace, automotive, and construction
- CO 4.** Students will understand how different manufacturing processes affect material properties and how to choose the right process for a given application
- CO 5.** Students will understand the principles of heat treatment and its effects on material properties. .

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will learn to describe and interpret phenomena like strength, deformation, ductility, fracture, and fatigue in materials	K ₁
CO2	They will understand how atomic and molecular structures, as well as crystalline and microscopic structures, influence material properties.	K ₂
CO3	They will gain knowledge of the applications of various materials, including metals, polymers, ceramics, and composites, in different industries like aerospace, automotive, and construction	K ₃
CO4	Students will understand how different manufacturing processes affect material properties and how to choose the right process for a given application	K ₂
CO5	Students will understand the principles of heat treatment and its effects on material properties. .	K ₂

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	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

STRENGTH OF MATERIAL

Subject Code: -	BTME406	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours:-	60	CREDITS	04

Course Objectives:

A strength of materials course, also known as mechanics of materials, focuses on the behavior of solid objects subjected to various forces and loads. It explores how materials deform under stress and strain, and aims to help students understand how to design structures and machine components to withstand these forces without failure.

Course Contents:

Module I: Types of forces; Stress, Strain and their nature; Mechanical properties of common engineering materials; Significance of various points on stress – strain diagram for M.S. and C.I. specimens, Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite, Strain energy or resilience, proof resilience and modulus of resilience; Derivation of strain energy for the following cases: i) Gradually applied load, ii) Suddenly applied load, iii) Impact/shock load; Related numerical problems.

Module II: Types of beams, Types of Loads, Definition and explanation of shear force and bending moment, S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Over hanging beam with point loads, at the centre and at free ends, f) Over hanging beam with UDL throughout, g) Combination of point and UDL for the above; Related numerical problems.

Module III: Explanation of terms: Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending, Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams, Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Related numerical problems.

Module IV: Definition and function of shaft; Calculation of polar M.I. for solid and hollow shafts; Assumptions in simple torsion, Derivation of the equation $T/J = fs/R = G\theta/L$; Problems on design of shaft based on strength and rigidity; Numerical Problems related to comparison of strength and weight of solid and hollow shafts, Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation), stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

Module V: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell, Derivation of expressions for the longitudinal and hoop stress for seamless and seam shells; Related numerical Problems for safe thickness and safe working pressure.

Text /Reference Books:

1. Strength of Materials, R. S. Khurmi, S. Chand & Co., Ram Nagar, New Delhi – 2002

2. Strength of Materials, D.S. Bedi, Khanna Book Publishing Co., Delhi.
3. Strength of Materials, S. Ramamrutham, 15 thEdn 2004, Dhanpat Rai Pub. Co., New Delhi.

Course outcomes:

The course also covers concepts like combined stresses, column stability, and the relationship between stress, strain, and material properties. Ultimately, students will be able to apply these concepts to design and analyze structural elements and machine components.

- CO 1.** Students will be able to define and calculate different types of stress (tensile, compressive, shear, bending) and strain (normal, shear) and understand their relationships
- CO 2.** They will learn about key material properties like Young's modulus, Poisson's ratio, shear modulus, and their significance in determining material behavior under load.
- CO 3.** Students will be able to differentiate between various types of loads (axial, shear, bending, torsional) and understand their effects on structural members.
- CO 4.** They will learn to analyze the effects of combined stresses (e.g., bending and torsion) on structural elements.
- CO 5.** They will understand the concepts of torsion and be able to analyze and design members subjected to torsional loads.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to define and calculate different types of stress (tensile, compressive, shear, bending) and strain (normal, shear) and understand their relationships	K ₁
CO2	They will learn about key material properties like Young's modulus, Poisson's ratio, shear modulus, and their significance in determining material behavior under load.	K ₂
CO3	Students will be able to differentiate between various types of loads (axial, shear, bending, torsional) and understand their effects on structural members.	K ₃
CO4	They will learn to analyze the effects of combined stresses (e.g., bending and torsion) on structural elements.	K ₂
CO5	They will understand the concepts of torsion and be able to analyze and design members subjected to torsional loads.	K ₂

KL- Bloom’s Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

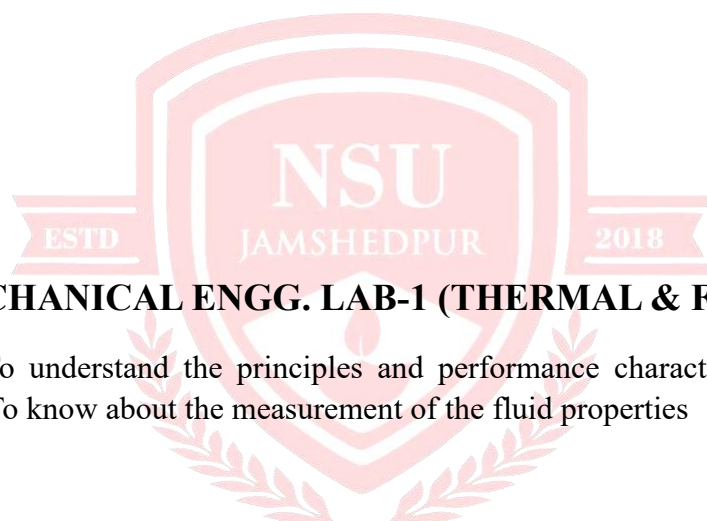
K₁-Remember, K₂- Understand, K₃- Apply, K₄- Analyze, K₅- Evaluate, K₆- Create

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	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



MECHANICAL ENGG. LAB-1 (THERMAL & FLUID)

Objectives: To understand the principles and performance characteristics of flow and thermal devices. To know about the measurement of the fluid properties

Contents:

1. Measurement of Coefficient of Discharge of given Orifice and Venturi meters
2. Determination of the density & viscosity of an oil and friction factor of oil flow in a pipe
3. Determination of the performance characteristics of a centrifugal pump
4. Determination of the performance characteristics of Pelton Wheel
5. Determination of the performance characteristics of a Francis Turbine
6. Determination of the performance characteristics of a Kaplan Turbine
7. Determination of the thermal conductivity and specific heat of given objects
8. Determination of the calorific value of a given fuel and its flash & fire points
9. Determination of the p-V diagram and the performance of a 4-stroke diesel engine
10. Determination of the convective heat transfer coefficient for flow over a heated plate
11. Determination of the emissivity of a given sample
12. Determination of the performance characteristics of a vapour compression system

Course Outcomes: The students who have undergone the course will be able to measure various properties of fluids and characterize the performance of fluid/thermal machinery.

- CO 1.** Students will gain knowledge about the fundamental properties of fluids and their behavior under different conditions.
- CO 2.** Students will study and apply the principles of fluid dynamics, including concepts like mass, momentum, and energy balance in flow systems.
- CO 3.** Students will be able to analyze and interpret data related to flow systems, including pressure drop, velocity profiles, and flow rates.
- CO 4.** Students will study and apply the principles of heat transfer, including conduction, convection, and radiation.
- CO 5.** Students will develop skills in setting up experiments, collecting data, and using appropriate instruments.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to define and calculate different types of stress (tensile, compressive, shear, bending) and strain (normal, shear) and understand their relationships	K ₁
CO2	They will learn about key material properties like Young's modulus, Poisson's ratio, shear modulus, and their significance in determining material behavior under load.	K ₂
CO3	Students will be able to differentiate between various types of loads (axial, shear, bending, torsional) and understand their effects on structural members.	K ₃
CO4	They will learn to analyze the effects of combined stresses (e.g., bending and torsion) on structural elements.	K ₂
CO5	They will understand the concepts of torsion and be able to analyze and design members subjected to torsional loads.	K ₂

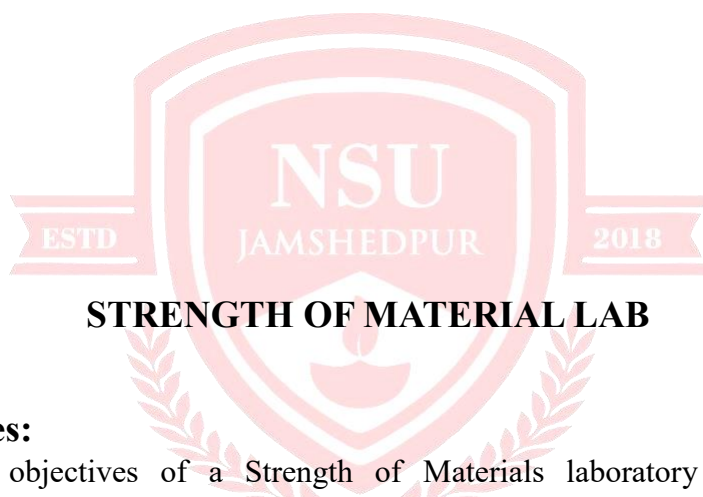
KL- Bloom's Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

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	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



STRENGTH OF MATERIAL LAB

Objectives:

The main objectives of a Strength of Materials laboratory are to demonstrate fundamental principles of mechanics and structural analysis to students and to provide hands-on experience in testing and analyzing material properties. These labs allow students to measure properties like tensile strength, compressive strength, hardness, and impact strength.

Contents:

Tension Testing: Determining the tensile strength, yield strength, elongation, and reduction of area of a material (typically mild steel) using a Universal Testing Machine (UTM).

Compression Testing: Determining the compressive strength of materials like steel, brass or composite alloy. Testing the compressive behavior of helical springs.

Bending/Flexure Testing: Analyzing the bending behavior of beams (cantilever or simply supported) made of steel or wood. Determining the deflection of beams under load.

Torsion Testing: Determining the torsional properties (shear stress, shear strain, modulus of rigidity) of a material (usually mild steel).

Impact Testing: Performing Charpy or Izod impact tests to assess the toughness and impact resistance of materials.

Hardness Testing: Conducting Rockwell and Brinell hardness tests to determine the hardness of various metals.

Shear Testing: Performing double shear tests on materials like mild steel and aluminum.

Strain Measurement: Using electrical resistance strain gauges to measure strain on a material under stress.

Course Outcomes:

In a Strength of Materials lab, students typically learn to evaluate material properties like tensile and compressive strength, hardness, and impact resistance, through hands-on experiments. They also gain experience in applying these concepts to the design of structural elements and machine components.

- CO 1.** Students will be able to determine key mechanical properties of materials through various tests, including tensile, compressive, shear, impact, and hardness tests.
- CO 2.** Students will gain a practical understanding of stress and strain concepts and their relationship to material behavior under load.
- CO 3.** Students will learn to apply the knowledge gained from experiments to the design of simple structural elements like beams and columns, as well as machine components.
- CO 4.** Analyzing Failure Modes: Students will be exposed to different failure modes of materials under various loading conditions.
- CO 5.** Interpreting Experimental Data: Students will learn to collect, analyze, and interpret data from experiments to draw meaningful conclusions.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to determine key mechanical properties of materials through various tests, including tensile, compressive, shear, impact, and hardness tests.	K ₁
CO2	Students will gain a practical understanding of stress and strain concepts and their relationship to material behavior under load.	K ₂
CO3	Students will learn to apply the knowledge gained from experiments to the design of simple structural elements like beams and columns, as well as machine components.	K ₃

CO4	Analyzing Failure Modes:Students will be exposed to different failure modes of materials under various loading conditions.	K ₂
CO5	Interpreting Experimental Data:Students will learn to collect, analyze, and interpret data from experiments to draw meaningful conclusions.	K ₂

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	PO1 0	PO1 1	PO1 2	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



SEMESTER V

SEMESTER V**MACHINE ELEMENT & SYSTEM DESIGN**

Subject Code: -	BTME 501	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	04

Objectives:

1. To understand safety-critical design of machine components using failure criteria based on Mechanics of materials
2. To understand the origins, nature and applicability of empirical design principles, relevant codes, Standards and design guidelines for different machine elements
3. To appreciate the relationships between component level design and overall machine system Design and performance

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.
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Contents

MODULE I

Introduction: Anatomy of machines; Functional dissection of motorcycle, washing machine, sewing machine, etc. into machine elements including gears, rack and pinions, cams, chains, belts, pulleys, flywheels, bearings, shafts, keys, brakes, etc.; Design considerations – Limits, fits and standardization; Friction and lubrication.

MODULE II

Free-body Diagrams: Force analysis of machine elements and machine systems; Application to power screws and couplings, clutches, and brakes.

MODULE III

Failure Theories: Static failure theories including normal stress theory, shear stress theory, distortion energy theory; von Mises stress; Factor of safety; Stress concentration factors; Fatigue failure theories: mean and alternating stresses, yield, ultimate, and endurance strength; Goodman, Gerber, and Soderberg lines.

MODULE IV

Design of Machine Elements: Springs – Helical compression, tension, torsional and leaf springs; Fasteners – threaded fasteners, bolted joints, preloaded bolts, rivets and welded joints; Shafts – shafts under static and fatigue loadings; Keys; Sliding and rolling contact bearings; Transmission elements – transmission ratio and efficiency of spur, helical, bevel and worm gears; belt and chain drives; Flywheels.

MODULE V

Vibrations of Machine Elements: Single degree-of-freedom systems; Natural frequency and critical damping; Forced vibration; Resonance; Balancing of reciprocating and rotating masses; Torsional vibration and critical speeds of shafts.

MODULE VI

Mechanical Systems: Case studies on automobile suspensions, automatic transmissions, material conveyor systems, construction machinery, etc.

Text /Reference Books:

1. Shigley, J.E. and Mischke, C.R., “Mechanical Engineering Design,” McGraw-Hill, 1989.
2. Deutschman, D., & Wilson, C.E., “Machine Design Theory & Practice,” Macmillan, 1992

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AICTE revised Model Curriculum for UG Degree Course in Mechanical Engineering

3. Juvinal, R.C., “Fundamentals of Machine Component Design,” John Wiley, 1994.
4. Spottes, M.F., “Design of Machine elements,” Prentice-Hall India, 1994.
5. R. L. Norton, “Mechanical Design – An Integrated Approach,” Prentice Hall, 2009.
6. Sadhu Singh, “Machine Design”, Khanna Book Publishing, 2021.
7. Sadhu Singh, “Machine Design Data Book”, Khanna Book Publishing, 2022.

Online Resources:

1 <https://archive.nptel.ac.in/courses/112/105/112105124/>

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Principles of machine elements and how they can be combined to function as a system

CO2. Failure analysis of machine elements

CO3. An overview of codes, standards and design guidelines for different elements

CO4. Ability to analyse mechanical systems

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Principles of machine elements and how they can be combined to function as a system	K ₁
CO2	Failure analysis of machine elements	K ₂
CO3	An overview of codes, standards and design guidelines for different elements	K ₃
CO4	Ability to analyse mechanical systems	K ₄

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 0	PO 1	PO 2	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

3 –High; 2 –Medium; 1 –Low

MECHATRONICS, ROBOTICS AND CONTROL

Subject Code: -	BTME 502	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Objectives:

1. Model and analyze mechatronic systems for an engineering application
2. Identify sensors, transducers and actuators to monitor and control a process or product.
3. Develop PLC programs for an engineering application.
4. Evaluate the performance of mechatronic systems.

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 I**

Introduction: Electro-mechanical systems; Typical applications; Examples – automobiles, home appliances, medical instruments, etc.

MODULE II

Sensors: Transduction principles; Sensitivity, accuracy, range, resolution, noise sources; Sensors for common engineering measurements – proximity, force, velocity, temperature, etc.; Signal processing and conditioning; Selection of sensors.

MODULE III

Actuators: Pneumatic and hydraulic actuators; Electric motors including DC, AC, BLDC, servo and stepper motors; Solenoids and relays; Active materials – piezoelectric and shape memory alloys.

MODULE IV

Machine Controls: Microprocessors and their architecture; Memory and peripheral interfacing; Programming; Microcontrollers; Programmable Logic Controllers; PLC principle and operation; Analog and digital input/output modules; Memory module; Timers, internal

relays, counters and data handling; Industrial automation systems; Basic PLC programming; Industry kits (Arduino, Raspberry Pi, etc.).

MODULE V

Robotics: Robot configurations: serial and parallel; Denavit–Hartenberg parameters; Manipulators kinematics; Rotation matrix, Homogenous transformation matrix; Direct and inverse Kinematics for robot position and orientation; Workspace estimation and path planning; Robot vision; Motion tracking; Robot programming and control; Industrial robots - Pick and place robots, sorting, assembly, welding, inspection, etc.

MODULE VI

Control Theory and Systems: Basic control concepts; Feedback; Open and closed loop control; Concept of block diagrams; P, PI and PID controllers; Tuning the gain of controllers; System models, transfer functions, system response, frequency response; Root Locus method and Bode plots.

MODULE VII

Computational Tools: Demonstration and projects using simulation software (e.g., Matlab, Scilab, ROBODK) for control systems and robotics.

Text /Reference Books:

1. W. Bolton, “Mechatronics,” Addison Wesley Longman, 2010.
2. J. J. Craig, Introduction to Robotics Mechanics and Control, Addison Wesley, 1999.
3. G.K. McMillan, “Process/Industrial Instruments and Controls Handbook,” McGraw-Hill, 1999.
4. S. Mukherjee, “Essentials of Robotics Process Automation”, Khanna Book Publishing, 2021.

Online Resources:

1. <https://nptel.ac.in/courses/107/106/107106090/>
2. <https://nptel.ac.in/courses/112/101/112101098/>
3. <https://nptel.ac.in/courses/112/107/112107289/>
4. <https://nptel.ac.in/courses/112/104/112104298/>

Course Outcomes:

At the end of this course students will demonstrate the ability to

- CO1.** Ability to recognize and analyse electro-mechanical systems in daily lives.
- CO2.** Understand the role of sensors, actuators, and controls in mechatronic systems.
- CO3.** Understand the basic theory of robot kinematics.
- CO4.** Familiarity with control theory and controller design.

CO5. Understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Ability to recognize and analyse electro-mechanical systems in daily lives.	K ₁
CO2	Understand the role of sensors, actuators, and controls in mechatronic systems.	K ₂
CO3	Understand the basic theory of robot kinematics.	K ₃
CO4	Familiarity with control theory and controller design.	K ₄
CO5	Understand the measurement of various quantities using instruments, their accuracy & range, and the techniques for controlling devices automatically.	K ₂

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	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

MANUFACTURING PROCESSES

Subject Code: -	BTME 503	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	04

Objectives:

To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing 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.	

Contents

Module I

Manufacturing Processes and Classification: Additive, subtractive and shaping processes; Relative advantages and limitations; Inter-dependency of geometry, material and process; Effect on product quality and cost; Part design for manufacturability; Process selection criteria.

Module II

Material Shaping Processes: Metal casting (sand, die and investment casting), Bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending); Thermoplastic and thermoset plastic processes (ex. injection and blow molding); Powder metallurgy; Metal injection molding; Glass and composite processes (layup).

Module III

Material Removal Processes: Turning, Drilling, Milling, Grinding and other finishing processes; Single and multi-point cutting tools; Cutting tool materials; Cutting fluids; Material removal rates, surface finish, accuracy, integrity and machinability

Module IV

Other (unconventional) Manufacturing Processes: Abrasive Jet Machining, Water Jet Machining; Ultrasonic Machining; Electrical Discharge Machining, Wire EDM; Electrochemical Machining; Laser Beam Machining, Plasma Arc Machining and Electron Beam Machining; Micro and nano manufacturing.

Module V

Additive Manufacturing Processes: Extrusion; vat polymerization, powder bed fusion; material jetting, binder jetting; direct energy deposition and lamination processes.

Module VI

Joining and Fastening Processes: Arc welding, gas welding, shielded metal arc welding; GMAW (MIG) and GTAW (TIG); Brazing and soldering; Solid state joining; Adhesive bonding.

Module VII

Manufacturing Process Modeling (for any one process, including simulation and industrial case study): Casting – metal flow, solidification and cooling; application to design of gating and feeding systems for quality and yield optimization; OR Forming – Plastic deformation and yield criteria; load estimation; OR Machining – Orthogonal cutting, various force components; Chip formation, Tool wear and tool life.

Text /Reference Books:

1. Amitabha Ghosh and A.K. Mallick, Manufacturing Science. Affiliated East-West Press Pvt. Ltd. 2010.
2. Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials, Pearson India, 2014
3. M. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
4. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

Online Resource:

- 1 <https://www.mooc-list.com/tags/manufacturing>

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1: Analyse static and dynamic forces in various mechanisms, including slider-crank mechanisms.

CO2: To Understand and Apply Balancing Principles to Estimate the magnitude and position of balancing masses required for rotating and reciprocating parts.

CO3: Analyse the Behaviour of Flywheels and Governors

CO4: Understand and analyse the different types of Vibrations

CO5: Understand the concept of gyroscopic couple and its effects.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Analyse static and dynamic forces in various mechanisms, including slider-crank mechanisms.	K ₁
CO2	To Understand and Apply Balancing Principles to Estimate the magnitude and position of balancing masses required for rotating and reciprocating parts.	K ₂
CO3	Analyse the Behaviour of Flywheels and Governors	K ₃
CO4	Understand and analyse the different types of Vibrations	K ₄
CO5	Understand the concept of gyroscopic couple and its effects.	K ₂

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	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

MEASUREMENTS AND METROLOGY

Subject Code: -	BTME 504	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Objectives:

1. To understand the proper use and maintenance of important instruments, such as Vernier callipers, autocollimators, slip gauges, and pyrometers
2. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

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 I

Measurement Purpose and Parameters: Parameters – geometry (straightness, flatness, roundness, etc.), displacement, force, speed, torque, flow, level, pressure, temperature, acceleration, etc.; Definitions: Accuracy, precision, range, resolution, uncertainty and error sources; Regression analysis.

Module II

Measurement Principles: Structure and examples of measurement systems; Calibration principles; Linear and angular measurements; Comparators; Gauge design; Interferometry.

Module III

Limits, Fit and Tolerances: Definitions; Tolerance zone and grades, Hole and shaft system, Geometric tolerances, Tylor's principle of gauging, Design of tolerances for various applications; Tolerance analysis in manufacturing and assembly; Role of metrology in Design of Manufacturing.

Module IV

Mechanical Measurements and Equipment: Dimensional metrology – Vernier, micrometers, LVDT; Form metrology – form tester, surface profiler, CMM, 3D scanning; Surface metrology – optical microscopes, Laser scanning microscopes, electron microscopy (SEM/TEM), xray microscopy, Raman spectroscopy; Tool wear, workpiece quality and process metrology.

Module V

Thermal and Flow Measurement: Measurement of temperature, thermal conductivity and diffusivity; Flow obstruction methods; Magnetic flow meters.

Module VI

Electrical Measurements and Instruments: Signal generators and analysis; Wave analyzer; Spectrum analyzer; Frequency counters – measurement errors, extending the frequency range; Transducers – types, strain gages, displacement transducers; Digital data acquisition system - interfacing transducers to electronics control and measuring system; Instrumentation amplifier; Isolation amplifier; Computer controlled test systems.

Module VII

Design of Experiments and Statistical Analysis: DOE techniques; Taguchi orthogonal arrays; Data acquisition, signal processing and conditioning; Error of a system of ideal elements; Error probability density function of a system of non-ideal elements; Error reduction techniques; Quality control and assurance in industry.

Text /Reference Books:

1. E.O Doebelin and Dhanesh Manik, “Measurement Systems”, McGraw Hill, 2017

2. Bewoor & Kulkarni, “Metrology & Measurement” Tata McGraw Hill, 2009.
3. D. James, and S, Meadow, “Geometric Dimensioning and Tolerancing”, Marcel Dekker, 1995
4. Madhav S. Phadke, Quality Engineering using Robust Design, Prentice Hall, 1989

Online Resources:

1. Mechanical Measurements and Metrology by Prof. S P Venkateshan (IIT Madras), NPTEL

Course (Link: <https://nptel.ac.in/courses/112/106/112106138/>).

2. Principles of Mechanical Measurement by Prof. Dipankar N Basu (IIT Guwahati), NPTEL

Course (Link: <https://nptel.ac.in/courses/112/103/112103261/>).

Course Outcomes:

At the end of this course students will demonstrate the ability to

- CO1.** Basic knowledge about measurement systems and their components
- CO2.** Various instruments used for measurement of mechanical and electrical parameters
- CO3.** Integrate measurement systems for process monitoring and control
- CO4.** Design of limits, fits and tolerances for given applications
- CO5.** Know the functioning of various sensors, transducers, intermediate modifying devices, and terminating devices

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Basic knowledge about measurement systems and their components	K ₁
CO2	Various instruments used for measurement of mechanical and electrical parameters	K ₂
CO3	Integrate measurement systems for process monitoring and control	K ₃
CO4	Design of limits, fits and tolerances for given applications	K ₄
CO5	Know the functioning of various sensors, transducers, intermediate modifying devices, and terminating devices	K ₂

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	2	3				2			2				1	1
CO2	1			2								1		
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2			1	1	1

3 –High; 2 –Medium; 1 –Low

OPERATIONS RESEARCH

Subject Code: -	BTHSM 505	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Course Objectives:

1. Define and formulate linear programming problems and appreciate their limitations.
2. Solve linear programming problems using appropriate techniques and optimization solvers, interpret the results obtained and translate solutions into directives for action.
3. Conduct and interpret post-optimal and sensitivity analysis and explain the primal dual relationship.
4. Develop mathematical skills to analyse and solve integer programming and network models arising from a wide range of applications.
5. Effectively communicate ideas, explain procedures and interpret results and solutions in simulation.

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-I

Introduction: Development of OR – Definitions-Operation Research models– applications.
Resource Allocation: Linear Programming Problem Formulation –Graphical solution – Simplex method –Artificial variables techniques -Big-M method

MODULE –II

Transportation Problem: Formulation – Optimal solution, unbalanced transportation problem –Degeneracy. Assignment problem –Formulation –Optimal solution - Variants of Assignment Problem-Traveling Salesman problem.

MODULE –III

Theory of Games: Introduction – Minimax (maximin) – Criterion and optimal strategy – Solution of games with saddle points – Rectangular games without saddle points – 2 X 2 games – dominance principle – m X 2 & 2 X n games -graphical method.

MODULE –IV

Replacement Analysis: Introduction – Replacement of items that deteriorate with time – when money value is not counted and counted – Replacement of items that fail completely, group replacement. Inventory: Introduction – Single item – Deterministic models – Purchase inventory models with one price break and multiple price breaks – shortages are not allowed

MODULE –V

Sequencing: Introduction – Flow –Shop sequencing – n jobs through two machines – n jobs through three machines – Job shop sequencing – two jobs through ‘m’ machines. Simulation: Definition – Types of simulation models – phases of simulation– applications of simulation – Inventory and Queuing problems – Advantages and Disadvantages – Simulation Languages

TEXT BOOKS:

- 1 S.D.Sharma - Operations Research , Kedarnath, Ramnath 2015
2. Hiller &Libermann - Introduction to O.R , Mc Graw Hill 2011
3. Taha - Introduction to O.R , PHI 2010

REFERENCE BOOKS:

1. A.M.Natarajan,P.Balasubramani,A. Tamilarasi -Operations Research , Pearson . Education.
2. R.Pannerselvam - Operations Research ,PHI Publications 2006
3. J.K.Sharma- Operation Research , MacMilan 2010

Course Outcomes:

CO1. Student will be able to Identify and develop operational research models from the verbal description of the real system.

CO2. Understand the mathematical tools that are needed to solve optimization problems.

CO3. Develop a report that describes the model and the solving technique, analyses the results and propose recommendations in language understandable in Management Engineering.

CO4. Student able to understand Multi-criteria decision techniques, Decision making under uncertainty and risk, Game theory, and Dynamic programming.

CO5. Use mathematical software to solve the proposed simulation models.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Student will be able to Identify and develop operational research models from the verbal description of the real system.	K ₁
CO2	Understand the mathematical tools that are needed to solve optimization problems.	K ₂
CO3	Develop a report that describes the model and the solving technique, analyses the results and propose recommendations in language understandable in Management Engineering.	K ₃
CO4	Student able to understand Multi-criteria decision techniques, Decision making under uncertainty and risk, Game theory, and Dynamic programming.	K ₄
CO5	Use mathematical software to solve the proposed simulation models.	K ₅

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	2	3				2			2				1	1
CO2	1			2								1		
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2			1	1	1

3 –High; 2 –Medium; 1 –Low

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 (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	PO1 0	PO1 1	PO1 2	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

3 –High; 2 –Medium; 1 –Low

MECHATRONICS ROBOTICS & CONTROLS LAB

BTME 502P	PCC	Mechatronics Robotics & Controls Lab	0	0	2	1	30	20	50
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Course Objectives:

1. To enable students to understand and integrate the fundamentals of mechanical, electrical, control, and computer engineering.
2. To apply this knowledge to design and analyze mechatronic systems, including robotics.
3. To develop a systems approach to designing mechatronic systems, emphasizing the integration of various components.
4. To provide practical experience with sensors, actuators, PLCs, and control systems through laboratory experiments.
5. To foster the ability to work effectively in multidisciplinary teams.

LIST OF EXPERIMENTS:

1. Assembly language programming of 8085 – Addition – Subtraction – Multiplication – Division – Sorting – Code Conversion
2. Stepper motor interface
3. Traffic light interface.
4. Speed control of DC motor.
5. Study of various types of transducers.
6. Study of hydraulic, pneumatic and electro-pneumatic circuits.
7. Modelling and analysis basic hydraulic, pneumatic and electrical circuits using software.
8. Determination of maximum and minimum position of links.
9. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
10. Estimation of accuracy, repeatability and resolution.
11. Robot programming and simulation for pick and place
12. Robot programming and simulation for colour identification
13. Robot programming and simulation for Shape identification
14. Robot programming and simulation for machining (cutting, welding)
15. Robot programming and simulation for writing practice

16. Robot programming and simulation for any industrial process (Packaging, Assembly)

Course Outcomes:

1. To acquire the ability to acquire signals from sensors using A/D converters and to send signals to actuators using D/A converters.
2. To develop skills in programming Programmable Logic Controllers (PLCs) for various control applications, such as traffic light control or conveyor belt control.
3. To simulate and analyze control systems, including PID controllers, using tools like MATLAB.
4. To gain a basic understanding of robotics, including fabrication methods, material behavior, and additive manufacturing techniques.
5. To demonstrate the ability to integrate mechanical, electronic, control, and computer components into a functional mechatronic system.
6. To apply knowledge of mechatronics to solve practical engineering problems and to develop innovative solutions.
7. To gain experience with machine vision techniques and to simulate and analyze various robotic systems.

MEASUREMENTS & METROLOGY LAB

BTME 504P	PCC	Measurements & Metrology lab	0	0	2	1	30	20	50
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COURSE OBJECTIVES:

1. To provide students with the necessary skills for calibration and testing of different gauges and instruments.
2. To provide students with the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.

LIST OF EXPERIMENTS:

1. Measurement of thread parameters using Optical Projector (Profile Projector).
2. Measurement of thread parameters using Toolmaker Microscope.
3. Measurement of angle using Sine bar
4. Measurement of alignment using Autocollimator / Roller set
5. Measurement of cutting tool forces using Lathe tool Dynamometer, Measurement of torque & thrust force using Drill tool Dynamometer.
6. Measurement of Screw thread parameters using two wire or Three-wire method (Floating Carriage Micrometer)
7. Measurement of thickness by using Comparators
8. Measurement of gear tooth profile using gear tooth vernier/Gear tooth micrometer
9. Calibration of Micrometer using slip gauges.
10. Surface roughness measurement by Talysurf instrument.

11. Thread measurement by Two wire/Three wire method.
12. Alignment test on the lathe and milling machine using dial indicators

COURSE OUTCOMES:

Upon completion of this course, students should be able to:

CO1. Demonstrate the necessary skills for calibration and testing of different gauges and instruments.

CO2. Demonstrate the necessary skills to collect data, perform analysis and interpret results to draw valid conclusions through standard test procedures using various metrology instruments.

MECHANICAL ENGINEERING LAB-2 (DESIGN)

Subject Code: -	BTME 505P	IA Marks	30
Number of Lecture Hours/Week:-	03	Term End Exam Marks	20
Total Number of Lecture Hours: -	50	CREDITS	02

Objectives:

1. To understand the measurement of mechanical properties of materials
2. To understand the deformation behaviour of materials
3. To understand the kinematic and dynamic characteristics of mechanical devices

Contents

1. Uniaxial tension test on mild steel rod
2. Torsion test on mild steel rod
3. Impact test on a metallic specimen
4. Brinnell and Rockwell hardness tests on metallic specimen
5. Bending deflection test on beams
6. Strain measurement using Rosette strain gauge
7. Microscopic examination of heat-treated and untreated metallic samples
8. Velocity ratios of simple, compound, epicyclic and differential gear trains
9. Kinematics of four bar, slider crank, crank rocker, double crank, double rocker and oscillating cylinder mechanisms
10. Cam & follower and motion studies
11. Single degree of freedom Spring-mass-damper system, determination of natural frequency and damping coefficient

12. Determination of torsional natural frequency of single and double rotor systems- undamped and damped natural frequencies

Course Outcomes:

Students who have undergone the course will be able to understand the measurement of mechanical properties of materials and will be able to characterize the dynamic behaviour of mechanical systems



SEMESTER VI

COMPUTER AIDED DESIGN & ANALYSIS

Subject Code: -	BTME 601	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Objectives:

1. To provide an overview of how computers can be utilized in mechanical component design
2. Develop proficiency in CAD/CAE software for geometric modeling, simulation, and analysis of engineering designs.
3. Students will learn to apply CAD/CAE tools to analyze and solve complex engineering problems.

Contents

Module I

Introduction: Role of computers in design process; Computer aided design, analysis and manufacturing; Computer integrated manufacturing; Popular CAD software used in industry; Input and output devices.

Module II

Transformations: Matrix representation of points, lines and planes; 2D transformation for translation, scaling, rotation and reflection; Homogeneous representation & concatenation; 3D transformations.

Module III

Curves and Surfaces: Representation of curves; Hermite curves, Bezier curves, B-spline curves, Rational curves; Surface modelling – parametric representation, planar surface, surface of revolution, Coons and bicubic patches, Bezier and B-spline surfaces.

Module IV

Solid Modelling: Solid modelling techniques – sweep (linear and curved), Boolean (constructive solid geometry) and other techniques; Solid model representation (Boundary and Constructive Solid Geometry); Medical modelling (pixels, scans and voxels); Exchange standards (IGES, DXF, STEP, STL etc.).

Module V

Engineering Analysis: Introduction to finite element method; Principle of potential energy; FE analysis of 1D element problems (spring, bar, truss elements); Development of element stiffness equation and their assembly; Plain strain and plain stress problems; Domain discretization, pre-processing and post-processing; Verification and validation; Popular CAE software used in industry

Module VI

Introduction to CFD and HT: Basic theoretical framework, Boundary conditions, Application Examples: thermal and fluid machines.

Module VII

Design Optimization: Purpose and application of optimum design, Primary and subsidiary design equations, Limit Equations, Normal, redundant and incompatible specifications problems; Computer-aided design optimization.

Text /Reference Books:

1. Ibrahim Zeid, “Mastering CAD CAM,” Tata McGraw Hill Publishing Co. 2007.
2. C. McMohan and J. Browne, “CAD/CAM Principles,” Pearson Education, 2nd Edition, 1999.
3. Geometric Modeling, Michael E. Mortenson, Tata McGraw Hill, 2013.
4. W. M. Neumann and R.F. Sproul, “Principles of Computer Graphics,” McGraw Hill, 1989.
5. D. Hearn and M.P. Baker, “Computer Graphics,” Prentice Hall Inc., 1992.

Online Resources:

1 NPTEL Lecture Series:

- <https://nptel.ac.in/courses/112/102/112102101/>,
- <https://nptel.ac.in/courses/112/104/112104031/>

2 MIT OCW:

<https://ocw.mit.edu/courses/mechanical-engineering/2-158j-computational-geometry-spring-2003/>

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1.Students will be able to create and manipulate 2D and 3D geometric models using CAD software.

CO2.Students will be able to perform FEA to analyze stress, strain, and other parameters of engineering components.

CO3.Students will be able to create part programs for CNC machines based on CAD models.

CO4.Students will be able to simulate and visualize the behavior of engineering systems using CAD/CAE software.

CO5.Students will understand the role of CAD/CAE in modern manufacturing processes.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to create and manipulate 2D and 3D geometric models using CAD software.	K ₁
CO2	Students will be able to perform FEA to analyze stress, strain, and other parameters of engineering components.	K ₂
CO3	Students will be able to create part programs for CNC machines based on CAD models.	K ₃
CO4	Students will be able to simulate and visualize the behavior of engineering systems using CAD/CAE software.	K ₅
CO5	Students will understand the role of CAD/CAE in modern manufacturing processes.	K ₂

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	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

MANUFACTURING AUTOMATION

Subject Code: -	BTME 602	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Objectives:

1. To understand the importance of automation in the of field machine tool based manufacturing
2. To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC
3. To understand the basics of product design and the role of manufacturing automation

Contents**Module I**

Introduction: Definition; Reasons for automating; Strategies; Types of automation; Numerical control (NC, CNC, DNC); Introduction to CNC programming and computer-aided process planning.

Machine and Process Automation: CNC machines, Automated flow lines (types, selection); Work part transport and transfer mechanisms; Feedback systems and control; Modular and reconfigurable machines, adaptive machine controls.

Module II

Automated Assembly Systems: Historical developments; Choice of assembly methods; Design for automated assembly; Transfer systems; Vibratory and non-vibratory feeders; Feed tracks, part orienting and placing mechanisms.

Factory Automation: Lean manufacturing, Automation scalability (fixed, programmable, flexible and reconfigurable); Design and analysis of automated flow lines; Average production time, production rate, line efficiency; Analysis of transfer lines without storage; Partial and full automation.

Module III

Automation Tools and Techniques: Mechanical, electro-mechanical, pneumatic and hydraulic systems; Sensors integration; Process monitoring, data analysis and control using actuators; Robots (pick, place, assembly, welding, painting, etc.); Automatic Guided Vehicles; Automated inspection and measurement (CMM and 3D Scanning); Machine vision, AI and machine learning; Human machine interfaces; Examples and case studies.

Module IV

Advanced Automation Trends: Digital, inclusive, smart and distributed manufacturing; Industry 4.0; Digital transformations in shop-floors (CIM to Smart factory; Intelligent machines to Smart Machines; Factory automation to Distributed automation; Human sense to system sensed). Examples and Case Studies: Pick and place robots, testing and sorting based systems, etc;

Module V

Orientation of parts: in-bowl and out-of-bowl toolings; Manufacturing equipment embedded with digital data and driven by adoptive controls; Manufacturing automation with autonomous decisions taken by computers based on the realistic process/machines (production conditions) data acquired from the resources.

Text /Reference Books:

1. M. P. Groover, Automation, Production Systems and Computer-integrated Manufacturing, Prentice Hall, 2018.
2. S. Kalpakjian and S. R. Schmid, Manufacturing – Engineering and Technology, Pearson.
3. Yoram Koren, Computer Control of Manufacturing Systems, McGraw Hill, 2005
4. CAD/CAM Principles and Applications, P.N. Rao, Tata McGraw Hill, 2010.

Online Resources:

1. <https://nptel.ac.in/courses/112/104/112104289/>
2. <https://nptel.ac.in/courses/112/103/112103293/>
3. <https://nptel.ac.in/courses/112/103/112103174/>

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. To understand the importance of automation in manufacturing value chain

CO2. To get the knowledge of various elements of automation tools and techniques

CO3. To understand the emerging digital manufacturing trends.

CO4. Students will be able to analyze machining processes by considering input variables like speed, feed, and depth of cut and their impact on performance

CO5. Students will gain a thorough understanding of the role of PLCs and other control techniques in process automation.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	To understand the importance of automation in manufacturing value chain	K ₁

CO2	To get the knowledge of various elements of automation tools and techniques	K ₂
CO3	To understand the emerging digital manufacturing trends.	K ₃
CO4	Students will be able to analyze machining processes by considering input variables like speed, feed, and depth of cut and their impact on performance	K ₅
CO5	Students will gain a thorough understanding of the role of PLCs and other control techniques in process automation.	K ₂

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	PO1 0	PO1 1	PO1 2	PSO1	PSO2
CO1	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

PRODUCTION & OPERATIONS MANAGEMENT

Subject Code: -	BTME 603	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	04

Objectives:

1. To provide knowledge on machines and related tools for manufacturing various components.
2. To understand the relationship between process and system in manufacturing domain.
3. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Contents

Module I

Introduction: Scope of production management. Production system and resources (machines, tooling, etc.); Types of production (batch, flow and unit), Roles of line supervisors and production managers.

Module II

Project Management: Project life cycle: concept phase (RFQ, Quotations, Proposals), Project initiations, DPR preparation (project value, business case development and feasibility study); Project planning (obtaining resources, acquiring financing and procuring required materials); Project team, producing quality outputs, handling risk, acceptance criteria; Project execution (allocation of resources, scheduling, building deliverables); Project Monitoring and control: Project networks, progress review (physical and financial), CPM and PERT, critical path, re-scheduling; Project closure: acceptance of project deliverable; Analytics: Performance, capability aggregation, cost benefit analysis, variability analysis, Output-outcome analysis, project documentation, best practices, and depository.

Module III

Production Planning and Control: Production planning, Process planning, Resource planning, demand-utility mapping (production capability index, forecasting models, aggregate production planning, materials requirement planning); Inventory Management: Economic order Quantity, discount models, stochastic inventory models, practical inventory control models, JIT; Supply chain and management.

Module IV

Factory Management: Factory layout: line balancing, material flow and handling, Lean and green manufacturing, Human resource management, Training need analysis, Advantage and opportunities for Digitalization, Advanced factory systems: TQM; Important acts, regularities and safety norms, Reliability assessment of processes, Block chain, Energy management, Efficiency & throughput, Overall equipment effectiveness. Process capability, lean manufacturing.

Module V

Operation Management: Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment; Simple queuing theory models; Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model.

Text /Reference Books:

1. L.J. Krajewski and L.P Ritzmen, Operations Management: Strategy and Analysis, Pearson, 2010.
2. R.B. Chase, F.R. Jacobs and N.J. Aquilano, Operations Management for Competitive Advantage, Tata McGraw Hill, 2011.
3. W. J. Hopp and M. L. Spearman, Factory Physics: Foundations of Manufacturing Management, McGraw Hill International Edition, 2008.
4. Mahadevan. B., Operations Management: Theory and Practice, Pearson, 2015.
5. Taha H. A., Operations Research, 6th Edition, PHI India, 2003.
6. M.P. Poonia, Total Quality Management, Khanna Publishing House, 2022.

Online Resources:

1 https://onlinecourses.nptel.ac.in/noc20_mg06/preview

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Students will be able to analyze contemporary manufacturing and service operations in a global business environment.

CO2. Students will be able to evaluate the value chain and understand the use of current management theories and tools in operations.

CO3. Students will be able to apply the knowledge gained to solve practical problems in production planning, inventory management, and quality control.

CO4. Students will be able to analyze data and make effective decisions in various operations management contexts.

CO5. Students will be able to understand the role of sustainability in operations management and its impact on the environment and society.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to analyze contemporary manufacturing and service operations in a global business environment.	K ₁
CO2	Students will be able to evaluate the value chain and understand the use of current management theories and tools in operations.	K ₂
CO3	Students will be able to apply the knowledge gained to solve practical problems in production planning, inventory management, and quality control.	K ₃
CO4	Students will be able to analyze data and make effective decisions in various operations management contexts.	K ₅
CO5	Students will be able to understand the role of sustainability in operations management and its impact on the environment and society.	K ₂

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	2	3				2			2				1	1
CO2	1			2							1			

CO3	1	2											
CO4													
CO5													
CO(Average)	1.3	2.5		2		2		2		1		1	1

3 –High; 2 –Medium; 1 –Low

PRODUCT INNOVATION & ENTREPRENEURSHIP

Subject Code: -	BTME 604	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	04

Objectives:

To expose aspiring student entrepreneurs to various elements of a technology venture starting from market need identification to innovative solution development and its commercialization through business planning and start-up company incubation.

Contents

Module I

Entrepreneurship: Role of entrepreneurship in economic development; Entrepreneurial mindset, motivation and competencies; Market pull and technology push factors; New product development lifecycle; Technology readiness levels; Product-market fit validation; Commercialization pathways; Business vision & leadership; Team composition & management.

Module II

Product Innovation: Opportunity scanning, market survey, need identification and problem definition; Creative design thinking for concept generation; Detailed design & prototyping; Functionality & manufacturability; Bill of materials & components supply chain; Manufacturing & assembly plan; Product testing & quality assurance; Intellectual property rights management.

Module III

Marketing & Finance: Market segmentation & market sizing; Customer persona & value proposition; Marketing (Go-to-market) strategy; Distribution channels and sales network; Funding requirement (based on stage); Source of funding for startup ventures; Financial projections and accounting; Startup to scale up financing.

Module IV

Venture Creation: Sustainable business options & pathways; Business model & business canvas; Startup team & business partners; Startup ecosystem and stakeholders; Technology

business incubators & parks; Proposal pitching & agreements; Startup company incorporation; Social impact & responsibility.

Module V

Course Project: Need identification, innovative solution, business plan, go-to-market strategy.

Text /Reference Books:

1. Bill Aulet, “Technology Entrepreneurship”, 4th ed., Tata McGraw Hill, 2014.
2. Peter F. Drucker, “Innovation and Entrepreneurship”, 1st ed., Harper Business, 2006.
3. Chelat Bhuvanachandran, Innovision, Khanna Book Publishing, 2022.
4. Byers, Dorf, and Nelson, Technology Ventures: From Ideas to Enterprise, McGraw Hill, 2010
5. Steve Blank, “The Startup Owner's Manual”
6. T.V. Rao, “Entrepreneurship - A South Asian Perspective”

Online Resources:

- 1 https://onlinecourses.nptel.ac.in/noc22_ge03/preview

Course Outcomes:

At the end of this course students will demonstrate the ability to

CO1. Students will be able to identify promising business opportunities and assess their feasibility.

CO2. Students will be able to generate innovative product ideas and develop them into viable solutions.

CO3. Students will be able to create comprehensive business plans for new ventures.

CO4. Students will be able to manage financial, human, and other resources effectively for their ventures.

CO5. Students will understand the ethical implications of entrepreneurship and the importance of social responsibility.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students will be able to identify promising business opportunities and assess their feasibility.	K ₁
CO2	Students will be able to generate innovative product ideas and develop them into viable solutions.	K ₂
CO3	Students will be able to create comprehensive business plans for new ventures.	K ₃
CO4	Students will be able to manage financial, human, and other resources effectively for their ventures.	K ₅

CO5	Students will understand the ethical implications of entrepreneurship and the importance of social responsibility.	K ₂
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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	2	3				2			2				1	1
CO2	1			2								1		
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2			1	1	1

3 –High; 2 –Medium; 1 –Low

PROJECT MANAGEMENT

Subject Code: -	BTME 605	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	60	CREDITS	03

Course Objectives:

1. To understand the basic elements necessary for Project Management.
2. To enable the student to conduct preliminary screening of project.
3. To gain knowledge on conducting the studies of market, technical and operational feasibility of the Project.
4. To analyse the financial viability of the project.
5. To provide insight into Planning and implementation of project

CONTENTS

UNIT I:

Basics of project management: Meaning, Definition and Need for Project Management – Importance of Project Management- Types of Projects- Project Management Knowledge Areas and Processes - The Project Life Cycle - Phases of Project Management Life Cycle - Project Management Processes - Essentials elements of Project Management (Scope, Time , Cost, Quality, Risk) - Project Management Principles- Role of Project Manager (PM).

UNIT II:

Project identification and selection: Generation of Ideas, Sources of New Project Ideas, Preliminary Screening of Projects. Project Identification Process- Sources of Financial resources - Pre-Feasibility Study - Feasibility Studies: Market Feasibility, Financial Feasibility and Technical Feasibility - Project Break - even point –

UNIT III:

Project planning: Need of Project Planning - Project Life Cycle – Roles - Responsibility and Team Work - Project Planning Process – Network Analysis (basics) - Project Initiation and evaluation - Impact of Delays in Project Completions.

UNIT IV:

Project Leadership and Ethics: Introduction to project leadership, ethics in projects, Customer acceptance; Reasons of project termination, Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures;

UNIT V:

Resource loading and levelling, Goldratt's critical chain, Risk Management in projects: Risk management planning, Qualitative and quantitative risk assessment

REFERENCE BOOKS:

1. Prasanna Chandra, Projects, Planning, Analysis, Selection, Financing, Implementation and Review, Tata McGraw Hill Pvt. Ltd., New Delhi.
2. K. Nagrajan, Project Management, New Age International Publishers,
3. R. Paneerselvam, P. Senthil Kumar, Project Management, PHI.
4. Vasanth Desai, Project Management, Himalaya Publications.

COURSE OUTCOMES:

CO1. Students learn to identify what constitutes a project

CO2. Students learn to define project scope, create work breakdown structures (WBS), and manage changes to scope.

CO3. Students learn to identify potential risks, assess their impact, and develop mitigation strategies.

CO4. Students learn to build high-performing teams, foster collaboration, and manage team dynamics.

CO5. Students apply project management knowledge to real-world scenarios, often through case studies or simulations.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Students learn to identify what constitutes a project	K ₁
CO2	Students learn to define project scope, create work breakdown structures (WBS), and manage changes to scope.	K ₂
CO3	Students learn to identify potential risks, assess their impact, and develop mitigation strategies.	K ₃
CO4	Students learn to build high-performing teams, foster collaboration, and manage team dynamics.	K ₅
CO5	Students apply project management knowledge to real-world scenarios, often through case studies or simulations.	K ₂

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 2018												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														
CO5														
CO(Average)	1.3	2.5		2		2			2		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
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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 (KL)
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

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	2	3				2			2				1	1
CO2	1			2							1			
CO3	1	2												
CO4														
CO5														
CO(Average)	1.3	2.5		2		2			2		1		1	1

3 –High; 2 –Medium; 1 –Low

COMPUTER AIDED DESIGN & ANALYSIS LAB

BTME 601P	PCC	Computer Aided Design & Analysis	0	0	2	1	30	20	50
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Course Objectives:

To develop skill to use software to create 2D and 3D models.

LIST OF EXPERIMENTS:

1. Introduction to CAD.
2. AutoCAD – BASICS- Starting with AutoCAD, Layout and sketching, Drawing environment, Elements of drawing, Draw commands
3. 3D functions.
4. 2D – FIGURES for practice USING AutoCAD 2013
5. ISOMETRIC DRAWING for practice USING AutoCAD2013
6. Learning Different Operations like Threading, Sweep, Sweptblend.
7. Computational Fluid Dynamics(CFD) Analysis on Simple fluid flow and heat transfer problems.
8. Computational Fluid Dynamics(CFD) Analysis on Modeling Periodic flow and heat transfer.
9. Computational Fluid Dynamics(CFD) Analysis on Modeling external compressible flows.
10. Computational Fluid Dynamics(CFD) Analysis on Modeling transient compressible flows.
11. Computational Fluid Dynamics(CFD) Analysis on Modeling radiation and natural convection.

List of Software:

- Solidworks-2016
- CREO Version 2.0
- HyperMesh
- ANSYS
- OpenFoam
- Scilab 6.1.0

Course outcomes:

These experiments are designed to equip students with the skills to use CAD software for design, analysis, and manufacturing processes.

MANUFACTURING AUTOMATION LAB

BTME 602P	PCC	Manufacturing Automation	0	0	2	1	30	20	50
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COURSE OBJECTIVES:

1. Learn the fundamental concepts and strategies behind automating manufacturing processes.
2. Gain knowledge of various automation tools and methods employed in manufacturing industries.
3. Develop the ability to implement control and automation methods in process industries.
4. Become familiar with communication technologies used in manufacturing and process automation.
5. Understand how to analyze automated manufacturing systems, including flow lines and assembly systems.
6. Learn to apply optimization techniques relevant to manufacturing and automation.

LIST OF EXPERIMENTS:

1. To write a programme to generate a given profile through a NC machine tool.
2. To measure different dimensions of a job.
3. To programme the robot to pick an object from a given location and to place it in another location.
4. To list down physical configurations of the robot and study the degree of freedom of arm and wrist of the robot. Also, calculate the work volume of the robot.
5. To find a Quality Control Chart by Considering a lot of 20 cylindrical jobs with some nominal outside diameter produced on a particular centre lathe and observe their variation and construct a relevant control chart.
6. Industrial Automation Systems in-
 - a) **Hardware and Software Platforms:** Study of hardware and software platforms used in Distributed Control Systems (DCS).
 - b) **Simulation and Modeling:** Modeling and analysis of basic hydraulic, pneumatic, and electrical circuits using simulation software.
 - c) **Sensor Integration:** Measuring physical quantities like displacement, force, and temperature, and understanding signal conditioning circuits.
 - d) **Human-Machine Interface (HMI):** Developing graphical user interfaces for controlling industrial processes.
 - e) **PID Control:** Tuning PID controllers for systems like heat exchangers using DCS.

Course Outcomes:

1. Students will be able to identify and differentiate various automation technologies used in manufacturing and process industries.

2. Students will be able to implement different control strategies in automated systems.
3. Students will be able to analyze the performance and characteristics of different automation systems.
4. Students will be able to apply optimization techniques to improve the efficiency and effectiveness of automated processes.
5. Students will be able to design and implement automation solutions for specific manufacturing scenarios.
6. Students will be able to troubleshoot issues and identify solutions in automated manufacturing systems.

MECHANICAL ENGG. LAB-3 (MANUFACTURING)

BTME 605P	Mechanical Engg. Lab-3 (Manufacturing)	0L:1T:2P	2 credits
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Objectives:

1. To provide an understanding of advanced manufacturing methods.
2. To get an idea of the dimensional & form accuracy of products.

Contents:

About 12 experiments will be carried out as listed below:

1. Taper turning and external thread cutting using lathe
2. Contour milling using vertical milling machine
3. Spur gear cutting in milling machine
4. Measurement of cutting forces in Milling/ Turning process
5. CNC part programming
6. Drilling of a small hole using wire EDM
7. Microprocessor controlled pick & place robot
8. Use of Tool Maker's Microscope
9. Comparator and sine bar
10. Surface finish measurement equipment
11. Bore diameter measurement using micrometer and telescopic gauge
12. Use of Autocollimator

Course Outcomes:

Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced.

ENGINEERING PROJECT-1

BTME 607P	Engineering Project-1 (Literature Review)	0L: 0T: 4P	2 Credits
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Objectives:

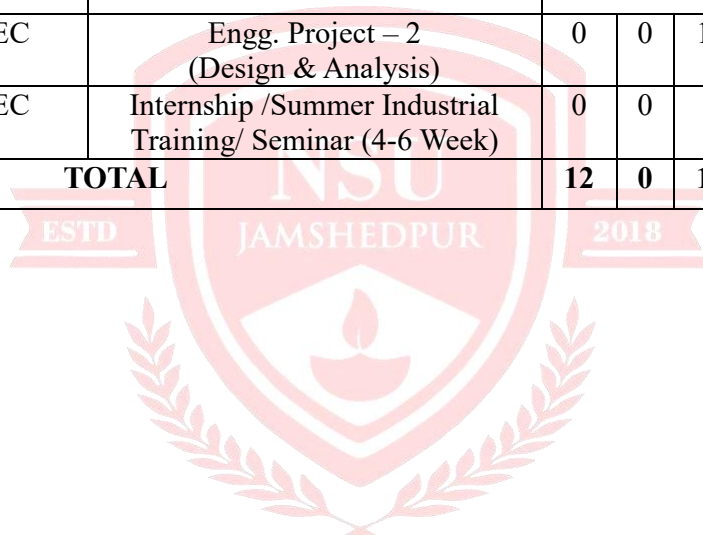
This course is aimed to provide more weightage for project work. The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.





SEMESTER -VII

Sl.	Code No	Category	Name of the subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTME 701	PEL	Professional Elective – 1	3	0	0	3	40	60	100
2	BTME 702	PEC	Professional Elective – 2	3	0	0	3	40	60	100
3	BTME 703	OEC	Open Elective – 1	3	0	0	3	40	60	100
4	BTME 704	OEC	Open Elective - 2	3	0	0	3	40	60	100
Practical										
7	BTME 705P	EEC	Engg. Project – 2 (Design & Analysis)	0	0	10	5	40	60	100
10	BTEEC 706P	EEC	Internship /Summer Industrial Training/ Seminar (4-6 Week)	0	0	4	2	30	20	50
TOTAL				12	0	14	19	230	320	550



PROFESSIONAL ELECTIVE COURSES**REFRIGERATION AND AIR CONDITIONING**

Subject Code: -	BTME701-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To familiarize with the terminology associated with refrigeration systems and air conditioning
2. To understand basic refrigeration processes.
3. To understand the basics of psychrometry and practice of applied psychrometrics.
4. To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.

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: Basic Definitions of Refrigeration and Air-Conditioning; History of Refrigeration; Natural and Artificial Refrigeration Methods; Techniques to produce low temperatures; Applications of Refrigeration; Refrigerants- Classification, Nomenclature, Desirable Properties, Selection.

Module II

Air Refrigeration: Air Refrigeration Cycles - reversed Carnot cycle; Bell-Coleman cycle analysis; various methods of Aircraft Refrigeration: Analysis, Merits and demerits. **Vapor Compression Refrigeration System:** Ideal VCR cycle (Working, Analysis and Limitations); Standard VCRS (Working and Analysis); Methods to improve performance of VCR; Multi-Stage VCRS; Cascade Refrigeration.

Module III

Components of Refrigeration Systems: Compressors: Positive Displacement (Reciprocating and Rotary); Dynamic (Centrifugal and Axial) Compressors; Condensers and Evaporators (Both Natural and Forced Convection type); Expansion Devices and other components of the system.

Module IV

Vapor Absorption Systems: Working and Analysis; Absorbent - Refrigerant combinations; Water- Ammonia Systems; Water-Lithium Bromide System; Modified Version of Aqua-Ammonia System with Rectifier and Analyzer Assembly. **Other Refrigeration systems:** Brief Discussion on (i) Steam-Jet refrigeration system; (ii) Vortex tube refrigeration; (iii) Thermoelectric refrigeration system; and (iv) Magnetic refrigeration.

Module V

Psychrometry: Classification of Air-Conditioning Systems; ASHRAE Nomenclature; Applications of Air-Conditioning; Psychrometry - Air-water vapor mixtures; Psychrometric Properties; Psychrometric or Air-Conditioning processes; Psychrometric Chart.

Air-Conditioning Systems: Classification of Air-Conditioning Systems; Psychrometry of Air-Conditioning Systems; Thermal Comfort (Definition and Psychrometric Properties for Thermal Comfort); Mathematical Analysis of Air-Conditioning Systems; Cooling and Heating Load Estimation; a brief discussion on Ventilation.

Text /Reference Books:

1. Singh, Sadhu., Refrigeration and Air conditioning, Khanna Book Publishing Edition, 2021.
2. Domkundwar, Refrigeration and Air conditioning, Dhanpat Rai.
3. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_me135/preview

Course Outcomes:

The students will learn:

- CO1.** Understand the working principles of refrigeration and air-conditioning systems.
- CO2.** Calculate Coefficient of Performance (COP), work input, heat rejected, and refrigerating effect for various systems.
- CO3.** Demonstrate understanding of thermodynamic principles behind refrigeration and air conditioning systems.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the working principles of refrigeration and air-conditioning systems..	K ₁
CO2	Calculate Coefficient of Performance (COP), work input, heat rejected, and refrigerating effect for various systems.	K ₂
CO3	Demonstrate understanding of thermodynamic principles behind refrigeration and air conditioning systems.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

POWER PLANT ENGINEERING

Subject Code: -	BTME701-B	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To provide an overview of power plants and the associated energy conversion issues.
2. Providing an overview of Power Plants and detailing the role of Mechanical Engineers in their operation and maintenance.

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: Power plants – types and classification based on energy sources. Coal based Thermal Power Plants: Basic Rankine cycle and its modifications; Layout of modern coal power plant; Super critical boilers, FBC boilers; Turbines, condensers, steam and heating rates; Subsystems of thermal power plants; Fuel and ash handling; Draught system; Feed water treatment; Binary cycles and cogeneration systems.

Module II

Gas Turbine and Combined Cycle Power Plants: Brayton cycle analysis and optimization; Components of gas turbine power plants; Combined cycle power plants; Integrated Gasifier based Combined Cycle (IGCC) systems.

Module III

Nuclear Power Plants: Basics of nuclear energy conversion; Layout and subsystems of nuclear power plants; Boiling Water Reactor (BWR); Pressurized Water Reactor (PWR); CANDU Reactor; Pressurized Heavy Water Reactor (PHWR); Fast Breeder Reactors (FBR); Gas cooled and liquid metal cooled reactors; Safety measures for nuclear power plants.

Module IV

Hydroelectric Power Plants: Classification; Typical layout and components. **Renewable Power Systems:** Principles of wind, tidal, solar photo-voltaic, solar thermal, geothermal, biogas and fuel cell power systems.

Module V

Energy Economics and Environment: Economic and environmental issues; Power tariffs; Load distribution parameters; Load curve; Capital and operating cost of different power plants; Pollution control technologies including waste disposal options for coal and nuclear plants.

Text /Reference Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.
3. Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_me73/preview

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.
- CO2.** Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.
- CO3.** Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.
- CO4.** Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.
- CO5.** Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Describe and analyze different types of sources and mathematical expressions related to thermodynamics and various terms and factors involved with power plant operation.	K ₁
CO2	Analyze the working and layout of steam power plants and the different systems comprising the plant and discuss about its economic and safety impacts.	K ₂
CO3	Combine concepts of previously learnt courses to define the working principle of diesel power plant, its layout, safety principles and compare it with plants of other types.	K ₃

CO4	Describe the working principle and basic components of the nuclear power plant and the economic and safety principles involved with it.	K ₃
CO5	Explain the applications of power plants while extend their knowledge to power plant economics and environmental hazards and estimate the costs of electrical energy production.	K ₃

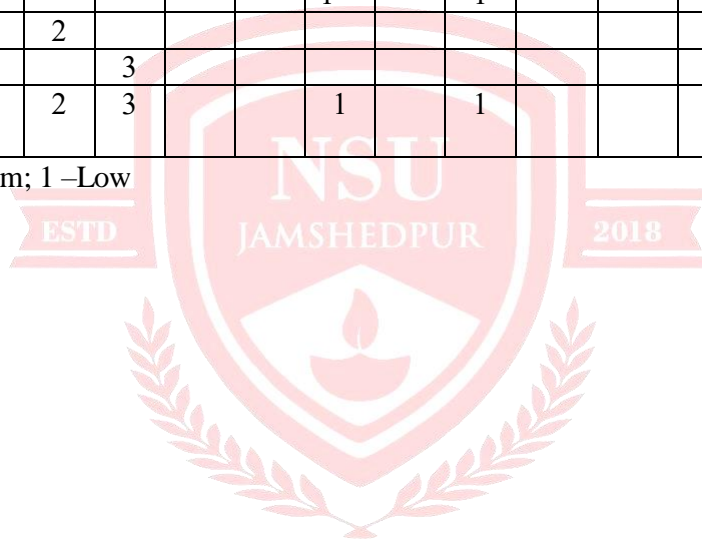
KL- Bloom's Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

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					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low



RENEWABLE ENERGY ENGINEERING

Subject Code: -	BTME702-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To acquire knowledge of technical competency combined with research to generate innovative solutions in Energy engineering.
2. To be acquainted with a variety of options in energy sources.
3. To prepare the students to exhibit a high level of professionalism, integrity, environmental and social responsibility, and life-long independent learning ability with environment in mind.

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: Basic concepts of energy; Introduction to Renewable Energy Technologies; Energy and Environment – global warming, acid rains, depletion of ozone layer; Global and Indian Scenario of renewable energy sources; Energy storage - necessity and energy storage methods.

Module II

Solar Energy: Fundamentals; Solar Radiation; Estimation of solar radiation on horizontal and inclined surfaces; Measurement of solar radiation data. **Solar Thermal Systems:** Introduction; Basics of thermodynamics and heat transfer; Flat plate collector; Evacuated Tubular Collector; Solar air collector; Solar concentrator; Solar distillation; Solar cooker; Solar refrigeration and air conditioning; Thermal energy storage systems. **Solar Photovoltaic Systems:** Introduction; Solar cell Fundamentals; Characteristics and classification; Solar cell: Module, panel and Array construction; Photovoltaic thermal systems.

Module III

Wind Energy: Introduction; Origin and nature of winds; Wind turbine siting; Basics of fluid mechanics; Wind turbine aerodynamics; wind turbine types and their construction; Wind energy conversion systems.

Module IV

Fuel cells: Overview; Classification of fuel cells; Operating principles; Fuel cell thermodynamics. **Biomass Energy:** Introduction; Photosynthesis Process; Biofuels; Biomass Resources; Biomass conversion technologies; Urban waste to energy conversion; Biomass gasification.

Module V

Other forms of Energy: Introduction: Nuclear, ocean and geothermal energy applications; Origin and their types; Working principles.

Text /Reference Books:

1. O.P. Gupta, "Energy Technology", Khanna Book Publishing, New Delhi.
2. V.V.N. Kishore, "Renewable Energy Engineering and Technology: Principles and Practice," Routledge, 1st Edition, 2019.
3. N. Jenkins and J. Ekanayake, "Renewable Energy Engineering," Cambridge University Press, 1st Edition, 2017.
4. G. Boyle, "Renewable Energy," OUP Oxford, 2nd Edition, 2009.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ph44/preview
2. https://onlinecourses.swayam2.ac.in/nou22_ge71/preview

Course Outcomes:

At the end of this course students will demonstrate the ability to

- CO1.** Acquire, apply and share in depth knowledge in the area of Energy Engineering and Management.
- CO2.** An ability to apply engineering and scientific principles for the effective management of energy systems.
- CO3.** Explain the basic principles of energy conversion processes and devices used therein
- CO4.** Identify suitable renewable source and technology for a given requirement.
- CO5.** Undertake field projects in these areas

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Acquire, apply and share in depth knowledge in the area of Energy Engineering and Management.	K ₁
CO2	An ability to apply engineering and scientific principles for the effective management of energy systems.	K ₂

CO3	Explain the basic principles of energy conversion processes and devices used therein	K ₃
CO4	Identify suitable renewable source and technology for a given requirement.	K ₂
CO5	Undertake field projects in these areas	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4														
CO5	2	3		3										
CO(Average)	2.5	2	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

ADDITIVE MANUFACTURING

Subject Code: -	BTME702-B	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 provide an overview of Additive Manufacturing processes, systems and 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 Additive Manufacturing (AM): Evolution of AM/3D printing; Comparison with subtractive and forming processes; Advantages of AM; Classification of AM processes; Key steps in AM.

Module II

Liquid State-based AM Processes: Stereo lithography – Process and working principle; Photopolymers; Photo polymerization, layering technology, Laser and Laser scanning; Micro-stereolithography; Equipment and specifications; Applications, advantages, disadvantages, examples; Solid ground curing: Process, Working principle; Equipment and specifications; Applications, advantages, disadvantages, examples.

Module III

Solid State-based AM Processes: Fused Deposition Modeling – Process, working principle and materials; Equipment and specifications; Laminated object manufacturing – Process and working principle; Equipment and specifications; Applications, advantages, disadvantages, examples; Other solid-state processes – Ultrasonic consolidation, Gluing, Thermal bonding; Demonstration of equipment.

Module IV

Powder Based AM Processes: Powder Bed Fusion Processes – Working principle and materials; Powder fusion mechanism and powder handling; Various LBF processes (principle,

materials, applications and examples) – Selective laser Sintering, Electron Beam Melting, Laser Engineered Net Shaping, Binder Jetting and Direct Metal Deposition; Comparison between LBF processes; Materials-process-structure-property relationships; relative advantages and limitations.

Module V

Applications of AM: Product development lifecycle applications – Rapid prototyping, concept models, visualization aids, replacement parts, tooling, jigs and fixtures, moulds and casting; Application sectors – aerospace, automobile, medical, jewelry, sports, electronics, food, architecture, construction and others.

Text /Reference Books:

1. Sabrie Soloman, 3D Printing & Design, Khanna Book Publishing Company, New Delhi, 2020.
2. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping and Direct Digital Manufacturing”, Springer, 2015
3. Chua Chee Kai, Leong Kah Fai, “3D Printing and Additive Manufacturing: Principles & Applications,” World Scientific, 2015.
4. C.P Paul, A.N Junoop, “Additive Manufacturing: Principles, Technologies and Applications,” McGrawHill, 2021.

Online Resources:

1. https://onlinecourses.nptel.ac.in/noc21_me115/preview
2. https://onlinecourses.nptel.ac.in/noc20_mg70/preview

Course Outcomes:

At the end of this course students will demonstrate the ability to

- CO1.** Understand the overall principle and various processes for additive manufacturing.
CO2. Select a particular additive manufacturing process based on the end application.
CO3. Plan the steps in fabricating a given part using additive manufacturing.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the overall principle and various processes for additive manufacturing.	K ₁
CO2	Select a particular additive manufacturing process based on the end application.	K ₂
CO3	Plan the steps in fabricating a given part using additive manufacturing.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low



OPEN ELECTIVE COURSES**FINITE ELEMENT ANALYSIS**

Subject Code: -	BTME703-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To introduce the concepts of Mathematical Modeling of Engineering Problems.
2. To appreciate the use of FEM to a range of 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 I**

INTRODUCTION: Historical Background, Mathematical Modeling of field problems in Engineering, Governing Equations – Discrete and continuous models. Boundary, Initial and Eigen Value problems, Weighted Residual Methods, Variation Formulation of Boundary Value Problems, Ritz Technique. Basic concepts of the Finite Element Method.

Module II

ONE-DIMENSIONAL PROBLEMS: One Dimensional Second Order Equations, Discretization, Element types- Linear and Higher order Elements. Derivation of Shape functions and Stiffness matrices and force vectors, Assembly of Matrices, Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation, Transverse deflections and Natural frequencies of beams.

Module III

TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS: Second Order 2D Equations involving Scalar Variable Functions, Variational formulation, Finite Element formulation, Triangular elements, Shape functions and element matrices and vectors. Application to Field Problems, Thermal problems, Torsion of Non circular shafts, Quadrilateral elements, Higher Order Elements.

Module IV

TWO DIMENSIONAL VECTOR VARIABLE PROBLEM: Equations of elasticity, Plane stress, plane strain and ax symmetric problems. Body forces and temperature effects – Stress calculations – Plate and shell elements. Body forces and temperature effects – Stress calculations – Plate and shell elements.

Module V

ISOPARAMETRIC FORMULATION: Natural co-ordinate systems, Isoparametric elements, Shape functions for iso parametric elements, One and two dimensions. Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques. Solutions Techniques to Dynamic problems – Introduction to Analysis Software

Text /Reference Books:

1. T1.Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw- Hill, 2025
2. R1. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.
- CO2.** Apply finite element formulations to solve one-dimensional Problems.
- CO3.** Apply finite element formulations to solve two-dimensional scalar Problems.
- CO4.** Apply finite element method to solve two-dimensional Vector problems.
- CO5.** Apply finite element method to solve problems on iso parametric element and dynamic Problems.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.	K ₁
CO2	Apply finite element formulations to solve one-dimensional Problems.	K ₂
CO3	Apply finite element formulations to solve two-dimensional scalar Problems.	K ₃
CO4	Apply finite element method to solve two-dimensional Vector problems.	K ₃
CO5	Apply finite element method to solve problems on iso parametric element and dynamic Problems.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4		2												
CO5		2												
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low



GAS DYNAMICS AND JET PROPULSION

Subject Code: -	BTME703-B	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To understand the features of compressible isentropic flows and irreversibility like shocks.
2. To provide a basic knowledge of jet and rocket propulsion 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**

BASIC CONCEPTS AND ISENTROPIC FLOWS: Energy and momentum equations of compressible fluid flows – Stagnation states. Compressible flow, definition, Mach waves and Mach cone. Isentropic flow through variable area ducts, nozzle s and diffusers. Subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow.

Module II

FLOW THROUGH DUCTS: Non-isentropic flow in constant area ducts, Rayleigh and Fanon flows. Variation of flow properties – Use of tables and charts – Generalized gas dynamics.

Module III

NORMAL AND OBLIQUE SHOCKS: Governing equations, Variation of flow parameters across the normal and oblique shocks. Prandtl – Meyer relations, Use of table and charts – Applications.

Module IV

JET PROPULSION: Theory of jet propulsion, thrust equation thrust power and propulsive efficiency. Operating principle and cycle analysis of ramjet. Turbojet, Turbofan and Turboprop engines.

Module V

SPACE PROPULSION: Types of rocket engines, propellants & feeding systems, ignition and combustion. Theory of rocket propulsion, performance study. Staging, terminal and characteristic velocity, space flights.

Text /Reference Books:

1. Ahmed F. El-Sayed, Aircraft Propulsion and Gas Turbine Engines, CRC Press, 2008.H.S.
2. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing, 2004.
3. Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley, 1992.

Reference Books

1. Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.
2. Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Understand the basic difference between incompressible and compressible flow.
- CO2.** Understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
- CO3.** Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion.
- CO4.** Understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.
- CO5.** Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand the basic difference between incompressible and compressible flow.	K ₁
CO2	Understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.	K ₂
CO3	Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion.	K ₃
CO4	Understand the phenomenon of shock waves and its effect on flow. To gain some basic knowledge about jet propulsion and Rocket Propulsion.	K ₃
CO5	Upon completion of this course, the students can able to successfully apply gas dynamics principles in the Jet and Space Propulsion.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4		2												
CO5		2												
CO(Average)	3	1	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

SUSTAINABLE DEVELOPMENT

Subject Code: -	BTME704-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To impart knowledge on the principles for balancing social, economic and environmental dimensions of development and the associated international and national frameworks.
2. Appreciate some of the scientific underpinnings of sustainability practice and how policymakers are trying to apply it for better governance of scarce resources.
3. Gain additional scientific knowledge regarding planetary boundaries and their influence on international economic development.

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: Historical Background, Mathematical Modeling of field problems in Engineering, Governing Equations – Discrete and continuous models. Boundary, Initial and Eigen Value problems, Weighted Residual Methods, Variation Formulation of Boundary Value Problems, Ritz Technique. Basic concepts of the Finite Element Method.

Module II

ONE-DIMENSIONAL PROBLEMS: One Dimensional Second Order Equations, Discretization, Element types- Linear and Higher order Elements. Derivation of Shape functions and Stiffness matrices and force vectors, Assembly of Matrices, Solution of problems from solid mechanics and heat transfer. Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation, Transverse deflections and Natural frequencies of beams.

Module III

TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS: Second Order 2D Equations involving Scalar Variable Functions, Variational formulation, Finite Element formulation, Triangular elements, Shape functions and element matrices and vectors. Application to Field Problems, Thermal problems, Torsion of Non circular shafts, Quadrilateral elements, Higher Order Elements.

Module IV

TWO DIMENSIONAL VECTOR VARIABLE PROBLEM: Equations of elasticity, Plane stress, plane strain and axis symmetric problems. Body forces and temperature effects – Stress calculations – Plate and shell elements. Body forces and temperature effects – Stress calculations – Plate and shell elements.

Module V

ISOPARAMETRIC FORMULATION: Natural co-ordinate systems, Iso-parametric elements, Shape functions for iso parametric elements, One and two dimensions. Serendipity elements – Numerical integration and application to plane stress problems – Matrix solution techniques. Solutions Techniques to Dynamic problems – Introduction to Analysis Software

Text /Reference Books:

1. T1.Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw- Hill, 2025
2. R1. Seshu, P, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd., New Delhi, 2007.

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Describe the national and global environmental, economic and social issues and the principles of different sustainable development frameworks
- CO2.** Apply the sustainable development principles during the planning of developmental activities.
- CO3.** Understand the practice and policy of sustainable pathways to development.

- CO4.** Understand how development leaders can apply various attributes of sustainability (environmental, economic and social).
- CO5.** Be aware of the current international policy landscape for the Sustainable Development Goals.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Describe the national and global environmental, economic and social issues and the principles of different sustainable development frameworks	K ₁
CO2	Apply the sustainable development principles during the planning of developmental activities.	K ₂
CO3	Understand the practice and policy of sustainable pathways to development.	K ₃
CO4	Understand how development leaders can apply various attributes of sustainability (environmental, economic and social).	K ₃
CO5	Be aware of the current international policy landscape for the Sustainable Development Goals.	K ₃

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	PO1 2	PSO1	PSO2
CO1	3						1		1					
CO2		1	2											
CO3				3									1	
CO4		2												
CO5		2												
CO(Average)	3	1.66	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

INTERNET OF THINGS

Subject Code: -	BTME704-B	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. 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.

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	K ₃
CO5	Application of IoT in automation of Commercial and Real world examples	K ₃

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					
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

ENGINEERING PROJECT-2

Subject Code: -	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: -	BTEEC706P	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:

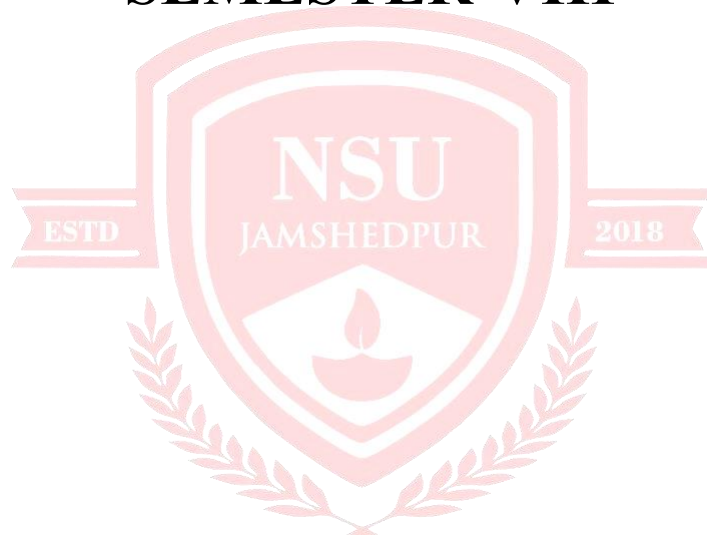
Criteria	Description	Maximum Marks
Internal Assessment (IA)	Internal Examination	40
Terminal Examination (TE)	Terminal Examination	60
Total		100
Attendance	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 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

SEMESTER-VIII



SEMESTER-VIII

Sl.	Code No.	Category	Name of the Subjects	Periods			Credits	Marks		
				L	T	P		IA	TE	TM
1	BTME 801	PEC		3	0	0	3	40	60	100
2	BTME 802	OEC	Open Elective-3	3	0	0	3	40	60	100
Professional Elective-3 Practical										
3	BTME 803P	EEC	Engineering Project-3 (Prototype & Testing)	-	-	16	8	80	120	200
Total				6	0	16	14	160	240	400



PROFESSIONAL ELECTIVE COURSES**ENERGY CONSERVATION AND MANAGEMENT**

Subject Code: -	BTME801-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	40	CREDITS	03

Course Objective:

Following are the intended objectives of the Project work:

1. To understand the energy data from industries and carry out energy audit for energy savings.

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.	

Course Content:**Module I**

INTRODUCTION: Introduction to energy & power scenario of world, National Energy consumption data, environmental aspects associated with energy utilization. Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Module II

COMPONENT: Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics. Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Module III

THERMAL SYSTEMS: Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures. Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Module IV

ENERGY: Energy conservation in major utilities; pumps, fans, blowers, compressed air systems. Refrigeration & Air Conditioning systems, Cooling Towers, DG sets.

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Understand and analyze the energy data of industries
- CO2.** Carryout energy accounting and balancing
- CO3.** Conduct energy audit and suggest methodologies for energy savings and
- CO4.** Utilize the available resources in optimal ways

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand and analyze the energy data of industries	K ₁
CO2	Carryout energy accounting and balancing	K ₂
CO3	Conduct energy audit and suggest methodologies for energy savings	K ₃
CO4	Utilize the available resources in optimal ways	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4		2												
CO(Average)	3	1.5	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

TEXT BOOKS

- Witte L.C. , Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988.
- Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.

REFERENCE BOOKS

- Murphy W.R. and McKay G., Energy Management, Butterworths, Lond

PROCESS PLANNING AND COST ESTIMATION

Subject Code: -	BTME801-B	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	40	CREDITS	03

Course Objective:

Following are the intended objectives of the Project work:

1. To introduce process planning concepts to make cost estimation for various products

1. 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.	

Course Content:

Module I

INTRODUCTION: Introduction of Process Planning- methods of process planning, drawing interpretation. Material evaluation, steps in process selection, production equipment and tooling selection.

Module II

PROCESS PLANNING: Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures. Selection of quality assurance methods, documents for process planning, economics of process planning, case studies

Module III

INTRODUCTION: Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation. Types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost.

Module IV

MACHINING: Machining time estimation- importance of machine time calculation,

machining time for different lathe operations, drilling and boring time calculations. Machining time calculation for Milling, Shaping, Planning and Grinding.

Module V

PRODUCTION: Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Upon completion of this course, the students will be able to use the concepts of process planning and cost estimation for various products
- CO2.** Describe the functions of production control, various production system, different aspects of product development and break even analysis.
- CO3.** Perform the analysis of problems in lack of product planning, quantity determination in batch production and analysis of process capabilities in a multi-product system.
- CO4.** Calculate the economic order quantity & economic lot size in inventory control.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Upon completion of this course, the students will be able to use the concepts of process planning and cost estimation for various products	K ₁
CO2	Describe the functions of production control, various production system, different aspects of product development and break even analysis.	K ₂
CO3	Perform the analysis of problems in lack of product planning, quantity determination in batch production and analysis of process capabilities in a multi-product system.	K ₃
CO4	Calculate the economic order quantity & economic lot size in inventory control.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4		2												
CO(Average)	3	1.5	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

TEXT BOOKS

1. Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci.&Tech. 2002.
2. Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.

REFERENCE BOOKS

1. Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002



PRINCIPLES OF MANAGEMENT

Subject Code: -	BTME801-C	IA Marks	40
Number of Lecture Hours/Week:-	04	Term End Exam Marks	60
Total Number of Lecture Hours: -	40	CREDITS	03

Course Objective:

Following are the intended objectives of the Project work:

1. To understand the principles of management and their application to the functioning of an organization

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.	

Course Content:**Module I**

DEFINITION: Definition of management, science or art, manager vs entrepreneur; Types of managers- managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches. Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

Module II

NATURE AND PURPOSE: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management. Planning Tools and Techniques, Decision making steps & processes.

Module III

INTRODUCTION: Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization. Job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Module IV

DIRECTING: Directing, individual and group behavior, motivation, motivation theories, motivational techniques. Jobsatisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

Module V

CONTROLLING: Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control. Productivity problems and management, control and Performance, direct and preventive control, reporting.

Course Outcomes:

At the end of this course students will demonstrate the ability

- CO1.** Upon completion of this course, the students will get a clear understanding of management functions in an organization.
- CO2.** Understand the principles and remember the applications of principles of management related to public and private administration in relation to production activities.
- CO3.** Apply human relation skills for motivating the employees.
- CO4.** Develop Logical and Analytical ability to apply analyze problems related to production

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Upon completion of this course, the students will get a clear understanding of management functions in an organization.	K ₁
CO2	Understand the principles and remember the applications of principles of management related to public and private administration in relation to production activities.	K ₂
CO3	Apply human relation skills for motivating the employees.	K ₃
CO4	Develop Logical and Analytical ability to apply analyze problems related to production	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4		2												
CO(Average)	3	1.5	2	3			1		1				1	

3 –High; 2 –Medium; 1 –Low

TEXT BOOKS

1. Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.
2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.

REFERENCE BOOKS

1. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999



AUTOMOBILE ENGINEERING

Subject Code: -	BTME801-D	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 understand the construction and working principle of various parts of an automobile

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: History of automobiles; Classification of automobiles; Power plant classification; Engine terminology; Types of cycles; Working principle of an IC engine; Advanced classification of engines and multi cylinder engines; Engine balance and firing order.

Module II

Fuel System, Ignition System and Electrical system: Spark Ignition engines – fuel tank, fuel filter, fuel pump, air filter, carburetor, direct injection of petrol engines; Compression Ignition engines – fuel injection (air and solid), pressure charging, super charging and turbo charging; Ignition systems – components, battery ignition, magneto ignition, electronic ignition and ignition timing; Main electrical circuits – generating & starting circuit, lighting, indicating devices.

Module III

Lubricating System and Cooling System: Functions & properties of lubricants, methods of lubrication; Oil filters, oil pumps, oil coolers; Characteristics of an effective cooling system; types of cooling systems; Radiator, thermostat, air cooling & water cooling.

Chassis & Transmission: Parts of automobile body; Automobile frames – functions, constructions, sub frames, materials and defects; Transmission – axles, clutches, propeller shafts, differential, gear boxes, automatic transmission, electronic transmission control, functions and types of front and rear axles, types and functions of clutches, Hotchkiss drive torque tube drive, traction control.

Module IV

Steering, Braking and Suspension: Steering mechanism, steering gear box types, wheel

geometry; Brakes – principle, functions, types, construction, operation and parking brake; Suspension - types of spring shock absorbers, objectives and types of suspension system, rear axle suspension, electronic control and proactive suspension system.

Module V

Automotive Air Conditioning: Ventilation, heating, air condition, refrigerant, compressor and evaporator. **Wheels and Tyres:** Wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications. **Recent Trends:** E-vehicles; Satellite-based navigation; Automated steering; Environment effect and mitigation.

Text /Reference Books:

1. A.K. Babu, S.C. Sharma, Automobile Mechanics, Khanna Book Publishing, 2019.
2. A.K. Babu, S.C. Sharma, Automobile Engines, Khanna Book Publishing, 2019.
3. Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.
4. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002.
5. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
6. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

Online Resources:

1. <https://archive.nptel.ac.in/courses/107/106/107106088/>

Course Outcomes:

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

- CO1.** Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.
- CO2.** Understand the Construction, working and other details about Internal Combustion Engines used in automobiles.
- CO3.** Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.
- CO4.** Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.

Course Outcome No	Statement	Knowledge Level (KL)

CO1	Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.	K ₁
CO2	Understand the Construction, working and other details about Internal Combustion Engines used in automobiles.	K ₂
CO3	Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.	K ₃
CO4	Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.	K ₂

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					
CO2		1	2											
CO3				3									1	
CO4	3		3								2			
CO(Average)	3	1	2.5	3			1		1		2		1	

3 –High; 2 –Medium; 1 –Low

DESIGN OF TRANSMISSION SYSTEMS

Subject Code: -	BTME801-E	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	50	CREDITS	03

Course Objective:

To learn about the design procedures for mechanical power transmission components

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**

FLEXIBLE TRANSMISSION ELEMENTS: Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets.

Module II

GEAR TRANSMISSION: Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, and gear materials. Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Module III

STRAIGHT BEVEL GEAR: Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears. Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses efficiency. Estimating the size of worm. Gear pair. Cross-helical gears, terminology, helix angles, sizing of a pair of helical gears

Module IV

GEAR BOX: Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-speed gear box for machine tool applications. Constant mesh gearbox, speed reducer unit; Variable speed gearbox; Fluid

couplings, Torque converters for automotive applications.

Module V

CAM DESIGN: Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses. Design of plate clutches, axial clutches, cone clutches, and internal expanding rim clutches; Electromagnetic clutches. Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Text /Reference Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.

Reference Books

Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001.

Course Outcome

- CO1.** The students will be able to design transmission systems for engines and machines.
CO2. The students will be able to design transmission systems for engines and machines.
CO3. To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
CO4. To understand the standard procedure available for Design of Transmission of Mechanical elements.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	The students will be able to design transmission systems for engines and machines.	K ₁
CO2	The students will be able to design transmission systems for engines and machines.	K ₂
CO3	To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.	K ₃
CO4	To understand the standard procedure available for Design of Transmission of Mechanical elements elements	K ₂

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					
CO2		1	2										
CO3				3								1	
CO4	3		3							2			
CO(Average)	3	1	2.5	3			1		1	2		1	

3 –High; 2 –Medium; 1 –Low

OPEN EL ELECTIVE COURSES

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

Subject Code: -	BTME802-A	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To have a thorough understanding of classical and modern AI applications.
2. To be able to implement a wide range of AI concepts using Prolog.
3. Understand non-classical AI approaches such as genetic algorithms and neural networks.
4. To be able to assess the potential of AI in research and real-world environment

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: History and foundations of AI, Problem solving: Uninformed and informed Search; Constraint Satisfaction Problems and Constrained Optimization problems (complete and incomplete techniques).

Module II

ADVERSARIAL SEARCH: Two players games, games with uncertainty; Decision support systems and technologies, Knowledge representation, Reasoning, Expert systems Contents

(2/2), Planning(basics).

Module III

MACHINE LEARNING BASICS: Decision trees, Ensemble learning, Reinforcement learning, Evolutionary computation, Neural networks, Problems, data, and tools; Visualization;

Module IV

LINEAR REGRESSION: Gradient descent; closed form; normal equations; features, Over fitting and complexity; training, validation, test data, and introduction to Matlab.

Module V

CLASSIFICATION PROBLEMS: Decision boundaries; Probability and classification, Bayes optimal decisions, Naive Bayes and Gaussian class-conditional distribution.

TEXT BOOKS

1. Russell, Norvig, Artificial intelligence: A modern approach, 2nd edition. Pearson/Prentice Hall.

REFERENCE BOOKS

1. R1.EthemAlpaydin, Introduction to Machine Learning, Second Edition,

Course Outcome

- CO1.** Identify problems that are amenable to solution by AI methods.
- CO2.** Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
- CO3.** Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
- CO4.** able to design and implement various machine learning algorithms in a range of real-world applications.
- CO5.** Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Identify problems that are amenable to solution by AI methods.	K ₁
CO2	Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.	K ₂
CO3	Have a good understanding of the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.	K ₃
CO4	able to design and implement various machine learning algorithms in a range of real-world applications.	K ₂

CO5	Machine Learning algorithms and the paradigms of supervised and un-supervised learning.	K2
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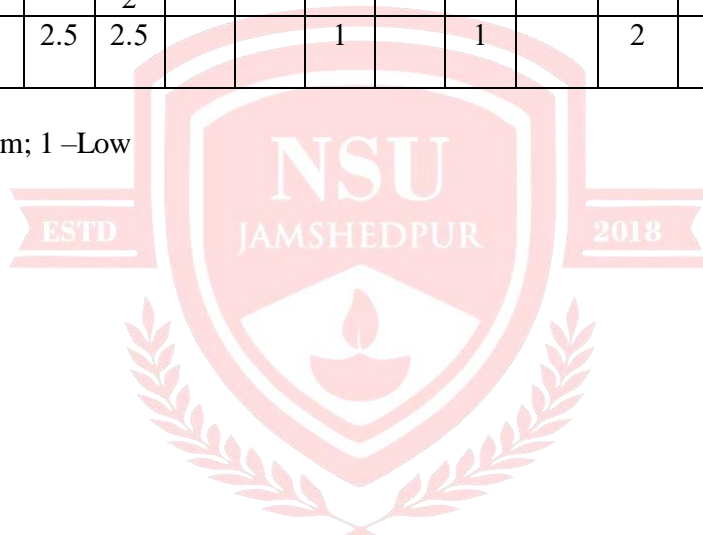
KL- Bloom's Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

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					
CO2		1	2											
CO3				3									1	
CO4	3		3								2			
CO5	3	3		2										2
CO(Average)	3	2	2.5	2.5			1		1		2		1	2

3 –High; 2 –Medium; 1 –Low



CYBER SECURITY LAWS, STANDARDS & IPR

Subject Code: -	BTME802-B	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. Cyber Security is to achieve these three elements (Confidentiality, Integrity and Availability) and also known as CIA Triad. For any organization, it's essential to protect its data, information using security tools.
2. Implement Cyber Security Best Practices and Risk Management

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:

BASIC OF COMPUTER AND CYBER SECURITY: History of Computers, Areas of Application Computers and its components, Application Software and System Software Introduction to Operating System. Basics of Networks and internet, Types of Network, Definition of Cyber Security, Search Engines, E –mails and WWW; Internetworking Devices, Internet Service provider, IP Address, Working of Email system, Domain Name System, Blogs, Peer to peer sharing, Computer & Cyber Security:(a) Types of Attacks,(b) Network Security(c) Overview of Security threats,(d) Hacking Techniques,(e) Password cracking(f) Insecure Network connections,(g) Malicious code(h) Concept of Fire wall Security.

INFORMATION TECHNOLOGY LAW (CYBER LAW): Evolution of the IT Act, Genesis and Necessity. Salient features of the IT Act, 2000, various authorities under IT Act and their powers. ; Penalties & Offences, amendments. Different kinds of cyber law in Indian history.

CYBER SPACE JURISDICTION: (a) Jurisdiction issues under IT Act, 2000.(b) Traditional principals of Jurisdiction(c) Extra-terrestrial Jurisdiction(d) Case Laws on Cyber Space Jurisdiction.

CYBER CRIME AND INVESTIGATION PROCEDURES: Cyber Forensic and Computer Crimes and types. Crimes targeting Computers: Definition of Cyber Crime & Computer related Crimes, Classification & Differentiation between traditional crime and cybercrimes. (a) Data Theft

(b) Hacking, (c) Spreading Virus & Worms (d) Phishing (e) Cyber Stalking / Bullying (f) Identity Theft & Impersonation (g) Credit card & Online Banking Frauds, Reasons for Cyber Crimes. Cyber Criminal Mode and Manner of Committing Cyber Crime Prevention of Cyber Crimes & Frauds Critical analysis & loop holes of The IT Act,2000Cyber Crimes: Freedom of speech in cyber space & human right issue Investigation of Cyber Crimes ,Investigation of malicious applications, Agencies for investigation in India, their powers and their constitution as per Indian Laws.

TEXT BOOKS

1. Cyber Law & Cyber Crimes by Advocat Prashant Mali; Snow White publications, Mumbai
2. Cyber Law in India by Farooq Ahmad; Pioneer Books
3. Information Technology Law and Practice by Vakul Sharma; Universal Law Publishing Co. Pvt. Ltd.
4. The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
5. Guide to Cyber and E – Commerce Laws by P.M. Bukshi and R.K. Suri; Bharat Law House, New Delhi
6. Guide to Cyber Laws by Rodney D. Ryder; Wadhwa and Company, Nagpur
7. The Information Technology Act, 2000; Bare Act – Professional Book Publishers, New Delhi

REFERENCE BOOKS

1. Computer Forensics: Principals and Practices by Linda Volonino, Reynaldo Anzaldua and Jana Godwin; Pearson Prentice – Hall 2007
2. First Responder’s Guide to Computer Forensics by Richard Nolan rt al; Carnegi Mellon, 2005.
3. Digital Evidence and Computer Crime, 2nd Ed. By Eoghan Casey; Academic Press, 2004.
4. The Regulation of Cyberspace by Andrew Murray, 2006; Rutledge – Cavendish.
5. Scene of the Cybercrime: Computer Forensics Handbook by Syngress.
6. Security and Incident Response by Keith J. Jones, Richard Bejtloich and Curtis W.Rose

Course Outcome

- CO1.** Conduct a cyber security risk assessment
CO2. Measure the performance and troubleshoot cyber security systems.
CO3. Implement cyber security solutions.
CO4. Students able to use cyber security, information assurance, and cyber/computer forensics software/tools.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Conduct a cyber security risk assessment	K ₁

CO2	Measure the performance and troubleshoot cyber security systems.	K ₂
CO3	Implement cyber security solutions.	K ₃
CO4	Students able to use cyber security, information assurance, and cyber/computer forensics software/tools.	K ₃

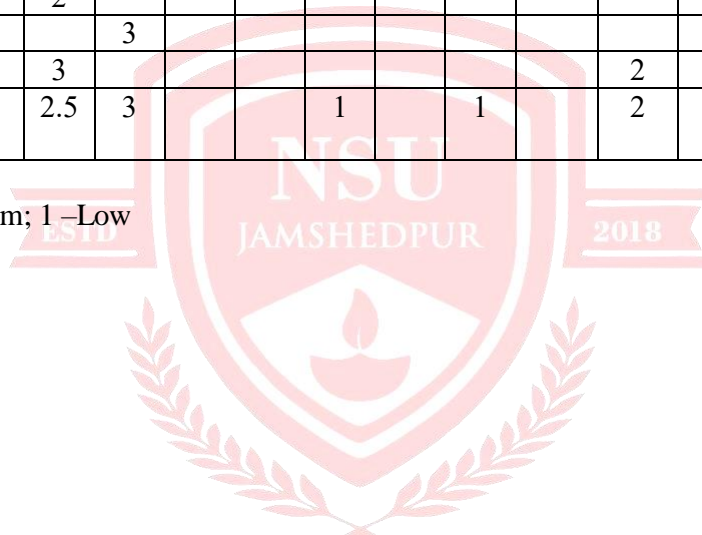
KL- Bloom's Knowledge Level (K₁, K₂, K₃, K₄, K₅, K₆)

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					
CO2		1	2											
CO3				3									1	
CO4	3		3								2			
CO(Average)	3	1	2.5	3			1		1		2		1	

3 –High; 2 –Medium; 1 –Low



PROJECT MANAGEMENT

Subject Code: -	BTME802-C	IA Marks	40
Number of Lecture Hours/Week:-	03	Term End Exam Marks	60
Total Number of Lecture Hours: -	45	CREDITS	03

Course Objective:

1. To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

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:

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS: Definition of Management – Science or Art – Manager Vs Entrepreneur – types of managers – managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization – Sole proprietorship, partnership, company-public and private sector enterprises – Organization culture and Environment – Current trends and issues in Management.

PLANNING: Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

ORGANISING: Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design – Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

DIRECTING: Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

CONTROLLING: System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting

TEXT BOOKS

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” 7th Edition, Pearson Education, 2011.
2. Robert Kreitner & Mamata Mohapatra, “Management”, Biztantra, 2008.

REFERENCE BOOKS

1. Harold Koontz & Heinz Weihrich “Essentials of management” Tata Mc Graw Hill, 1998.
2. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

Course Outcome

- CO1.** Understand key concepts of project management and project lifecycle
CO2. Apply the Project Management Techniques.
CO3. Describe the Project Management Planning Process.
CO4. Project Management Team concepts.

Course Outcome No	Statement	Knowledge Level (KL)
CO1	Understand key concepts of project management and project lifecycle	K ₁
CO2	Apply the Project Management Techniques.	K ₂
CO3	Describe the Project Management Planning Process.	K ₃
CO4	Project Management Team concepts.	K ₃

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					
CO2		1	2											
CO3				3									1	
CO4	3		3								2			

CO(Average)	3	1	2.5	3			1		1		2		1	
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3 –High; 2 –Medium; 1 –Low

ENGINEERING PROJECT-3

Subject Code: -	BTME803P	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 and this project to be carried over to next semester.

