SCHEME AND SYLLABUS

FIRST YEAR

for

BACHELOR OF TECHNOLOGY

in

MECHANICAL ENGINEERING

(w.e.f. session 2026-2027)

(As per NEP 2020)

(Choice Based Credit Scheme)

DEPARTMENT OF MECHANICAL ENGINEERING

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD

J. C. Bose University of Science and Technology, YMCA, Faridabad
(formerly YMCA University of Science and Technology)
A State Govt. University established wide State Legislative Act. No. 21 of 2009
SECTOR-6, FARIDABAD, HARYANA-121006

GOLDEN JUBILEE YEAR
(1969-2019)

VISION

"J.C. Bose University of Science and Technology, YMCA, Faridabad aspires to be a nationally and internationally acclaimed leader in technical and higher education in all spheres which transforms the life of students through integration of teaching, research and character building."

MISSION

- To contribute to the development of science and technology by synthesizing teaching, research and creative activities.
- To provide an enviable research environment and state-of-the-art technological exposure to its scholars.
- To develop human potential to its fullest extent and make them emerge as world class leaders in their professions and enthuse them towards their social responsibilities.

Department of Mechanical Engineering

VISION

"To be a centre of excellence by producing high caliber, competent and self-reliant mechanical engineers, who possess scientific temperament and would engage in activities relevant to industries with ethical values and flair to research."

MISSION

- To provide efficient engineers for global requirements by imparting quality education.
- To explore, create and develop innovations in various aspects of engineering through industries and institutions.
- To emphasize on practical skills and socially relevant technology.

ABOUT THE DEPARTMENT

J.C. Bose University of Science and Technology, YMCA, Faridabad established in 2009, formerly known as YMCA Institute of Engineering, Faridabad, was established in year 1969 as a Joint Venture of Govt. of Haryana and National Council of YMCAs of India with active assistance from overseas agencies of West Germany to produce highly practical oriented personnel in specialized fields of engineering to meet specific technical manpower requirements of industries. Mechanical Engineering Department was started in 1969 and has been conducting 4 years B.Tech. Course in Mechanical Engineering since 1997 with an intake of '60' students and subsequently, it was increased to '75' in 1999, '90' in 2004 and '120' in 2007. Students are admitted through centralized counseling conducted by State Government. Presently, the total intake for the B.Tech. programme is 120 and 12 through LEET in second year along with B.Tech. Mechanical Engineering in Regional Language with an intake of 30. Besides B.Tech. in Mechanical Engineering, B.Tech. in Robotics and Artificial Intelligence has also been started with an intake of 30 since 2021. The department is also running M.Tech. in Manufacturing Technology and Automation, M.Tech. in Environment and Energy with an intake of 18 each and PhD programmes. All programmes are duly approved by AICTE/ UGC. All eligible programmes are NBA accredited. The department has started minor degree in 'Robotics' and 'Industry 4.0' from session 2023-24 and 2024-25 onwards respectively. The Mechanical Engineering Department has been well known for its track record of employment of the pass out students since its inception.

The Department has a separate building with ICT enabled class rooms, state of the art laboratories, research lab, workshops, seminar room, conference hall and departmental library. It has established Centre of Excellences with M/s Daikin (P) Ltd. in the field of 'Refrigeration and Air Conditioning'. It has well qualified and experienced faculty. The syllabi of UG/PG courses in Mechanical Engineering Department have been prepared with active participation from Industry. The Department is organizing number of expert lectures from industry experts for students in every semester. One semester Industrial training is mandatory for every B.Tech. student. Emphasis has been given on project work and workshop for skill enhancement of students. Choice based credit system (CBCS) allows students to study the subjects of their choice from a number of elective & audit courses.

TABLE 1 PROGRAM EDUCATION OBJECTIVES (PEOs)

PEO1	To train students with practical skills and experimental practices related to core and applied areas of Mechanical Engineering to expand their knowledge horizon beyond books.
PEO2	To enable students to design, develop and maintain mechanical equipment's which are useful for the society.
PEO3	To improve team building, team working and leadership skills of the students with high regard for ethical values and social responsibilities.
PEO4	To enable students to communicate effectively and demonstrate the knowledge of project management and independent research.

TABLE 2 PROGRAM OUTCOMES (POs)

PO1	Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2	Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
PO3	Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4	Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5	Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
PO6	The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7	Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
PO8	Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9	Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10	Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11	Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

TABLE 3 PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1	Ability to assimilate the practical knowledge and Mechanical Engineering skills in profession.
PSO2	Ability to innovate in specific aspects of Mechanical Engineering maintaining high standard of social well being and ethical values.

TABLE 4 KNOWLEDGE & ATTITUDE PROFILES

WK1	Natural and Social Science
WK2	Mathematics, Computing, Data Analysis
WK3	Engineering Fundamentals
WK4	Specialized Engineering Knowledge
WK5	Engineering Design and Operations
WK6	Engineering Practice and Technology
WK7	Society, Sustainability, and Professional Responsibility
WK8	Research Literature and Critical Thinking
WK9	Ethics, Professional Responsibility, and Inclusion

TABLE 5 SUSTAINABLE DEVELOPMENT GOALS (SDGs)

SDG 1	**No Poverty** End poverty in all its forms everywhere.
SDG 2	**Zero Hunger** End hunger, achieve food security and improved nutrition, and promote sustainable agriculture.
SDG 3	**Good Health and Well-being** Ensure healthy lives and promote well-being for all at all ages.
SDG 4	**Quality Education** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
SDG 5	**Gender Equality** Achieve gender equality and empower all women and girls.
SDG 6	**Clean Water and Sanitation** Ensure availability and sustainable management of water and sanitation for all.
SDG 7	**Affordable and Clean Energy** Ensure access to affordable, reliable, sustainable, and modern energy for all.
SDG 8	**Decent Work and Economic Growth** Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.
SDG 9	**Industry, Innovation and Infrastructure** Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.
SDG 10	**Reduced Inequalities** Reduce inequality within and among countries.
SDG 11	**Sustainable Cities and Communities** Make cities and human settlements inclusive, safe, resilient, and sustainable.
SDG 12	**Responsible Consumption and Production** Ensure sustainable consumption and production patterns.
SDG 13	**Climate Action** Take urgent action to combat climate change and its impacts.
SDG 14	**Life Below Water** Conserve and sustainably use the oceans, seas, and marine resources.
SDG 15	**Life on Land** Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt biodiversity loss.
SDG 16	**Peace, Justice and Strong Institutions** Promote peaceful and inclusive societies, provide access to justice for all, and build effective, accountable, and inclusive institutions.
SDG 17	**Partnerships for the Goals** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

TABLE 6 COURSE CODES AND DEFINITIONS

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities, Social Sciences and Management Courses
PCC	Professional Core Courses
DSC	Discipline Specific Courses
PEC	Professional Elective Courses
OEC	Open Elective Courses
MAC	Mandatory Audit Courses
PR	Project
INT	Internship
SEC	Skill Enhancement Courses
MOOC	Massive Open Online Courses
VAC	Value Added Courses

MANDATORY INDUCTION PROGRAM (3-WEEKS DURATION)

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. A 3-week long induction program for the UG students entering the institution, right at the start, has to be planned. Normal classes will start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

Tentative activities which can be planned in this Induction Programme are as follows:

• Physical Activity

• Creative Arts

• Universal Human Values

• Literary

• Proficiency Modules

• Lectures by Eminent People

• Visits to Local Area

• Familiarization to Dept./Branch & Innovations

GUIDELINES FOR TREE PLANTATION AND CARE

As approved in Academic Council, Tree Plantation is a mandatory activity for every student admitted to J. C. Bose University of Science and Technology, YMCA, Faridabad.

Instructions for Students:

1. **Tree Plantation:** Each admitted student for undergraduate program of the University is required to plant at least 2-5 tree saplings during his/her first or second semester. The selected location for the plantation may be any place of their choice at/near their home places (e.g., parks, grounds, etc.). The student must capture geo-tagged photographs of the planted saplings and ensure to take proper care of their growth. Please note that the student should also be there in the geotagged photo along with the plant.

2. **Submission of Documents:** The student has to submit geo-tagged photographs of the planted saplings on university ERP platform in the given format, namely, plantation document including other details, viz., name of plant, date of plantation, and any additional information regarding the plantation.

3. **Ongoing Care and Monitoring:** After plantation, every student will take care for these plants and submit their updated geo-tagged photos in plantation document for 2nd and 3rd year also.

    - Each student will have to submit the plantation document once in every year of the program.

    - The plantation document including geo-tagged photos will be submitted for (N-1) times, where N is the total duration of the program in which student is admitted. For example, a student of 4 years B.Tech./B.Sc. program has to submit the plantation document for three consecutive years, i.e., till pre-final year indicating the growth and survival of the tree sapling planted by them.

4. **Tree Survival:** The student must ensure the successful survival of at least one tree out of 2-5 initially planted trees for being eligible for their degree.

5. **Verification of Documents:** The verification of submitted documents will be done by the respective teacher coordinator at each successive year during Practical Examinations towards the end of the semester as per the notified academic calendar for the session.

6. **Certificate of Achievement:** The certificate for eligible student will be auto generated, which may be downloaded from their respective ERP platform after due verification. These students will thereby fulfil the requirement for degree conferral within their respective programs.

The students admitted through LEET will take part in the initiative after their admission in 2nd year of respective program and the requirement of submission of geotagged photographs will be (N-2) times for them as per point 3.

Students have to earn 1 credit for the Tree Plantation Activity during the whole duration of the program.

EXIT CRITERIA FOR MECHANICAL ENGINEERING

For J. C. Bose University of Science and Technology, YMCA, under the NEP framework, the exit criteria generally require students to secure a minimum of 40% marks in the end-term examinations, in accordance with the University Examination Ordinance. In addition, students must fulfill the prescribed overall credit requirements to be eligible for different exit options—such as Certificate, Diploma, or Degree—aligned with the multiple entry and exit provisions of the National Education Policy and the guidelines of the University Grants Commission. Following table depicts exit option after first year.

TABLE 7 EXIT OPTION DETAILS

S.No.	Level	Semester	Exit Options	Credits	Additional Credits for exit students	List of Exit Courses
1.	4.5	Sem I &II	U.G. Certificate (Mechanical Engineering)	40	4	Minimum 4-6 Weeks of Industrial Internship **OR** Online two skill courses at NCrF/NSQF level 4.5 from NSQF/ESSC/Swayam/ NPTEL/ Any other agency that provides Certification/ Evaluation **OR** Technical Project/ Skill Based Courses offered by the department

Exit Option for UG Certificate (Level 4.5): Any student opting for exit option after the second semester will get UG Certificate provided he/she earns 40 Credits of first two semesters and additional 4 credits based on Exit options as per TABLE 8. Thus, he/she will be eligible to exit the course with 44 Credits. In addition, the Internship Report/ Certificate Course/ Technical Project would be evaluated by experts from panel approved by Chairperson, Department of Mechanical Engineering, J.C. Bose University of Science and Technology, YMCA, Faridabad.

The skill-based courses equivalent to NCrF/NSQF level 4.5 for Exit option for UG Certificate could be (but not limited to) is shown in Table 8.

TABLE 8 COURSES FOR EXIT OPTION FOR UG CERTIFICATE

S.No.	Course Code	Course name	Credits
1.		Welding Technology AC/Refrigeration Mechanic Fitting and Bench Work Sheet Metal Work Machining Practices CNC Machine Operation Lathe and Milling Operations Tool and Die Basics Engineering Drawing and Drafting	2 each

EMPLOYMENT PATHWAYS AFTER EXIT FOR UG CERTIFICATE:

1. Exit Qualification: UG Certificate

2. NSQF/NCrF Level: 4.5

3. Associated Industry Sectors: Manufacturing, Automotive, HVAC, Energy, Robotics, Maintenance, Design.

4. Mapped Job Roles: Mechanical Assistant, CNC Operator/Setter, AC/Refrigerator Assistant, Mechanical Fitter, Tool Room Assistant, Fabricator/Welder, Maintenance Assistant, Machine Shop Assistant, Support Staff in Store/ Logistics/ production planning and control.

5. Possibility of re-entry into higher semesters through Academic Bank of Credits (ABC).

TABLE 9 SEMESTER WISE SUMMARY OF THE FIRST YEAR

S.No.	Semester	Contact Hours	Marks	Credits
1.	I	27 per week	800	21
2.	II	26 per week	725	19

Note: A student has to earn at least 6 credits during the duration of Degree subject to passing of at least two MOOC course of 12 week duration (carrying minimum 3 credits) through SWAYAM Platform.

A student has to earn 1 credit for the Tree Plantation Activity during the whole duration of the progrm.

TABLE 10 PROFESSIONAL CORE COURSES (PCC)

S.No.	Course Code	Course Title	Classroom Instruction (CI) in hours per week per semester		Lab Instruction (LI) in hours per week per semester	Total Instruction (CI+LI) per week per semester	Total contact hours @15 weeks per semester	Team Work (TW) and Self Learning (SL) in hours per semester	Contact Hours required @30 hours per credit	Total Credits@30 hours per Credit	Semester
			L	T	P	Total					
1	MEU-105-V1	Discipline Specific Course-I (Essentials of Mechanical Engineering)	3	-	-	3	45	45	90	**3**	I
2	MEU-107-V1	Discipline Specific Course-II (Python Programming for Mechanical Engineering Lab)	-	-	2	2	30	0	30	**1**	I
		Total	**3**	**0**	**2**	**5**	**75**	**45**	**120**	**4**	

TABLE 11 BASIC SCIENCE COURSES (BSC)

S.No.	Course Code	Course Title	Classroom Instruction (CI) in hours per week per semester		Lab Instruction (LI) in hours per week per semester	Total Instruction (CI+LI) per week per semester	Total contact hours @15 weeks per semester	Team Work (TW) and Self Learning (SL) in hours per semester	Contact Hours required @30 hours per credit	Total Credits@30 hours per Credit	Semester
			L	T	P	Total					
1	MTU-147-V1	Mathematics-I	3	1	-	4	60	60	120	**4**	I
2	CHU-141-V1	Chemistry	3	-	-	3	45	45	90	**3**	I
3	CHU-142-V1	Chemistry Lab	-	-	2	2	30	0	30	**1**	I
4	PHU-161-V1	Physics (Introduction to Electromagnetic Theory)	3	-	-	3	45	45	90	**3**	II
5	PHU-163-V1	Physics (Introduction to Electromagnetic Theory) Lab	-	-	2	2	30	0	30	**1**	II
6	MTU-148-V1	Mathematics-II	3	1	-	4	60	60	120	**4**	II
7	ENU-101-V1	Biology for Engineers	2	-	-	2	30	30	60	**2**	II
		Total	**14**	**2**	**4**	**20**	**300**	**240**	**540**	**18**	

TABLE 12 ENGINEERING SCIENCE COURSES (ESC)

S.No.	Course Code	Course Title	Classroom Instruction (CI) in hours per week per semester		Lab Instru-ction (LI) in hours per week per semes-ter	Total Instru-ction (CI+LI) per week per semes-ter	Total contact hours @15 weeks per semester	Team Work (TW) and Self Learning (SL) in hours per semester	Contact Hours required @30 hours per credit	Total Credits @ 30 hours per Credit	Semester
			L	T	P	Total					
1	ELU-151-V1	Fundamentals of Electrical Engineering	3	-	-	3	45	45	90	**3**	I
2	MEU-101-V1	Workshop-I	-	-	4	4	60	0	60	**2**	I
3	ELU-153-V1	Fundamentals of Electrical Engineering Laboratory	-	-	2	2	30	0	30	**1**	I
4	MEU-103-V1	Engineering Graphics and 2D Modelling	-	-	4	4	60	0	60	**2**	II
5	CSU-101-V1	Programming for Problem Solving	3	-	-	3	45	45	90	**3**	II
6	MEU-102-V1	Workshop-II	-	-	4	4	60	0	60	**2**	II
7	CSU-103-V1	Programming for Problem Solving lab	-	-	2	2	30	0	30	**1**	II
		Total	**6**	**0**	**16**	**22**	**330**	**90**	**420**	**14**	

TABLE 13 HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSMC)

S.No.	Course Code	Course Title	Classroom Instruction (CI) in hours per week per semester		Lab Instru-ction (LI) in hours per week per semester	Total Instru-ction (CI+LI) per week per semes-ter	Total contact hours @15 weeks per semester	Team Work (TW) and Self Learning (SL) in hours per semester	Contact Hours required @30 hours per credit	Total Credits @ 30 hours per Credit	Semester
			L	T	P	Total					
1	ENG-101-V1	English	2	-	-	2	30	30	60	**2**	I
2	ENG-103-V1	English Lab	-	-	2	2	30	0	30	**1**	I
		Total	**2**	**0**	**2**	**4**	**60**	**30**	**90**	**3**	

TABLE 14 VALUE ADDED COURSES (VAC)

S.No.	Course Title	Classroom Instruction (CI) in hours per week per semester		Lab Instru-ction (LI) in hours per week per semes-ter	Total Instru-ction (CI+LI) per week per semes-ter	Total contact hours @15 weeks per semester	Team Work (TW) and Self Learning (SL) in hours per semester	Contact Hours required @30 hours per credit	Total Credits @ 30 hours per Credit	Semester
		L	T	P	Total					
1	VAC Elective	-	-	2	2	30	0	30	**1**	II
	Total	**0**	**0**	**2**	**2**	**30**	**0**	**30**	**1**	

TABLE 15 VALUE ADDED COURSES (VAC)

S.No.	Course Code	Course Title	Hours Per Week	Total Credits	Semester
1.	VAC-112-V1	VAC-I (Constitution of India)	2	1	II
2.	VAC-105-V1	VAC-II (Universal Human Values)	2	1	II
3.	AEC-106-V1	VAC-III (Message of Bhagavad Gita)	2	1	II
4.	VAC-115-V1	VAC-IV (Essence of Indian Traditional Knowledge)	2	1	II
Total			**2**	**1**	

Students have to select any one Value Added Course from the list of courses.

TABLE 16 GRADING SCHEME

Marks %	Grade	Grade points	Category
90-100	O	10	Outstanding
80≤ marks<90	A+	9	Excellent
70≤marks< 80	A	8	Very good
60≤ marks< 70	B+	7	Good
50≤ marks< 60	B	6	Above average
45≤ marks< 50	C	5	Average
40≤marks< 45	P	4	Pass
<40	F	0	Fail
	Ab	0	Absent

Percentage Calculation= CGPA * 9.5

Cumulative Grade Point Average (CGPA)

A student is required to maintain a Cumulative Grade Point Average (CGPA) which is the weighted average of all the Letter Grades obtained by the student since his/ her entry into the University upto and including the latest semester and is computed as follows:

$$CGPA= \sum(C_i G_{i)} / C_i$$

Where, C_i denotes the credits assigned to i^{th} course and G_i indicates the Grade Point Equivalent to the Letter Grade obtained by the student to the i^{th} course. Provided that when a student re-appears in/ repeats a course, the new Grade will replace the earlier one in the calculation of the CGPA.

Note:

At the end of the semester (i.e. after End Semester Examination), students will be supplied a DMC indicating the grades secured in each course, Semester Grade Point Average (SGPA) and up-to-date CGPA.

B.TECH. MECHANICAL ENGINEERING

(I & II SEMESTER)

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B. Tech. Mechanical Engineering
[Level 4.5, UG Regular] I Year, Semester – I
(2026-27) (As per NEP 2020)

TABLE 17 SCHEME FOR SEMESTER – I

Course Notation	Course Code	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examinations		Total Marks	Credits	Course Type
			L	T	P	Total		Theory	Practical			
B	PHU-161-V1	Physics (Introduction to Electromagnetic Theory)	3	-	-	3	40	60	-	100	3	BSC
C	MTU-147-V1	Mathematics-I	3	1	-	4	40	60	-	100	4	BSC
A	ELU-151-V1	Fundamentals of Electrical Engineering	3	-	-	3	40	60	-	100	3	ESC
B	MEU-103-V1	Engineering Graphics and 2D Modelling	-	-	4	4	50	-	50	100	2	ESC
A	CHU-141-V1	Chemistry	3	-	-	3	40	60	-	100	3	BSC
B	CSU-101-V1	Programming for Problem Solving	3	-	-	3	40	60	-	100	3	ESC
A	MEU-101-V1	Workshop-I	-	-	4	4	50	-	50	100	2	ESC
B	MEU-102-V1	Workshop-II	-	-	4	4	50	-	50	100	2	ESC

A	ENG-101-V1	English	2	-	-	2	40	60	-	100	2	HSMC
B	PHU-163-V1	Physics (Introduction to Electromagnetic Theory) Lab	-	-	2	2	25	-	25	50	1	BSC
A	ELU-153-V1	Fundamentals of Electrical Engineering Laboratory	-	-	2	2	25	-	25	50	1	ESC
A	CHU-142-V1	Chemistry Laboratory	-	-	2	2	25	-	25	50	1	BSC
B	CSU-103-V1	Programming for Problem Solving lab	-	-	2	2	25	-	25	50	1	ESC
A	ENG-103-V1	English Lab	-	-	2	2	25	-	25	50	1	HSMC
B	ENU-101-V1	Biology for Engineers	2	-	-	2	40	60	-	100	2	BSC
B	-	VAC Elective	-	-	2	2	25	-	-	25	1	VAC
D	MEU-105-V1	Discipline Specific Course-I (Essentials of Mechanical Engineering)	3	-	-	3	40	60	-	100	3	PCC
D	MEU-107-V1	Discipline Specific Course-II (Python Programming for Mechanical Engineering Lab)	-	-	2	2	25	-	25	50	1	PCC

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration

c. Workshop exam will be of 03 hours duration

Important Notes:

Significance of the Course Notations used in this scheme:

C = These courses are common to both the groups Group-1 and Group-2.
A = Other compulsory courses for Group-1.
B = Other compulsory courses for Group-2.
D = Discipline Specific Course

Students will study either:

Group 1=A + C +D

or

Group 2=B + C

Group-1: All programs under Department of Computer Science & Engineering, Department of Mechanical Engineering and Department of Mathematics.

Group-2: All programs under Department of Electronics Engineering, Department of Electrical Engineering, Department of Civil Engineering and Environmental Sciences and others.

J. C. BOSE UNIVERSITY OF SCIENCE AND TECHNOLOGY, YMCA, FARIDABAD
B. Tech. Mechanical Engineering
[Level 4.5, UG Regular] I Year, Semester – II
(2026-27) (As per NEP 2020)

TABLE 18 SCHEME FOR SEMESTER – II

Course Notation	Course Code	Course Title	Teaching Schedule				Marks for Sessionals	Marks for End Term Examinations		Total Marks	Credits	Course Type
			L	T	P	Total		Theory	Practical			
A	PHU-161-V1	Physics (Introduction to Electromagnetic Theory)	3	-	-	3	40	60	-	100	3	BSC
C	MTU-148-V1	Mathematics-II	3	1	-	4	40	60	-	100	4	BSC
B	ELU-151-V1	Fundamentals of Electrical Engineering	3	-	-	3	40	60	-	100	3	ESC
A	MEU-103-V1	Engineering Graphics and 2D Modelling	-	-	4	4	50	-	50	100	2	ESC
B	CHU-141-V1	Chemistry	3	-	-	3	40	60	-	100	3	BSC
A	CSU-101-V1	Programming for Problem Solving	3	-	-	3	40	60	-	100	3	ESC
B	MEU-101-V1	Workshop-I	-	-	4	4	50	-	50	100	2	ESC
A	MEU-102-V1	Workshop-II	-	-	4	4	50	-	50	100	2	ESC
B	ENG-101-V1	English	2	-	-	2	40	60	-	100	2	HSMC
A	PHU-163-V1	Physics (Introduction to Electromagnetic	-	-	2	2	25	-	25	50	1	BSC

		Theory) Lab										
B	ELU-153-V1	Fundamentals of Electrical Engineering Laboratory	-	-	2	2	25	-	25	50	1	ESC
B	CHU-142-V1	Chemistry Laboratory	-	-	2	2	25	-	25	50	1	BSC
A	CSU-103-V1	Programming for Problem Solving lab	-	-	2	2	25	-	25	50	1	ESC
B	ENG-103-V1	English Lab	-	-	2	2	25	-	25	50	1	HSMC
A	ENU-101-V1	Biology for Engineers	2	-	-	2	40	60	-	100	2	BSC
A	-	VAC Elective	-	-	2	2	25	-	-	25	1	VAC
D	MEU-105-V1	Discipline Specific Course-I (Essentials of Mechanical Engineering)	3	-	-	3	40	60	-	100	3	PCC
D	MEU-107-V1	Discipline Specific Course-II (Python Programming for Mechanical Engineering Lab)	-	-	2	2	25	-	25	50	1	PCC

Note: Exams duration will be as under

a. Theory exams will be of 03 hours duration.

b. Practical exams will be of 02 hours duration.

c. Workshop exam will be of 03 hours duration.

Important Notes:

Significance of the Course Notations used in this scheme: -

C = These courses are common to both the groups Group-1 and Group-2.
A = Other compulsory courses for Group-1.
B = Other compulsory courses for Group-2.
D = Discipline Specific Course

Students will study either

Group 1 = A + C

or

Group 2 = B + C + D

Group-1: All programs under Department of Computer Science & Engineering, Department of Mechanical Engineering and Department of Mathematics.

Group-2: All programs under Department of Electronics Engineering, Department of Electrical Engineering, Department of Civil Engineering and Environmental Sciences and others.

Exit Option for UG Certificate (Level 4.5): Any student opting for exit option after the second semester will get UG Certificate provided he/she earns 40 Credits of first two semesters and additional 4 credits based on Exit options as per TABLE 8. Thus, he/she will be eligible to exit the course with 44 Credits. In addition, the Internship Report/ Certificate Course/ Technical Project would be evaluated by experts from panel approved by Chairperson, Department of Mechanical Engineering, J.C. Bose University of Science and Technology, YMCA, Faridabad.

SYLLABUS CONTENTS

PHU-161-V1
PHYSICS (INTRODUCTION TO ELECTROMAGNETIC THEORY)
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		3	
L	T	P	Total
3	0	0	3

Sessional	40 Marks
Theory	60 Marks
Total	100 Marks
Duration of Exam	3 Hours

Pre- Requisite: Nil

Course Objective

This course provides fundamental knowledge of the laws of electricity and magnetism and their applications to various physical problems. Students will learn the electrostatic and magnetic phenomena and various parameters like electric field and potentials, electric polarization, magnetic fields and potentials, magnetization, electromagnetic induction, Displacement current and introduction to Maxwell's electromagnetic theory. It will develop analytical, numerical, and problem-solving skills for applications in communication technology and modern physical systems.

Course Contents

Unit 1: **Electrostatics**

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

[WK1, WK2, WK3]

Unit 2: **Magnetostatics**

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, Magnetization and associated bound currents; Boundary conditions on Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility.

[WK1, WK2, WK3, WK7]

Unit 3: **Magnetic materials and Electromagnetic Induction**

Ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussion of magnetic field in presence of magnetic materials. Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications.

[WK1, WK2, WK3, WK7, WK8, WK9]

Unit 4: Fundamentals of Maxwell's Electromagnetic Theory
Displacement current, Continuity equation for current densities; Modification of Ampere's law; displace current, calculating magnetic field due to changing electric fields in quasi- static approximation. Maxwell's

equation in vacuum and non-conducting medium; electromagnetic wave equation and energy in an electromagnetic field; Flow of energy and Poynting vector.

[WK1, WK2, WK3, WK7, WK9]

Reference Books:

1. David Griffiths, Introduction to Electrodynamics
2. Halliday and Resnick, Physics
3. W. Saslow, Electricity, magnetism and light

Course Outcomes:

After the successful completion of the course, the students are expected to:

CO 1: Know the basic concepts of electric field and potential
CO 2: Understand of dielectric behaviour of matter
CO 3: Learn the laws of magnetism and electromagnetic induction.
CO 4: Have an understanding of Maxwell's equations and energy propagation in media.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	1	-	1	3	2
CO2	3	2	1	-	2	1	-	-	1	-	1	3	2
CO3	3	3	1	1	2	2	-	-	1	-	1	3	2
CO4	3	2	2	1	2	1	-	-	1	-	1	3	2

Contribution to SDGs:

This course contributes primarily to **SDG 4: Quality Education** by developing a strong foundation in electromagnetism, analytical thinking, and scientific problem-solving essential for engineering education. It also supports **SDG 7: Affordable and Clean Energy** by providing an understanding of electromagnetic principles that underpin modern electrical systems, power generation, transmission, and energy-efficient technologies. Furthermore, the course contributes to **SDG 9: Industry, Innovation and Infrastructure** through the study of Maxwell's electromagnetic theory, magnetic materials, and electromagnetic induction, which form the basis of modern communication systems, electronic devices, and advanced engineering applications. The emphasis on efficient utilization of electromagnetic technologies and sustainable engineering solutions also supports **SDG 13: Climate Action** by enabling the development of energy-efficient systems and environmentally responsible technological innovations.

PHU-163-V1

PHYSICS LAB (INTRODUCTION TO ELECTROMAGNETIC THEORY LAB)

B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	**T**	**P**	**Total**
0	**0**	**2**	**1**

Sessional	**25 Marks**
Practical	**25 Marks**
Total	**50 Marks**
Duration of Exam	**2 Hours**

Pre- Requisite: Electromagnetic Theory

Course Objective:

This course complementary lab courses for Introduction to Electromagnetic Theory which provides practical knowledge of different fundamental topics learned in the theory part of the course.

Contents:

Each student needs to perform at least 6 experiments from the following:

1. To verify the law of Malus for plane polarized light.
2. To determine the specific rotation of sugar solution using Polarimeter.
3. To analyze elliptically polarized Light by using a Babinet's compensator.
4. To study dependence of radiation on angle for a simple Dipole antenna.
5. To determine the wavelength and velocity of ultrasonic waves in a liquid (Kerosene Oil, Xylene, etc.) by studying the diffraction through ultrasonic grating.
6. To study the reflection, refraction of microwaves.
7. To study Polarization and double slit interference in microwaves.
8. To determine the refractive index of liquid by total internal reflection using Wollaston's air-film.
9. To determine the refractive Index of (1) glass and (2) a liquid by total internal reflection using a Gaussian eyepiece.
10. To study the polarization of light by reflection and determine the polarizing angle for air-glass interface.
11. To verify the Stefan`s law of radiation and to determine Stefan's constant.
12. To determine Boltzmann constant using V-I characteristics of PN junction diode.

[WK1, WK2, WK3, WK7, WK9]

Reference Books:

1. Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House.
2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 1511, Kitab Mahal.
3. Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers.
4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal, 1985, Vani Pub.
5. Electromagnetic Field Theory for Engineers & Physicists, G. Lehner, Springer.

Course Outcomes:

After the successful completion of the laboratory course, the students are expected to:

CO 1: Know the basic concepts of electric field and potential
CO 2: Understand of dielectric behavior of matter
CO 3: Learn the laws of magnetism and electromagnetic induction.
CO 4: Have an understanding of Maxwell's equations and energy propagation in media

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	1	-	1	3	2
CO2	3	2	1	-	2	1	-	-	1	-	1	3	2
CO3	3	3	1	1	2	2	-	-	1	-	1	3	2
CO4	3	2	2	1	2	1	-	-	1	-	1	3	2

Contribution to SDGs:

The study of electronics engineering advances several United Nations Sustainable Development Goals by preparing students to build energy-efficient and highly resilient technological infrastructure. It directly drives **SDG 4 (Quality Education)** and **SDG 9 (Industry, Innovation, and Infrastructure)** by providing foundational technical skills in semiconductor networks, precision instrumentation, and advanced telecommunication systems. Furthermore, analyzing low-power components and smart sensor interfaces directly supports **SDG 7 (Affordable and Clean Energy)** and **SDG 12 (Responsible Consumption and Production)**, ensuring that future engineers design long-lasting hardware that reduces global electronic waste and energy demands.

MTU-147-V1
MATHEMATICS-I
B. Tech. (Mechanical Engineering) I Semester

No. of Credits		4	
L	**T**	**P**	**Total**
3	**1**	**0**	**4**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre-requisites: Basic understanding of algebra, trigonometry, coordinate geometry, and elementary differential and integral calculus.

Course Objectives:

1. To develop an understanding of convergence and divergence of infinite series.
2. To apply differential and multivariable calculus techniques to engineering problems.
3. To use integral calculus for computing areas, volumes, and related engineering quantities.
4. To apply vector calculus and integral theorems in physical and engineering applications.

Unit 1: Infinite Series

Convergence and divergence, comparison tests, D' Alembert's ratio test, integral test, Raabe's test, logarithmic and Cauchy root tests, Gauss's test, Alternating series, Absolute and conditional convergence. **[WK1, WK2, WK3]**

Unit 2: Differential Calculus

Successive differentiation, Leibnitz theorem and applications, Taylor's and Maclaurin's series, Curvature, Asymptotes.

Functions of two or more variables, limit and continuity, partial derivatives, total differential and differentiability, derivatives of composite and implicit functions, Jacobians, higher order partial derivatives, homogeneous functions, Euler's Theorem and applications. Taylor's series for functions of two variables (without proof), maxima-minima of function of two variables. Lagrange's method of undetermined multipliers, differentiation under integral sign (Leibnitz rule).

[WK1, WK2, WK3, WK4]

Unit 3: Integral Calculus

Applications of single integration to find volume of solids and surface area of solids of revolution. Double integral, change of order of integration, double integral in polar coordinates, applications of double integral to find area enclosed by plane curves, triple integral, change of variables, volume of solids. Beta and gamma functions and relationship between them. **[WK1, WK2, WK3, WK4]**

Unit 4: Vector Calculus

Differentiation of vectors, scalar and vector point functions. Gradient of a scalar field and directional derivative, divergence and curl of a vector field and their physical interpretations. Integration of vectors, line integral, surface integral, volume integral, Green, Stoke's and Gauss theorems (without proof) and their applications. **[WK1, WK2, WK3, WK4, WK6]**

References:

1. E. Kreyszig, Advanced Engineering Mathematics, Wiley India.
2. G. B. Thomas and R. L. Finney, Calculus and Analytic Geometry, Narosa Publishing.
3. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, Narosa Publishing.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1: Apply mathematical concepts and techniques to physical sciences and engineering problems.

CO2: Identify, formulate, and solve engineering problems using differential and integral calculus.

CO3: Model physical and engineering situations using multivariable and vector calculus.

CO4: Analyze and solve problems involving infinite series, differential calculus, integral calculus, and vector calculus.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	-	-	-	-	1	-	1	3	1
CO2	3	3	2	2	1	-	-	-	1	-	1	3	2
CO3	3	3	3	2	1	1	-	-	1	-	1	3	2
CO4	3	2	2	2	1	1	-	-	1	-	1	3	1

Contribution to SDGs:

This course contributes primarily to **SDG 4: Quality Education** by developing strong mathematical foundations, logical reasoning, analytical ability, and problem-solving skills essential for engineering education and lifelong learning. It supports **SDG 8: Decent Work and Economic Growth** by strengthening quantitative and computational competencies that improve students' employability and their ability to contribute effectively in engineering, research, and technology-driven industries. The course significantly contributes to **SDG 9: Industry, Innovation and Infrastructure** because differential calculus, integral calculus, multivariable analysis, infinite series, and vector calculus are fundamental tools for engineering design, modelling, optimization, simulation, infrastructure planning, and technological innovation. It also supports S**DG 11: Sustainable Cities and Communities** through mathematical modelling of transportation systems, structural designs, fluid flow, energy distribution, and urban infrastructure. Further, it contributes to **SDG 12: Responsible Consumption and Production** by enabling optimization of materials, processes, energy, and resources. Applications of vector calculus, gradients, divergence, curl, surface integrals, and volume integrals also support **SDG 13: Climate Action** by providing the mathematical basis for environmental modelling, renewable energy analysis, fluid dynamics, heat transfer, pollution dispersion, and climate-related simulations. Finally, the course contributes to **SDG 17: Partnerships for the Goals** by providing a common quantitative language for interdisciplinary collaboration among engineers, scientists, researchers, industries, and policymakers working on sustainable development challenges.

MEU-103-V1
ENGINEERING GRAPHICS AND 2D MODELLING
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		2	
L	**T**	**P**	**Total**
0	**0**	**4**	**4**

Sessional	**50 Marks**
Practical	**50 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre- Requisite: Nil

Successive: Computer Aided Machine Drawing, Computer Aided Design and Analysis

Course Objectives:

To develop students' ability to visualize, interpret, and communicate engineering concepts through graphical representation, understand principles of projections and sectioning of engineering objects, and apply CAD tools for creating and modifying technical drawings in accordance with engineering drawing standards.

Course Contents:

Unit 1:

Introduction: Importance, Significance and scope of Engineering Drawing, Usage of drawing Instruments, Dimensioning, Scales, Different types of projections, B.I.S Specifications.

Projection of Points and Lines: Introduction of plane of projection, reference & auxiliary planes, projection of points and line in different quadrants, traces, inclinations & true lengths of the lines, projections on auxiliary plane. **(16)**

[**WK1, WK2, WK3, WK4, WK5, WK6, WK9**]

Unit 2:

Projection of Planes and Solids: Parallel to one reference plane, inclined to one plane but perpendicular to the other, inclined to both reference planes. Projection of Polyhedra, solids of revolution-in simple positions with axis perpendicular/inclined to a plane, with axis parallel/inclined to both planes.

Isometric & Orthographic Projections: Introduction, isometric scale, Isometric view of plane figures, prisms, pyramids and cylinders. Orthographic projections of simple engineering objects.

Sectioning of Solids and Development of Surfaces: Projections of sections of prisms, pyramids, cylinders and cones. Development of simple object with and without sectioning. **(20)**

[**WK2, WK3, WK4, WK5, WK6, WK8**]

Unit 3:

Basics of CAD Software: CAD interface, Units & its modification, Sketcher workbench, Reference Planes, Snap to point, Grid, Specification Tree, Compass, Drawing points, lines, circle, rectangle, arcs, random profiles, spline etc. Using tools like Fit all In, Pan, Zoom in & Out, Normal View, Plane Rotate etc. Move, Copy, Mirror, Rotate, Array, Constraint, Auxiliary Point, Line & Plane, Fillet, Chamfer etc. **(8)**

[**WK2, WK3, WK4, WK5, WK6, WK8**]

Unit 4:

Drawing 2D Sketches: Orthographic projections using CAD software; Related Problems on CAD software. **(8)**

[**WK2, WK3, WK4, WK5, WK6, WK8**]

Textbooks:

1. Engineering Drawing by N. D. Bhatt. Charotar Publishing House.
2. Engineering Graphics and Design by P S Gill. S K Kataria & Sons.
3. Engineering Graphics & Design by Prof. Pradeep Jain (Hindi Language). Available at https://ekumbh.aicte-india.org/allbook.php

Recommended/ Reference Books:

1. A Text Book of Engineering Drawing and Machine Drawing by M. L. Aggarwal and Sandhya Dixit. Dhanpat Rai & Co.
2. Engineering Drawing and Graphics using AutoCAD by T. Jeyapoovan. Vikas Publishing House.
3. Engineering Drawing with a Primer on Autocad by Arshad N. Siddique, Zahid A. Khan, Mukhtar Ahmad. Publisher: Prentice Hall India.

Web Links:

1. Engineering Drawing and Computer Graphics by NPTEL:
https://www.youtube.com/playlist?list=PLbRMhDVUMngel6OpnNppYzfJUQHSFePQb

Course Outcomes:

At the successful completion of the course, the student shall have the ability to:
CO 1: Apply engineering drawing standards and projection principles to represent geometric entities.
CO 2: Generate orthographic, isometric, and projection views of planes and solids.
CO 3: Construct sectional views and developments of engineering solids.
CO 4: Prepare dimensioned 2D engineering drawings using CAD software.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	-	1	-	2	-	1	2	-
CO2	3	2	3	-	2	-	-	-	2	-	1	3	1
CO3	3	2	3	1	2	-	-	-	2	-	1	3	2
CO4	3	1	2	-	3	-	-	-	2	1	2	3	1

Contribution to SDGs:

The course Engineering Graphics and 2D Modelling is most strongly aligned with **SDG 4** (Quality Education) and **SDG 9** (Industry, Innovation and Infrastructure) because it develops the graphical communication, visualization, and CAD competencies that form the foundation of modern engineering design, manufacturing, and infrastructure development. It also indirectly supports **SDG 12** through accurate design documentation that reduces material wastage and production errors.

ELU-151-V1
FUNDAMENTALS OF ELECTRICAL ENGINEERING
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		3	
L	**T**	**P**	**Total**
3	**0**	**0**	**3**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Prerequisite: Mathematics and Physics at the senior secondary (10+2) level

Successive: Electrical Circuit Analysis, Electrical Machines, Renewable Energy Systems

Course Objectives: The course aims to:

1. Develop a fundamental understanding of electrical circuit concepts, network theorems, and DC/AC circuit analysis.
2. Introduce the principles of single-phase and three-phase AC circuits, power measurement, and power factor concepts.
3. Explain the fundamentals of magnetic circuits, transformers, and their applications in electrical engineering.
4. Familiarize students with the construction, operating principles, and applications of electrical machines, along with an introduction to electric vehicle architecture and renewable energy technologies.

Unit 1: Introduction **(10)**

Role and importance of circuits in engineering; concepts of fields, charge, current, voltage, and energy and their interrelationships. V-I characteristics of ideal voltage and ideal current sources. Various types of controlled sources. Passive circuit components. V-I characteristics and ratings of different types of **R, L, and C** elements. Series and parallel circuits. Power and energy. Kirchhoff's Laws. Mesh and Nodal analysis, Delta-Star transformation. Superposition theorem. Thevenin's theorem. Norton's theorem. Maximum Power Transfer theorem. Tellegen's theorem. **[WK1, WK2, WK3, WK4]**

Unit 2: Single-Phase & Three Phase AC Circuits **(12)**

Single-Phase AC Circuits: Single-phase EMF generation. Average and effective values of sinusoidal quantities. Complex representation of impedance. Series and parallel AC circuits. Concept of phasor and phasor diagrams. Power factor. Complex power. Real, reactive and apparent power. Resonance in series and parallel circuits. Q-factor. Bandwidth and their relationship. Half-power points.

Three-Phase AC Circuits: Three-phase EMF generation. Delta and star connections. Line and phase quantities. Solution of balanced three-phase circuits. Balanced supply and balanced load. Phasor diagrams. Three-phase power measurement using the two-wattmeter method.

[WK1, WK2, WK3, WK4, WK6]

Unit 3: Magnetic Circuits and Transformers (10)

Ampere's circuital law. B-H curve. Concept of reluctance, flux, and MMF. Analogies between electrical and magnetic quantities. Solution of magnetic circuits. Hysteresis and eddy current losses. Mutual inductance and dot convention. Single-phase transformer: Construction. Principle of operation. Autotransformers and their applications.

[WK1, WK2, WK3, WK6, WK7]

Unit 4: Rotating Electrical Machines, Electric Vehicle Architecture, Renewable Energy Sources (10)

Construction and working principles of: DC machines. Three-phase and single-phase Induction motor. Synchronous machines. Special Electrical Machines (BLDC and PMSM only) Introduction to the basic architecture, components, and working principles of electric vehicles. Introduction to renewable energy sources, their generation methods, and applications (Wind and Solar energy sources).

[WK1, WK2, WK3, WK6, WK7, WK8, WK9]

Course Outcomes (COs):

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

CO1: Understand the fundamental concepts of electrical quantities, circuit elements, sources, and DC network principles.
CO2: Apply electrical laws, network theorems, and phasor concepts to solve DC and AC circuit problems
CO3: Analyse magnetic circuits and transformers to determine their operating characteristics and performance.
CO4: Describe the operating principles and applications of electrical machines, electric vehicle architecture, and renewable energy systems.

References:

1. Basic Electrical Engineering, A. E. Fitzgerald, D. Higginbotham, and Arvin Grabel, Tata McGraw-Hill Publishing Company, 5th Edition.
2. Introduction to Electrical Engineering, Mulukutla S. Sarma, Oxford University Press.
3. Electrical and Electronic Technology, Edward Hughes, Pearson Education, 10th Edition.
4. Fundamentals of Electric Circuits, Charles K. Alexander and Matthew N. O. Sadiku, McGraw-Hill Education.
5. Electric Machinery, A. E. Fitzgerald, Charles Kingsley Jr., and Stephen D. Umans, McGraw-Hill Education.
6. Basic Electrical Engineering, C. L. Wadhwa, New Age International (P) Ltd. Publishers.
7. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Tata McGraw-Hill, 2010.
8. Electrical Engineering Fundamentals, Vincent Del Toro, Prentice Hall of India.
9. Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, and Ali Emadi, CRC Press, New York, Washington, DC.

CO–PO Mapping

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	–	–	–	–	–	–	1	–	–	3	1
CO2	3	3	1	–	2	–	–	–	1	–	–	3	2
CO3	3	3	1	2	2	–	–	–	1	–	–	3	2
CO4	2	1	–	–	–	2	3	1	1	–	–	2	3

Contribution to SDGs:

The course primarily contributes to **SDG 4** (Quality Education) by developing a strong foundation in electrical engineering principles, circuit analysis, and problem-solving skills essential for engineering education. It supports **SDG 7** (Affordable and Clean Energy) by introducing students to energy-efficient electrical systems, transformers, renewable energy technologies, and the fundamentals of electric vehicles. The course also contributes to **SDG 9** (Industry, Innovation and Infrastructure) by building competencies required for modern electrical infrastructure and industrial applications, while promoting sustainable energy utilization and environmentally responsible engineering practices aligned with **SDG 11** (Sustainable Cities and Communities) and **SDG 13** (Climate Action) through the study of renewable energy systems and electric mobility technologies.

ELU-153-V1
FUNDAMENTALS OF ELECTRICAL ENGINEERING LABORATORY
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	**T**	**P**	**Total**
0	**0**	**2**	**2**

Sessional	**25 Marks**
Practical	**25 Marks**
Total	**50 Marks**
Duration of Exam	**2 Hours**

Prerequisite: Familiarity with basic mathematical calculations and elementary electrical circuit analysis.

Successive: Electrical Circuit Analysis, Electrical Machines, Renewable Energy Systems

Lab Course Objectives: The course aims to:

1. Demonstrate safe work practices and use electrical measuring instruments for testing and analysis of basic electrical circuits.
2. Verify fundamental electrical circuit laws and network theorems through laboratory experiments.
3. Analyze the behavior of AC circuits, resonance, three-phase systems, and power measurements.
4. Conduct basic tests on transformers and analyze the construction and operational features of electrical machines.
5. Develop awareness of conventional and renewable energy systems through laboratory demonstrations and simulation-based activities.

List of Laboratory Experiments

1. To study electrical safety practices and the use of basic electrical measuring instruments.
2. To verify Ohm's Law and determine the equivalent resistance of series and parallel resistor networks.
3. To verify Kirchhoff's Current Law (KCL) and Kirchhoff's Voltage Law (KVL).
4. To verify the Superposition, Thevenin's, Norton's, and Maximum Power Transfer Theorems using suitable electrical networks.
5. To obtain the frequency response characteristics and determine the resonance frequencies of series and parallel RLC circuits.
6. To measure real power, reactive power, apparent power, and power factor in a single-phase AC circuit.
7. To measure three-phase power and power factor in a balanced load using the two-wattmeter method.
8. To determine the polarity and transformation ratio of a single-phase transformer.
9. To study the constructional features and working principles of DC, three-phase induction, and synchronous machines.
10. To demonstrate the basic components and operation of Solar Photovoltaic (PV) Systems, Wind Energy Conversion Systems (WECS), and Electric Vehicle (EV) Systems.
11. To determine the phase sequence of a 3-phase supply and perform forward and reverse operation of a 3-phase induction motor using phase sequence reversal.

12. To plot the B-H hysteresis loop of a transformer core using CRO/DSO and determine its magnetic characteristics.

[WK2, WK3, WK5, WK7, WK8, WK9]

Course Outcomes:

After successful completion of the laboratory, the students will be able to:

CO1: Perform basic electrical measurements and experimentally verify fundamental circuit laws and network theorems in DC circuits. **(Bloom's Level: Apply – L3)**

CO2: Analyze the performance of single-phase and three-phase AC circuits, resonance, and electrical power measurements through laboratory experiments. **(Bloom's Level: Analyze – L4)**

CO3: Conduct basic tests on transformers and identify the constructional features and operating principles of electrical machines. **(Bloom's Level: Apply – L3)**

CO4: Explain the fundamentals of conventional power generation, renewable energy systems, and electric vehicle technologies through laboratory demonstrations and simulation tools. **(Bloom's Level: Understand – L2)**

References/ Web Links for Virtual Labs and Simulation Software:
Virtual Labs | Electrical Engineering
https://asnm-iitkgp.vlabs.ac.in/ (Analog Signal, Network and Measurement Lab- IIT Kharagpur)
https://bes-iitr.vlabs.ac.in/ (Basic Electrical Science Lab -IIT Roorkee)
https://bee-iitk.vlabs.ac.in/ (Basic Electrical Engineering Lab – IIT Kanpur)
LTspice Simulation: LTspice | Analog Devices

CO–PO Mapping

COs / POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	1	2	2	–	1	1	1	–	1	3	2
CO2	3	3	2	2	2	1	–	1	1	–	1	3	2
CO3	3	2	2	2	2	1	1	1	1	–	1	3	2
CO4	2	1	1	1	2	2	2	1	1	–	2	2	3

Contribution to SDGs:

This course primarily contributes to **SDG 4 (Quality Education)** by providing hands-on learning experiences in electrical measurements, circuit analysis, transformers, and electrical machines, thereby strengthening practical engineering competencies. It supports **SDG 7 (Affordable and Clean Energy)** through laboratory exposure to energy-efficient electrical systems, transformers, renewable energy technologies, and electric vehicle systems. The laboratory also contributes **to SDG 9 (Industry, Innovation and Infrastructure)** by developing technical skills in modern electrical engineering practices and testing techniques, while promoting sustainable technologies and responsible engineering practices aligned with **SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action).**

CHU-141-V1
CHEMISTRY
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		3	
L	**T**	**P**	**Total**
3	**0**	**0**	**3**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Course Objectives

1. To illustrate the basic understanding of Applied Chemistry and to improve the reasoning ability of the student towards Chemistry in everyday life, enhance the basic knowledge for the theoretical aspect of Engineering Chemistry.
2. To make students aware about the various applications of chemical sciences in engineering.
3. To analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
4. Rationalise bulk properties and processes using thermodynamic considerations.
5. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques.
6. List major chemical reactions that are used in the synthesis of molecules.

Unit 1: Atomic and Molecular Structure **(10)**

Postulates of quantum mechanics, solution of Schrodinger wave equation for Particle in one-dimensional box. Pi-molecular orbitals for ethylene, butadiene and benzene Crystal field theory and the energy level diagrams for transition metal complexes – tetrahedral and octahedral and their magnetic properties.

[WK1, WK2, WK3]

Unit 2: Spectroscopic Techniques and Their Applications **(12)**

Electromagnetic spectrum, Types of energy transitions in atoms and molecules. UV–Visible Spectroscopy: Principle and Types of Electronic transitions, Chromophores and auxochromes, Bathochromic and hypsochromic shift, hyperchromic and hypochromic shift, Applications in qualitative and quantitative analysis**.** Infrared (IR) Spectroscopy: Principle of molecular vibrations, Stretching and bending vibrations, Functional group identification, Functional group region and fingerprint region, factor affecting stretching frequencies and Applications of IR spectroscopy.

[WK1, WK2, WK4, WK6]

Unit 3: Thermodynamics, Phase Equilibrium and Corrosion **(11)**

Thermodynamic functions: Work, heat, entropy and free energy. Estimations of work done for reversible and irreversible processes: Isothermal and adiabatic. Phase, Component and Degree of Freedom, Gibbs Phase Rule, Phase diagram of One-Component System: Water and Carbon dioxide systems, Clausius–Clapeyron Equation, Corrosion: Types of corrosion and methods of prevention.

[WK1, WK2, WK6, WK7]

Unit 4: Stereochemistry and Organic Reactions **(12)**

Structural isomers and stereoisomers, Representations of structures-Flying Wedge, Newman, Fischer and Saw Horse, configurations (absolute and relative) and. Chirality, enantiomers, diastereomers, optical activity, Principle of Polarimeter. Introduction to reactions involving substitution (SN1 and SN2), addition, elimination (E1, E2 and E1cb), oxidation (Bayer-Villiger and Oppenauer oxidation), reduction (Clemmensen and Birch reduction), Synthesis of commonly used drug molecules: Paracetamol, Aspirin and Chloroxylenol. **[WK1, WK2, WK3, WK6]**

References:

1. Organic Chemistry by Jonathan Clayden
2. Chemistry: Principles and Applications, by M. J. Sienko and A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition
7. Introduction to Spectroscopy by Donald L. Pavia, Gary M. Lampman, George S. Kriz, and James R. Vyvyan
8. "Organic Spectroscopy" by William Kemp
9. Concise Inorganic Chemistry by J.D. Lee
10. Engineering Chemistry-I Concepts and Applications by Jit Chakarborty, A.D. Gupta, R. Kamlekar

Course Outcomes:

The course will enable the students to:

CO1: Develop a strong foundation in the fundamental principles of chemistry relevant to engineering and technology applications.

CO2: Understand atomic and molecular structure, chemical bonding, intermolecular forces, and their role in material properties and engineering systems.

CO3: Apply concepts of thermodynamics, electrochemistry and corrosion in solving engineering problems and industrial applications.

CO4: Understand principles of spectroscopy, analytical chemistry, and instrumental techniques for characterization and analysis of chemical systems.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	1	–	–	–	1	–	1	3	1
CO2	3	3	2	1	2	1	1	–	1	–	1	3	2
CO3	3	2	2	1	2	1	–	–	1	–	1	3	2
CO4	3	3	2	2	2	1	2	–	1	–	1	3	2

Contribution to SDGs:

This course contributes primarily to **SDG 4: Quality Education** by developing scientific knowledge, analytical thinking, and problem-solving skills in chemistry for engineering applications. It also supports **SDG 9: Industry, Innovation and Infrastructure** through the study of materials, spectroscopy, thermodynamics, corrosion prevention, and chemical processes that underpin technological advancement. Furthermore, the course contributes to **SDG 12: Responsible Consumption and Production** by promoting sustainable chemical practices, efficient resource utilization, and green chemistry principles. The emphasis on corrosion control, environmental protection, and sustainable chemical technologies also supports **SDG 13: Climate Action**, enabling learners to develop environmentally responsible and sustainable engineering solutions.

CHU-142-V1
CHEMISTRY LABORATORY
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	T	P	Total
0	0	2	2

Sessional	25 Marks
Practical	25 Marks
Total	50 Marks
Duration of Exam	2 Hours

Course Objectives:

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.

Choice of 8–10 Experiments from the followings:

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. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry – determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Models of Potential Energy Surfaces
13. Chemical Oscillations – Iodine Clock Reaction
14. Determination of Partition Coefficient of a substance between two immiscible liquids
15. Polarimeter – To determine specific optical rotation of given compound
16. Adsorption of acetic acid by charcoal

[WK1, WK2, WK3, WK4, WK6]

References:

1. Engineering Practical Chemistry by B. Sethi, B. Mangla & R. Sachdeva (Manakin Press)
2. Chemistry: Principles and Applications, by M. J. Sienko and A. Plane
3. Engineering Practical Chemistryby M. R. Senapati (Laxmi Publications)
4. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Practical Chemistry for Engineering Students by H. A. James

Course Outcomes:

CO1: Perform fundamental chemistry experiments using standard laboratory techniques to determine the physical and chemical properties of materials and solutions.

CO2: Apply analytical and instrumental methods such as chromatography, conductometry, potentiometry, polarimetry, and ion-exchange techniques for qualitative and quantitative chemical analysis.

CO3: Conduct experiments related to reaction kinetics, colligative properties, adsorption, polymer/drug synthesis, and electrochemical processes, and interpret the experimental results using scientific principles.

CO4: Demonstrate safe laboratory practices, accurate data analysis, and effective reporting while recognizing the role of chemistry in sustainable engineering, water quality assessment, and materials development.

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	2	–	–	–	1	–	1	3	1
CO2	3	3	2	1	2	1	1	–	1	–	1	3	2
CO3	3	2	2	2	2	1	–	–	1	–	1	3	2
CO4	3	2	2	2	2	1	2	–	1	–	1	3	2

Contribution to SDGs:

This laboratory course contributes primarily to **SDG 4: Quality Education** by providing practical knowledge of chemical principles, analytical techniques, and scientific experimentation. It also supports **SDG 9: Industry, Innovation and Infrastructure** through hands-on training in modern laboratory methods, material characterization, and chemical analysis. Furthermore, the course contributes **to SDG 6: Clean Water and Sanitation** by developing skills in water quality analysis and treatment techniques, and **SDG 12: Responsible Consumption and Production** by promoting safe laboratory practices, efficient use of chemicals, and sustainable experimentation. The emphasis on environmentally responsible laboratory practices and chemical process optimization also supports **SDG 13: Climate Action**.

CSU-101-V1
PROGRAMMING FOR PROBLEM SOLVING
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		3	
L	**T**	**P**	**Total**
3	**0**	**0**	**3**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre- Requisite: Nil

Course Objectives:

1. To provide a strong foundation in programming concepts and computational thinking using the C programming language.
2. To develop analytical and problem-solving skills through the design and implementation of algorithms and structured programs.
3. To familiarize students with advanced programming concepts such as functions, arrays, pointers, structures, dynamic memory allocation, and file handling.
4. To enable students to develop efficient, reliable, and maintainable software solutions that form the basis for advanced courses in computer science and engineering.

Course Contents:

Unit 1: Introduction to Programming

Introduction to components of a computer system (disks, memory, processor, operating system, compilers etc.), Algorithm: idea, characteristics, Representation (Flowchart/Pseudocode with examples). Source code, constants and variables, data types, Syntax and Logical Errors in compilation, object and executable code.

Operators and precedence, expression evaluation, Conditional branching: if statement, if-else, nested if-else, switch case statement, Loops: For loop, while loop, do-while loop.

[WK2, WK3, WK6]

Unit 2: Arrays and Basic Algorithms

Arrays (1-D,2-D), Character arrays and strings, searching, basic sorting algorithms (Bubble, Insertion and Selection), finding roots of equations, notion of order of complexity through example programs (no formal definition required). **[WK2, WK3, WK4, WK5]**

Unit 3: Function and Recursion

Functions (including using built in libraries), parameter passing in functions, call by value, passing arrays to functions: idea of call by reference. Recursion as a different way of solving problems. Example programs, such as finding factorial, Fibonacci series, Ackerman function etc. Quick sort/ Merge sort.

[WK2, WK3, WK4, WK6]

Unit 4: Structure, Pointers and File Handling

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

File Handling: Need for file handling, perform operations on file. (only if time is available, otherwise should be done as part of the lab). **[WK3, WK4, WK6]**

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India.
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.
3. Yashavant P. Kanetkar, Let Us C, BNB Publications.
4. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill.
5. Jeri R. Hanly & Elliot B. Koffman, Problem Solving and Program Design in C, Pearson.

Course Outcomes:

At the successful completion of the course, the student shall have the ability to:

CO1: Apply the fundamental concepts of C programming, including data types, operators, control structures, and functions, to develop structured programs.

CO2: Design and implement algorithms to solve engineering and computational problems using appropriate programming constructs.

CO3: Utilize arrays, pointers, structures, dynamic memory allocation to develop efficient software solutions.

CO4: Analyze, test, debug, and optimize C programs while adhering to standard coding practices and software development principles.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	2	-	-	-	-	-	1	3	1
CO2	3	3	3	2	2	-	-	-	-	1	1	3	2
CO3	3	3	3	2	3	-	-	-	-	-	1	3	3
CO4	2	3	2	3	3	-	-	1	-	1	2	2	3

Contribution to SDGs:

The course Programming for Problem Solving is most strongly aligned with SDG 4 (Quality Education), SDG 8 (Decent Work and Economic Growth), SDG 9 (Industry, Innovation and Infrastructure), and SDG 12 (Responsible Consumption and Production) because it develops computational thinking, algorithmic problem-solving, and programming skills that form the foundation of software development and digital innovation. The course equips students to design efficient, reliable, and maintainable programs, enabling them to contribute to technological advancement, automation, and sustainable digital solutions while promoting the efficient use of computational resources and best programming practices.

CSU-103-V1

PROGRAMMING FOR PROBLEM SOLVING LAB

B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	**T**	**P**	**Total**
0	**0**	**2**	**2**

Sessional	**25 Marks**
Practical	**25 Marks**
Total	**50 Marks**
Duration of Exam	**2 Hours**

Course Objective:

This course aims to develop computational thinking and problem-solving skills by enabling students to formulate algorithms and implement efficient solutions using the C programming language. The course provides a strong foundation in structured programming concepts, including data types, control structures, functions, arrays, pointers, structures, recursion, file handling, and dynamic memory allocation. It emphasizes program design, debugging, testing, and the use of modular programming techniques to solve engineering problems efficiently. The course also prepares students with the programming skills and analytical abilities required for advanced courses in computer engineering and real-world software development.

List of Experiments*:*

Operators (1-10)

1. Write a program to add two numbers.
2. Write a program to subtract two numbers.
3. Write a program to multiply two numbers.
4. Write a program to divide two numbers.
5. Write a program to find the remainder using modulus operator.
6. Write a program to find the largest of two numbers.
7. Write a program to find the largest of three numbers.
8. Write a program to check whether a number is even or odd.
9. Write a program to check whether a number is positive, negative, or zero.
10. Write a program to check whether a year is a leap year.

Loops (11-24)

11. Write a program to print numbers from 1 to N.
12. Write a program to print numbers from N to 1.
13. Write a program to print all even numbers from 1 to N.
14. Write a program to print all odd numbers from 1 to N.

15. Write a program to find the sum of first N natural numbers.
16. Write a program to calculate the factorial of a number.
17. Write a program to generate the Fibonacci series.
18. Write a program to check whether a number is prime.
19. Write a program to reverse a number.
20. Write a program to check whether a number is palindrome.
21. Write a program to find the sum of digits of a number.
22. Write a program to count the digits in a number.
23. Write a program to print a multiplication table of a number.
24. Write a program to print a star pattern.

Arrays (25-36)

25. Write a program to store and display elements of an array.
26. Write a program to find the sum of array elements.
27. Write a program to find the largest element in an array.
28. Write a program to find the smallest element in an array.
29. Write a program to reverse an array.
30. Write a program to search an element using linear search.
31. Write a program to search an element using binary search.
32. Write a program to sort an array using bubble sort.
33. Write a program to sort an array using selection sort.
34. Write a program to sort an array using insertion sort.
35. Write a program to calculate the average of array elements.
36. Write a program to find the second largest element in an array.

Functions (37-41)

37. Write a program to calculate the area of a circle using a function.
38. Write a program to find the factorial of a number using a function.
39. Write a program to check whether a number is prime using a function.
40. Write a program to calculate the power of a number using a function.
41. Write a program to find the GCD of two numbers using a function.

Recursion (42-44)

42. Write a program to find the factorial of a number using recursion.

43. Write a program to generate Fibonacci series using recursion.

44. Write a program to find the sum of array elements using recursion.

Structures (45-46)

45. Write a program to store student details using structures.

46. Write a program to store employee details using structures.

Pointers (47-49)

47. Write a program to swap two numbers using pointers.

48. Write a program to find the sum of array elements using pointers.

49. Write a program to demonstrate dynamic memory allocation using malloc().

File Handling (50)

50. Write a program to read from and write to a file.

[WK2, WK3, WK4, WK5, WK8]

References:

1. E. Balagurusamy, **Programming in ANSI C**, 8th Edition, McGraw Hill Education, 2019.
2. Brian W. Kernighan and Dennis M. Ritchie, **The C Programming Language**, 2nd Edition, Pearson Education.
3. Yashavant P. Kanetkar, **Let Us C**, 18th Edition, BPB Publications.
4. Byron S. Gottfried, **Programming with C**, Schaum's Outline Series, McGraw Hill.
5. Reema Thareja, **Programming in C**, Oxford University Press.

Web links:

1. **https://nptel.ac.in/courses/106105171**
2. **https://nptel.ac.in**
3. https://www.geeksforgeeks.org/c-programming-language/
4. https://www.programiz.com/c-programming
5. https://www.tutorialspoint.com/cprogramming
6. **https://gcc.gnu.org**

Course Outcomes:

At the successful completion of the course, the student shall have the ability to:

CO1: To Formulate algorithms for arithmetic and logical problems, and develop, test, debug, and execute C programs to obtain correct solutions.

CO2: To Design and implement structured C programs using conditional statements, iterative constructs, functions, and recursion to solve computational problems.

CO3: To Apply arrays, pointers, structures, and modular programming techniques to develop efficient solutions for engineering and computational problems.

CO4: To Develop C programs to solve searching, sorting, matrix operations, and basic numerical method problems using appropriate programming techniques and problem-solving approaches

CO-PO Mapping:

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	3	–	–	–	1	1	–	2	3	2
CO2	3	3	3	2	3	–	–	–	1	1	–	2	3	3
CO3	3	3	3	2	3	–	–	–	2	1	–	2	3	3
CO4	3	3	3	3	3	–	–	–	1	1	1	3	3	3

Contribution to SDGs:

This course primarily contributes to **SDG 4** (Quality Education) by developing computational thinking, programming skills, and problem-solving abilities among engineering students. It also supports **SDG 9** (Industry, Innovation and Infrastructure) by equipping learners with fundamental programming knowledge required for software development, automation, and digital innovation. Furthermore, the course promotes **SDG 8** (Decent Work and Economic Growth) by enhancing employability and technical competencies, and **SDG 12** (Responsible Consumption and Production) by encouraging the development of efficient, optimized, and resource-conscious software solutions.

MTU-148-V1
MATHEMATICS- II
B. Tech. (Mechanical Engineering) II Semester

No. of Credits		4	
L	T	P	Total
3	1	0	4

Sessional	40 Marks
Theory	60 Marks
Total	100 Marks
Duration of Exam	3 Hours

Pre-requisites:

Basic understanding of matrices, differential equations, partial differential equations, Laplace transforms, and basic calculus.

Course Objectives:

1. To develop understanding of matrices, eigenvalues, eigenvectors, and their engineering applications.
2. To solve ordinary differential equations arising in engineering problems.
3. To apply partial differential equations in heat flow and wave propagation.
4. To apply Laplace transforms for solving engineering differential equations.

Course Contents:

MODULE 1: MATRICES & ITS APPLICATIONS

Rank of a matrix, elementary transformations, elementary matrices, inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, Consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley- Hamilton theorem and its applications, diagonalization of matrices, similar matrices, quadratic forms.

[WK1, WK2, WK3]

MODULE 2: ORDINARY DIFFERENTIAL EQUATIONS AND APPLICATIONS

Exact differential equations, equations reducible to exact differential equations. Applications of differential equations of first order & first degree to simple electric circuits, Newton's law of cooling, heat flow and orthogonal trajectories, linear differential equations of second and higher order. Complete solution, complementary function and particular integral, method of variation of parameters to find particular integral, Cauchy's and Legendre's linear equations. Simultaneous linear equations with constant co-efficient. Applications of linear differential equations to simple pendulum, oscillatory electric circuits. **[WK4, WK5, WK6]**

MODULE 3: PARTIAL DIFFERENTIAL EQUATIONS AND ITS APPLICATIONS

Formation of partial differential equations, Lagrange' linear partial differential equation, first order non-linear partial differential equation, Charpit's method. Method of separation of variables and its

applications to wave equation, one dimensional heat equation and two-dimensional heat flow (steady state solutions only) **[WK7, WK8, WK9]**

MODULE 4: LAPLACE TRANSFORMS AND ITS APPLICATIONS

Laplace transforms of elementary functions. Properties of Laplace transforms, existence conditions, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t. Evaluation of integrals by Laplace transforms. Laplace transform of unit step function, unit impulse function and periodic function. Inverse transforms, convolution theorem, application to linear differential equations and simultaneous linear differential equations with constant coefficients.

[WK10, WK11, WK12]

REFERENCES:

1. Advanced Engineering Mathematics : E. Kreyszing ; Wiley-India
2. Calculus and Analytic Geometry : G.B. Thomas, R.L. Finney; Narosa Publication
3. Higher Engineering Mathematics : B.S. Grewal; Khanna Publishers
4. Advanced Engineering Mathematics : Jain/Iyenger ; Narosa Publication

Course Outcomes:

After successful completion of the course, students will be able to:

CO1: Acquire knowledge of Matrix Algebra, Determinants and their applications in engineering subjects.

CO2: Solve exact differential equations, equations reducible to exact form and linear differential equations of second and higher order with constant and variable coefficients

CO3: Solve system of simultaneous linear differential equations

CO4: Solve problems based on electric circuits, heat flow, Newton's law of cooling and orthogonal trajectories

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	-	1	3	1
CO2	3	3	2	2	1	-	-	-	1	-	1	3	2
CO3	3	3	3	2	2	-	1	-	1	-	1	3	2
CO4	3	3	2	2	3	-	-	-	1	-	1	3	2

Contribution to SDGs:

This course contributes to **SDG 4** (Quality Education) by strengthening analytical and mathematical skills essential for engineering education. It supports **SDG 7** (Affordable and Clean Energy) through applications in electrical circuits and energy systems, **SDG 9** (Industry, Innovation and Infrastructure) through mathematical modelling and engineering analysis, **SDG 11** (Sustainable Cities and Communities) through modelling of infrastructure and heat transfer systems, **SDG 12** (Responsible Consumption and Production) by promoting optimization techniques, and **SDG 13** (Climate Action) by enabling mathematical analysis of thermal and environmental systems.

ENG-101-V1

ENGLISH

B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		2	
L	**T**	**P**	**Total**
2	**0**	**0**	**2**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre-requisites: There are no formal prerequisites for this course.

Course Objectives:

1. To introduce the students to the basics of English.
2. To familiarize students with active reading strategies and hone their textual comprehension skills.
3. To equip students with basic writing skills.
4. To build communicative confidence and interpersonal fluency through targeted language lab exercises.

Unit 1: Basics of English

Root words: Prefixes and suffixes, synonyms and antonyms, homonyms and homophones, idioms and phrases, one word substitution, Review of basic grammar rules, common grammatical errors, sentence structures and error spotting, contextual clues and their use. **[WK1, WK7, WK9]**

Unit 2: Reading Skills

Reading Comprehension for vocabulary building, Identifying main ideas, supporting details, drawing inferences, Reading exercises for understanding different text types: articles, stories, reports, and emails, Reading strategies: skimming, scanning, and close reading. **[WK1, WK7, WK8]**

Unit 3: Writing Skills

Writing exercises for sentence and paragraph construction, Grammar review and practice, writing different types of texts: emails, letters, paragraphs and essays, Process writing, Precis writing, Exercises in Creative writing (Poem/Story/Impression).

[WK3, WK7, WK9]

Unit 4: Communication Exercises (This unit involves interactive practice sessions in Language Lab)

Exercises on Listening, Impromptu Speeches, Storytelling, Role-Playing, and Pronunciation drills, "Just-a-Minute" Speeches, Conversations and Dialogues, Group Discussions and Presentations. Team building exercises, Interviews.

[WK6, WK7, WK9]

References:

1. Blum, M. Rosen. How to Build Better Vocabulary. Bloomsbury.
2. Comfort, Jeremy et al. Speaking Effectively. Cambridge University Press.
3. English Grammar and Competition – S.C. Gupta.
4. Remedial English Grammar – F.T. Wood.

5. On Writing Well – William Zinsser.
6. Selected short stories by Gogol, Tolstoy, Melville, Poe and Tagore.

Course Outcomes:

CO1: Understand the basics of English language and grammar.

CO2: Analyze and interpret different reading materials using reading strategies.

CO3: Develop structured academic and professional writing skills.

CO4: Communicate confidently through presentations, discussions and interviews.

CO–PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	-	1	3	1
CO2	3	3	2	1	2	1	-	-	1	-	1	3	2
CO3	3	2	2	1	1	2	-	-	1	-	1	3	2
CO4	3	2	1	1	2	1	-	-	1	-	1	3	1

Contribution to SDGs:

This course contributes to **SDG 4 (Quality Education)**, **SDG 8 (Decent Work and Economic Growth)**, **SDG 10 (Reduced Inequalities)**, and **SDG 16 (Peace, Justice and Strong Institutions)** by strengthening communication, critical thinking, inclusivity, and professional skills.

ENU-101-V1

BIOLOGY FOR ENGINEERS

B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		2	
L	**T**	**P**	**Total**
2	**0**	**0**	**2**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Course Objectives: To develop and understanding of construct of cellular life forms and their use for various technological uses.

Unit 1: Cell as Basic Unit of Life

Introduction to cell. Concept of prokaryotic and eukaryotic cells. Ultrastructure of eubacterial, plant and animal cells. Functions of different components of the cell.
Cell division cycles: mitosis and meiosis.
Cell to cell signalling: concept, types including quorum sensing, contact dependent, paracrine, synaptic, endocrine and autocrine signalling

[WK1, WK3, WK6, WK7]

Unit 2: Biomolecules and Biocatalysts

Biomolecules: Properties, classification and functions of Carbohydrates, Nucleic acids, proteins, lipids.
Enzymes: Properties, Classification, Mechanism of enzyme action (Michaelis Menton plot), Factors affecting enzyme activity
Classification and functions of hormones and vitamins.

[WK1, WK2, WK3, WK4, WK6]

Unit 3: Adaptations and Applications For Bioengineering

Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system, Microbial cell factories, Microbial fuel cells. Enzymes in biosensors, food processing, detergent formulation, textile processing. PHA and PLA in bioplastics. Biosurfactants and bioemulsifiers. Human blood substitutes

[WK3, WK4, WK5, WK6, WK7]

Unit 4: Applications for Biomedical Engineering and Biocomputing

Introduction to biomedical engineering, Bioinstrumentation: Diagnostic and Therapeutic devices; Bio-medical imaging: Principle, types and examples, Electrical tongue and electrical nose in food science.
Introduction to bioinformatics, Bioinformatics analysis of DNA Microarray, FASTA and BLAST, Bioinformatics tools for various applications- Clustal family, BioEdit, MEGA, Arlequin, Protein structure prediction and visualization tools.

[WK2, WK4, WK6, WK7, WK8]

References:

1. Lehninger, A. L., Nelson, D. L., & Cox, M. M. (2000). Lehninger principles of biochemistry. New York: Worth Publishers.
2. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.
3. Palsson B.O. and Bhatia S.N. (2009) Tissue Engineering. Pearson.
4. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
6. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

7. Shu Chien, Peter C Y Chen & Y C Fung (Ed.) (2000) An Introductory Text to Bioengineering. World Scientific.
8. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016
9. NPTEL Course on Biology for engineers and other non-biologists (4 weeks UG Course) By Prof. G.K. Suraishkumar & Prof. Madhulika Dixit (IIT. Madras)

Course Outcomes:

Students will be able to

CO1: Develop an understanding of cell and cellular functions

CO2: Generate understanding of various biomolecules and their potential industrial/environmental applications.

CO3: Correlate biological structures and functioning to various technologies and comprehend use in bioengineering.

CO4: Develop and understanding of use of computation in modern biology

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	1	-	-	1	-	1	3	1
CO2	3	3	2	1	1	2	1	-	1	-	1	3	2
CO3	3	2	3	2	2	2	2	-	1	-	1	3	2
CO4	3	3	2	2	3	1	1	-	1	1	2	3	3

Contribution to SDGs:

The course "Biology for Engineers" is most strongly aligned with **SDG 3 (Good Health and Well-being)**, **SDG 4 (Quality Education)**, **SDG 9 (Industry, Innovation and Infrastructure)**, and **SDG 12 (Responsible Consumption and Production)**. It develops foundational knowledge of biological systems, biomolecules, biomedical engineering, and bioinformatics while promoting innovation in healthcare technologies, sustainable bioprocesses, bio-based materials, and computational biology. The course also encourages interdisciplinary engineering solutions that contribute to improved healthcare, sustainable industrial practices, and responsible utilization of biological resources.

MEU-101-V1
WORKSHOP – I
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		2	
L	**T**	**P**	**Total**
0	**0**	**4**	**4**

Sessional	**50 Marks**
Practical	**50 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre- Requisite: Nil

Successive: Workshop- III, Workshop- IV, Workshop- V, Workshop- VI, Workshop- VII

PART-A
Computer Engineering Workshop

1. To study and demonstrate Block diagram of Digital Computer System and explanation of each unit.
2. To study and demonstrate internal parts of a Computer System (Card level) and other peripheral devices and explanation of POST & BIOS.
3. To study and demonstrate primary memory and secondary memory.
4. To demonstrate Mother Board/ Main Board and its parts, Chipset, Connectors, Add On Card
5. To study various processor (Pentium-I, II, III, DUAL Core, i-3, i-5, i-7 etc.).
6. To study various types of monitors: LCD /LED/TFT/PLASMA DISPLAY & New Technologies.
7. To study different printer types and their working.
8. Assembly / Installation and Maintenance of Personnel Computer Systems: Practical exercise on assembly of Personnel Computer System, Installation of Operating System: Windows; Linux etc., Installation of other Application Software's and Utility Software's, Fault finding in Personnel Computers: Software or Hardware wise, Virus: Introduction, its Types & Removal techniques, Data Backup and Restore, Data Recovery Concepts, Typical causes of Data loss.
9. Introduction to computer networking concepts: Introduction of Connecting devices: Hub, Switch & Router etc., Networking Cable preparation: Normal & Cross Cables, Data Transferring Techniques from one Computer System to another Computer System, Configuration of Switch/ Routers etc.
10. Introduction to system security and network security.

[WK2, WK3, WK4, WK6]

PART-B

Electrical Workshop

1. Introduction of Electrical Safety and precautions, Electrical Symbols, Electrical Materials, abbreviations commonly used in Electrical Engineering and familiarization with tools used in Electrical Works.
2. Demonstration and familiarization of domestic and industrial accessories i.e. MCBs, ELCBs, three phase main switches, selector switch, contactor, different types and use of Earthing and fuses.
3. To know about electrical AC and DC system, single and three phase system & measurements of electrical parameters.

Any four from Sr. No. 4 to 9

4. Prepare and test an extension board and draw schematic and wiring diagram and connection method in three pin power plug.
5. To install and check the function of IoT based smart power strip.
6. To know how and draw about different types of domestic and industrial wiring, Stair case or Go- down wiring.
7. To draw, wire up and test the schematic and wiring diagram for control one lamp by fan regulator and study the effect of increasing and decreasing luminous of the lamp.
8. Familiarization and circuit study of Electrical equipment i.e. Electric Iron, Electric Toaster, Electric heater, Air coolers and Fans etc.
9. To know how the working of Digital and Analog multimeters, clamp meter, earth tester, continuity tester high precision table top multimeters etc.

[WK1, WK3, WK6, WK7]

PART- C

Electronics Workshop

1. To study and demonstrate basic electronic components, Diode, Transistor, Resistance, Inductor and capacitor.
2. To study and demonstrate resistance color coding, measurement using color code and multimeter and error calculation considering tolerance of resistance.
3. To study and demonstrate multimeter and CRO- front panel controls, description of block diagram of CRT and block diagram of CRO.

4. To study and demonstrate Vp (peak voltage),Vpp (peak to peak voltage), Time, frequency and phase using CRO.
5. Introduction to function generator. Functions of front panel controls and measurement of different functions on CRO.
6. To study and demonstrate variable DC regulated power supply, function of controls and DC measurement using multimeter and CRO.
7. Soldering practice on wire mesh or a resistance decade board includes fabrication, soldering, lacing, harnessing forming and observation.
8. Testing of components using multimeter and CRO like diode, transistor, resistance capacitor, Zener diode and LED.
9. To study and demonstrate rectification, half wave, Full wave and bridge rectifier. Fabrication, assembly and wave form observation.
10. To design and fabricate a printed circuit board of a Zener regulated/ series regulated power supply and various measurements, testing of power supply.

[WK1, WK3, WK4, WK6]

Note: At least 8 exercises are to be performed from each part by the students.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Identify, assemble, configure, and troubleshoot computer hardware, operating systems, and basic computer networks.

CO2. Apply safe engineering practices while working with electrical tools, components, domestic wiring, and electrical installations.

CO3. Perform measurements, testing, fabrication, and troubleshooting of basic electronic circuits using appropriate electronic instruments.

CO4. Demonstrate multidisciplinary workshop skills in computer, electrical, and electronics engineering for practical problem-solving, maintenance, and industrial applications.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	1	1	-	-	1	-	1	3	1
CO2	3	3	2	1	1	2	1	-	1	-	1	3	2
CO3	3	2	3	2	2	2	2	-	1	-	1	3	2
CO4	3	3	2	2	3	1	1	-	1	1	2	3	3

Contribution to SDGs:

This workshop course contributes primarily to **SDG 4**: Quality Education by developing practical skills in computer, electrical, and electronics engineering through hands-on learning and experimentation. It also supports **SDG 8**: Decent Work and Economic Growth by building industry-relevant technical competencies in installation, maintenance, troubleshooting, networking, and electrical safety. Furthermore, the course contributes to **SDG 9**: Industry, Innovation and Infrastructure through exposure to modern computing systems, networking technologies, IoT applications, PCB fabrication, and electronic circuit design. The emphasis on maintenance, repair, efficient utilization of resources, and safe engineering practices also supports **SDG 12**: Responsible Consumption and Production and **SDG 3**: Good Health and Well-being by promoting sustainable engineering practices and workplace safety. Additionally, the strong emphasis on workshop safety makes the course significantly relevant to **SDG 3** (Good Health and Well-Being)

MEU-102-V1

WORKSHOP – II

B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		2	
L	**T**	**P**	**Total**
0	**0**	**4**	**4**

Sessional	**50 Marks**
Practical	**50 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre- Requisite: Nil

Successive: Workshop- III, Workshop- IV, Workshop- V, Workshop- VI, Workshop- VII

Course Objectives:

To familiarize students with basic manufacturing processes, workshop tools, measuring instruments, and safe engineering practices through hands-on training in machine shop, fitting, sheet metal, carpentry, smithy, and welding operations.

MECHANICAL ENGINEERING WORKSHOP

List of Exercises:

Machine shop, fitting shop, sheet metal shop, carpentry, smithy & welding shop

Section (A): Machine Shop

1. To understand the layout, safety measures and fundamental concept of different engineering materials used in the workshop.
2. To study and demonstrate the various parts, specifications, accessories, attachments & operations on lathe, milling, shaping machine, drilling machine and various cutting fluids used during operations on conventional machine processes.
3. To study different types of digital and manual measuring tools used in metrology and determine the least count of vernier calipers, vernier height gauges and micrometers.

Section (B): Fitting & Sheet Metal Shop

4. To study different types of tools, equipment's, devices and machines used in fitting shop.
5. To prepare a job involving filing, drilling, tapping and hacksaw cutting operations on mild steel plate.
6. To study various types of sheet metal tools and prepare a simple sheet metal joint.

Section (C): Carpentry Shop and Smithy shop

7. To study various types of carpentry tools and equipment's and timber used in carpentry section.
8. To prepare a simple wooden joint (cross lap / Tee-lap/dovetail joint) using kail wood in carpentry shop.
9. To study various types of forging / black smithy tools and prepare a ring or hook by hand forging operation.

Section (D): Welding Shop

10. To understand the layout, safety measures and fundamental concept of different tools and engineering materials used in welding workshop.
11. To understand and demonstrate the working principle of various welding machines namely, SMAW, TIG, MIG/MAG, SAW, Oxy-Acetylene Gas welding & Resistance welding machines.

12. To prepare straight continuous bead & Butt Joint on given M.S plate in flat position by arc welding.

NOTE: - Total nine exercises should be performed from the above list. At least two from each section and remaining two may either be performed from above list or designed by the concerned institution as per the scope of the syllabus and facilities available.

References:

1. Workshop / Manufacturing Practices by Veeranna D. Kenchakkanavar (English/Hindi Edition). Published by: Khanna Book Publishing Co. (P) Ltd. Available at https://ekumbh.aicte-india.org/allbook.php

Course Outcomes (COs): After studying this course the students will be able to:

CO1: Acquire skills on basic engineering materials and safety aspects.
CO2: Understand the fundamental concept of various basic engineering practices namely fitting, sheet metal, carpentry and welding etc.
CO3: Learn and use different marking & measuring instruments used in machine shop, fitting shop, sheet metal shop, carpentry & pattern making shop etc.
CO4: Practice real time job preparation using various operations related to fitting, sheet metal, carpentry, welding etc.

CO-PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	2	-	3	3	3	–	1	–	2	3	2
CO2	3	2	2	-	3	2	2	2	1	–	2	3	2
CO3	3	2	2	-	3	1	–	–	1	–	2	3	3
CO4	3	2	3	-	3	2	2	3	1	1	2	3	3

Contribution to SDGs:

The Mechanical Engineering Workshop course is most strongly aligned with:

- **SDG 4** (Quality Education) through experiential and skill-based learning.
- **SDG 8** (Decent Work and Economic Growth) by developing employable technical competencies.
- **SDG 9** (Industry, Innovation and Infrastructure) through exposure to manufacturing and fabrication technologies.
- **SDG 12** (Responsible Consumption and Production) by promoting precision, quality control, and efficient use of engineering materials.

Additionally, the strong emphasis on workshop safety makes the course significantly relevant to **SDG 3** (Good Health and Well-Being).

VALUE ADDED COURSES

VAC-112-V1
CONSTITUTION OF INDIA
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	T	P	Total
-	-	2	2

Sessional	25 Marks
Practical	-
Total	25 Marks

Pre- Requisite: Nil

Course Objectives:
The objective of this course is to familiarize students with the philosophy, historical evolution, and salient features of the Constitution of India, enabling them to understand the principles that govern the nation's democratic framework. The course aims to develop awareness of Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, the structure and functioning of the government, constitutional amendments, emergency provisions, and local self-governance. It also seeks to cultivate constitutional values, ethical responsibility, and responsible citizenship by promoting an understanding of justice, equality, liberty, fraternity, and the rule of law, thereby preparing students to contribute effectively to society and uphold the ideals enshrined in the Constitution.

Course Contents:

Unit 1: Introduction to the Constitution of India
Meaning of Constitution and Constitutionalism, Historical perspective of the Constitution of India, Salient features and characteristics of the Constitution of India.

[**WK1, WK7, WK8, WK9]**

Unit 2: Fundamental Rights, Duties and Directive Principles

Scheme of the Fundamental Rights, Scheme of the Fundamental Duties and their legal status Directive Principles of State Policy (DPSPs): Importance and implementation. **[WK7, WK9]**

Unit 3: Structure of Government and Constitutional Framework
Federal structure and distribution of legislative and financial powers, Parliamentary form of Government in India Constitutional powers and status of the President of India**.** **[WK7, WK9]**

Unit 4: Constitutional Amendments, Governance and Fundamental Rights

Constitutional amendment: Powers and procedure, Historical perspective of constitutional amendments, Emergency provisions: National Emergency, President's Rule and Financial Emergency, Local Self Government: Constitutional scheme in India. Fundamental Right to Equality, Fundamental Right to Freedom under Article 19, Right to Life and Personal Liberty under Article 21, Role of constitutional values in democracy, justice, equality and responsible citizenship.

[**WK7, WK8, WK9]**

References:

1. The Constitutional Law Of India 9th Edition, by Pandey. J. N.
2. The Constitution of India by P.M. Bakshi
3. Constitution Law of India by Narender Kumar
4. Bare Act by P. M. Bakshi

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the historical evolution, philosophy, and salient features of the Constitution of India.
CO2: Interpret the Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, and the structure of Indian governance.
CO3: Analyze the constitutional framework relating to federalism, parliamentary democracy, constitutional amendments, and emergency provisions.
CO4: Apply constitutional values, legal principles, and civic responsibilities in professional practice and public life.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	1	–	–	–	2	2	3	2	–	2	1	–
CO2	1	2	–	–	–	2	2	3	2	1	2	1	–
CO3	2	2	1	1	–	2	2	3	2	1	2	1	1
CO4	1	2	1	–	–	2	3	3	2	2	2	1	1

Contribution to SDGs

This course contributes primarily to **SDG 4: Quality Education** by enhancing constitutional literacy, civic awareness, ethical reasoning, and responsible citizenship. It also supports **SDG 10**: Reduced Inequalities by promoting equality, justice, and the protection of fundamental rights guaranteed by the Constitution of India. Furthermore, the course contributes to **SDG 16:** Peace, Justice and Strong Institutions by fostering an understanding of democratic governance, the rule of law, constitutional values, and institutional accountability. The emphasis on citizen participation, constitutional duties, and inclusive governance also supports **SDG 17: Partnerships for the Goals**, encouraging collaborative efforts towards nation-building and sustainable development.

VAC-105-V1
UNIVERSAL HUMAN VALUES
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	T	P	Total
-	-	2	2

Sessional	25 Marks
Practical	-
Total	25 Marks

Course Objectives:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
2. Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence
3. Strengthening of self-reflection.
4. Development of commitment and courage to act

Human Values Course

This course also discusses their role in their family. It, very briefly, touches issues related to their role in the society and the nature, which needs to be discussed at length in one more semester for which the foundation course named as "H-102 Universal Human Values 2: Understanding Harmony" is designed which may be covered in their III or IV semester. During the Induction Program, students' world get and initial exposure to human values through Universal Human Values –I. This exposure is to be augmented by this compulsory full semester foundation course.

Unit-1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

[WK7, WK8, WK9]

Unit-2: Understanding Harmony In The Human Being - Harmony In Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
2. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

[WK7, WK8, WK9]

Unit-3: Understanding Harmony in the Family and Society- Harmony in Human – Human Relationship

1. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
2. Understanding the meaning of Trust; Difference between intention and competence
3. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
4. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
5. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

[WK7, WK8, WK9]

Unit-4: Understanding Harmony in the Nature and Existence - Whole Existence as Coexistence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfilment among the four orders of nature-recyclability and self regulation in nature
3. Understanding Existence as Co-existence of mutually interacting units in all pervasive space
4. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

[WK1, WK7, WK8, WK9]

Unit-:5 Implications of the Above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values
2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
7. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

[WK7, WK8, WK9]

References:

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 - PanditSunderlal
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 Outcomes:

After successful completion of the course, students will be able to:

CO1: Develop self-awareness and understand harmony within oneself through self-exploration and right understanding.

CO2: Demonstrate harmonious relationships in family and society based on universal human values and ethical behaviour.

CO3: Understand the interconnectedness of nature and existence, and apply sustainable practices in personal and professional life.

CO4: Apply human values and professional ethics in engineering practice for responsible, sustainable, and socially beneficial development.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	1	–	–	–	–	2	2	3	2	–	3	1	–
CO2	1	1	–	–	–	2	2	3	3	1	2	1	1
CO3	1	2	–	1	–	2	3	2	2	–	2	1	1
CO4	2	2	1	1	–	2	3	3	2	2	2	2	1

Contribution to SDGs:

This course contributes primarily to **SDG 4: Quality Education** by fostering value-based education, ethical reasoning, self-awareness, and lifelong learning. It also supports **SDG 3: Good Health and Well-being** by promoting mental well-being, self-discipline, and harmonious living. Furthermore, the course contributes to **SDG 11: Sustainable Cities and Communities** and **SDG 12: Responsible Consumption and Production** by encouraging responsible citizenship, sustainable lifestyles, and social harmony. The emphasis on environmental responsibility, ethical decision-making, and professional conduct also supports **SDG 13: Climate Action** and **SDG 16: Peace, Justice and Strong Institutions**, enabling learners to contribute towards an inclusive, peaceful, and sustainable society.

AEC-106-V1
MESSAGE OF BHAGAVAD GITA
B. Tech. (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	T	P	Total
-	-	2	2

Sessional	25 Marks
Practical	-
Total	25 Marks

Course Objectives:

To enable the students to create an awareness on Message of Bhagwat Gita to instill Moral, Social Values and to appreciate the Karma Yoga.

Unit-1: Introduction

Relevance of Bhagavad Gita today- Background of Mahabharatha, Spritual Background of Srimad Bhagvad Geeta.

Arjuna Vishada Yoga: Arjuna's Anguish and Confusion- Symbolism of Arjuna's Chariot. Sankhya Yoga: Sankhya perspective, Qualities of Soul, Swadharm perspective, Yoga perspective, Qualities of a Sthita-prajna

[**WK7, WK8, WK9]**

Unit-2: Karma Yoga and Dhyana Yoga

Meaning of Karma Yoga, Sakam Karma, Nishkam Karma, Means of Meditation, Qualities of a Dhyan Yogi, Methods for controlling the mind

[**WK7, WK8, WK9]**

Unit-3: Bhakti Yoga

Nature of the Supreme and his realization, Types of Devotion, Sakam Bhakti, Nishkam Bhakti, Universal Form of God, Sagun Devotion, Nirgun Devotion, Inner Qualities of a True Devotee.

[**WK7, WK8, WK9]**

Unit-4: Gunatraya Vibhaga Yoga

Dynamics of the Three Gunas: Tamas, Rajas, Sattva- Going Beyond the Three Gunas- Description of A Gunatheetha.

[**WK7, WK8, WK9]**

References:

1. Dr. Satyavrat Vidyaalankar, "Srimad Bhagvad Geeta", 2021
2. Swami Chinmayananda: The Holy Geeta", Central Chinmaya Mission Trust 2002.

3. Swami Chinmayananda, " A Manual of Self Unfordment", Central Chinmaya Mission Trust, 2001.
4. Essence of Gita by Dr. O. P. Mishra, Notion Press, PVT Ltd., 2026.

Course Outcomes:

Upon completion of the course, the student should be able to:

CO1: Interpret the concepts of the soul (*Atman*), *Swadharma*, *Sthita-prajna*, and the symbolism presented in the *Bhagavad Gita*, and relate them to ethical decision-making and personal development and apply the principles of *Karma Yoga*, to promote responsible conduct and professional ethics.

CO2: Demonstrate an understanding of the principles of *Dhyana Yoga* and *Bhakti Yoga*, including meditation techniques, mind control, forms of devotion, and the qualities of an ideal devotee, for enhancing self-discipline and emotional well-being.

CO3: Analyze the characteristics and influence of the three *Gunas* (*Sattva*, *Rajas*, and *Tamas*) and evaluate their role in shaping human behavior, personality, and spiritual growth.

CO4: Evaluate the teachings of the *Bhagavad Gita* as a guide for value-based living, leadership, ethical decision-making, and holistic personality development in contemporary life.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	1	1	–	–	–	2	2	3	2	–	3	1	–
CO2	1	1	–	–	–	2	2	3	2	1	3	1	–
CO3	1	2	–	1	–	2	2	3	2	–	2	1	1
CO4	2	2	1	1	–	2	3	3	2	2	2	2	1

Contribution to SDGs:

This course contributes primarily to **SDG 4: Quality Education** by fostering ethical reasoning, value-based learning, self-awareness, and lifelong personal development. It also supports SDG 3: Good Health and Well-being by promoting mental well-being, emotional balance, self-discipline, and meditation practices. Furthermore, the course contributes to **SDG 16: Peace, Justice and Strong Institutions** by encouraging ethical leadership, responsible decision-making, integrity, and respect for universal human values. The emphasis on selfless action, compassion, social harmony, and collective responsibility also supports **SDG 17: Partnerships for the Goals**, inspiring collaborative efforts for sustainable and inclusive societal development.

VAC-115-V1
ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	T	P	Total
-	-	2	2

Sessional	25 Marks
Practical	-
Total	25 Marks

Pre-requisites
There are no formal prerequisites for this course.

Course Objectives
1. Understand the fundamentals of Indian Knowledge Systems and traditional wisdom.
2. Explain the significance of ancient Indian scriptures and philosophical traditions.
3. Correlate modern science with Indian Knowledge Systems.
4. Understand Yoga, Ayurveda and holistic healthcare.

Unit 1: Introduction of Traditional Knowledge
Indian traditional knowledge of social, science, medicines, warfare, judiciary etc. **[WK1, WK7]**

Unit 2: Ancient Indian Scriptures
Veda--- Meaning, Types of Vedas-- Rig-Veda, Sama-Veda, Yajur-Veda, and Atharva-Veda,;

Upveda---Meaning, types of upveda, Description of each upveda;

Vedang--- Meaning, no. of Vedang, Description of each Vedang;

Updesha: Dharmshastra, Mimans, Puran, Tarkshastra., Important scriptures of scripture of other religions. **[WK1, WK8]**

Unit 3: Modern Science and Indian Knowledge System
Various field of Indian knowledge; Communication, Mathematics, Phonetics, Metaphysics and Philosophy, Life Sciences, Medical Sciences, Cosmology, Military Science etc. **[WK2, WK3, WK4]**

Unit 4: Yoga and Holistic Health Care

Introduction, Yogic Concepts of Wellbeing, Relationship between Health and Disease, Maintain wellbeing,Aurveda.

Case study of development of an Ayurvedic treatment centre; Patanjali; Development of Yoga as World Yoga Divas; any other case study related to Indian traditions.

[WK4, WK6, WK7]

References:

1) Essence of Indian Traditions, by Dr. O. P. Mishra, Khanna Publishers, PVT ltd. New Delhi.
2) V. Sivaramakrishnan (Ed.), Cultural Heritage of India-course material, Bharatiya VidyaBhavan, Mumbai.
3) Swami Jitatmanand, Modern Physics and Vedant, Bharatiya VidyaBhavan
4) Swami Jitatmanand, Holistic Science and Vedant, Bharatiya VidyaBhavan
5) Fritzof Capra, Tao of Physics
6) Fritzof Capra, The Wave of life VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad, Arnakulam Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata
7) GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya,
8) Vidyanidhi Prakashan, Delhi RN Jha, Science of Consciousness Psychotherapyand Yoga Practices, Vidyanidhi
9) Prakashan, Delhi P B Sharma (English translation), ShodashangHridayan
10) Pedagogy: Problem based learning, group discussions, collaborative mini projects. Outcome: Ability to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1: Explain the evolution, significance, and multidisciplinary nature of the Indian Knowledge System, including its contributions to society, science, medicine, governance, and culture.

CO2: Describe the structure and significance of the Vedas, Upvedas, Vedangas, and other Indian scriptures, and appreciate their role in preserving knowledge and ethical values.

CO3: Analyze the contributions of the Indian Knowledge System to modern disciplines such as mathematics, communication, philosophy, life sciences, medical sciences, cosmology, and military science, and relate them to contemporary developments.

CO4: Demonstrate an understanding of the principles of Yoga, Ayurveda, and holistic healthcare, and evaluate case studies highlighting the application of Indian traditional knowledge in promoting sustainable development, health, and societal well-being.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	-	1	3	1
CO2	3	3	2	1	1	-	-	-	1	-	1	3	2
CO3	3	2	2	1	2	1	-	-	1	-	1	3	2
CO4	3	2	1	1	2	1	1	-	1	-	1	3	2

Contribution to SDGs:

This course contributes to the following Sustainable Development Goals (SDGs): **SDG 3** – Good Health and Well-being: Promotes Yoga, Ayurveda and holistic healthcare for physical and mental well-being. **SDG 4** – Quality Education: Enhances awareness of Indian Knowledge Systems, traditional wisdom and lifelong learning. **SDG 11** – Sustainable Cities and Communities: Encourages preservation of cultural heritage and sustainable traditional practices. **SDG 16** – Peace, Justice and Strong Institutions: Develops ethical values, harmony and responsible citizenship through Indian philosophical traditions.

PROFESSIONAL CORE COURSES

MEU-105-V1
ESSENTIALS OF MECHANICAL ENGINEERING
B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		3	
L	**T**	**P**	**Total**
3	**0**	**0**	**3**

Sessional	**40 Marks**
Theory	**60 Marks**
Total	**100 Marks**
Duration of Exam	**3 Hours**

Pre- Requisite: Nil

Successive: Thermodynamics, Strength of Materials, Manufacturing Processes.

Course Objective:

To provide students with fundamental knowledge of manufacturing processes, manufacturing systems, power transmission mechanisms, refrigeration and air-conditioning systems, internal combustion engines, engineering materials and its properties used in mechanical engineering applications.

Course Contents:

Unit 1:

Basics of Manufacturing Processes: Brief introduction to classification of different manufacturing processes: Primary forming processes, metal cutting processes, joining processes, finishing processes and processes bringing change in properties, Working principle, parts and specification of commonly used machine tools in workshop such as Lathe, Shaper, Planar, Drilling and Milling. **(10)**

[**WK3, WK4, WK5, WK6**]

Unit 2:

Manufacturing Systems: Introduction to Manufacturing Systems, Fundamentals of Numerical Control (NC), Advantage of NC systems, Classification of NC and CNC.

Basics of Power Transmission: Transmission of mechanical power: introduction belt drives, chain drives, gear drives. Introduction to brakes and clutches. **(10)**

[**WK3, WK4, WK5, WK6**]

Unit 3:

Refrigeration & Air Conditioning: Laws of thermodynamics, Introduction to Refrigeration & Air conditioning, units of refrigeration, Coefficient of performance, Difference between a Heat engine, refrigerator and heat pump, simple vapour compression refrigeration cycle, Psychometric charts and its use, simple problems on Coefficient of performance**.**

I.C. Engines: Introduction, classification, Constructional details and working of 2 stroke & 4 stroke petrol engine & diesel engine. **(10)**

[**WK2, WK3, WK4, WK5, WK6, WK7**]

Unit 4:

Strength of Materials: Introduction to Stresses and types of Stresses, Strain and types of Strain, Hooke's Law**,** Simple Numerical problems on stresses and strains.

Introduction to Engineering Materials: Metals and Alloys, Ferrous Metals, Non-Ferrous Metals, Polymers, Ceramics, Composites. Mechanical, Physical and Chemical Properties of Engineering Materials. Factors Affecting Material Selection, Emerging Materials.

(10)

[**WK3, WK4, WK5, WK6**]

Textbooks:

1. Basics of Mechanical Engineering by R.K Rajput Laxmi Pub, Delhi.
2. Elements of Mechanical Engineering by D.S Kumar, S.K Kataria and Sons.
3. Basic Mechanical Engineering, M.P. Poonia, S.C. Sharma & T.R. Banga, Khanna Publishing House.

Reference Books:

1. Engineering Thermodynamics by P.K Nag TMH, New Delhi.
2. Workshop Technology Vol I & II by Hazra & Chaudhary, Asian Book Comp., New Delhi.
3. Manufacturing Science by Amitabha Ghosh & Ashok Kumar Malik, - East- West Press.
4. Manufacturing Process & Systems by Oswald, Munoz, John Wiley.
5. Workshop Technology Vol I, II & III by Chapman, WAJ, Edward Arnold.
6. Basics of Mechanical Engineering by Vineet Jain, Dhanpat Rai Publications.

Course Outcomes:

At the successful completion of the course, the student shall have the ability to:

CO1: Explain the fundamentals of manufacturing processes, machine tools, and manufacturing systems used in mechanical engineering practice.

CO2: Describe manufacturing systems and mechanical power transmission mechanisms used in industrial applications.

CO3: Apply fundamental thermodynamic concepts to describe the operation and performance of refrigeration, air-conditioning systems, and internal combustion engines.

CO4: Identify engineering materials based on their properties and applications, and select suitable materials for basic mechanical engineering applications.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	-	1	-	-	-	1	-	1	3	1
CO2	3	3	2	1	2	1	-	-	1	-	1	3	2
CO3	3	2	2	1	1	2	-	-	1	-	1	3	2
CO4	3	2	1	1	3	1	-	-	1	-	1	3	1

Contribution to SDGs:

The course Essentials of Mechanical Engineering is most strongly aligned with **SDG 4** (Quality Education), **SDG 9** (Industry, Innovation and Infrastructure), and **SDG 12** (Responsible Consumption and Production) because it develops foundational engineering competencies in manufacturing, materials, thermal systems, and industrial technologies while promoting efficient use of resources and engineering practices that support sustainable industrial development.

MEU-107-V1

PYTHON PROGRAMMING FOR MECHANICAL ENGINEERING

B. Tech (Mechanical Engineering) I/II Semester

No. of Credits		1	
L	**T**	**P**	**Total**
0	**0**	**2**	**2**

Sessional	**25 Marks**
Practical	**25 Marks**
Total	**50 Marks**
Duration of Exam	**2 Hours**

Pre- Requisite: Nil

Successive: Robotics and Artificial Intelligence

Course Objective:

This laboratory course introduces mechanical engineering students to Python programming with emphasis on engineering applications. Students learn programming fundamentals, numerical computation, data visualization, engineering calculations, scientific computing, and simulation techniques commonly used in mechanical engineering analysis and design.

List of Experiments:

1. Introduction to Python: Variables, Data Types, Input-Output Operations.
2. Python Programs using Arithmetic, Relational and Logical Operators.
3. Decision-Making Programs using if, if-else, and nested if statements.
4. Iterative Programs using for and while loops.
5. Programs using Functions and Modular Programming.
6. String Manipulation and Python Data Structures (List, Tuple, Set, and Dictionary) for Engineering Applications.
7. Introduction to NumPy Arrays, Matrix Operations, and Vectorized Computation.
8. Solution of Simultaneous Linear Equations and Linear Algebra Applications using NumPy.
9. Data Handling, Cleaning, and Analysis using Pandas DataFrames.
10. Statistical Analysis of Experimental Data using Pandas and NumPy (Mean, Median, Variance, Standard Deviation).
11. Scientific Computing using SciPy: Numerical Integration, Differentiation, and Root Finding.
12. Plotting Basic Graphs and Engineering Data Visualization using Matplotlib.
13. Visualization of Stress-Strain, Temperature Variation, and Experimental Data using Seaborn.
14. Interactive Engineering Dashboards and Plots using Plotly.
15. Mechanical Engineering Simulations using Python, NumPy, and SciPy (Projectile Motion and Spring-Mass System Analysis).

[WK2, WK3, WK4, WK5, WK6, WK8]

References:

1. Introduction to Python for Science & Engineering by David J. Pine. CRC Press.
2. Python Programming by Dr. Rupesh Nasre (in English and Hindi Language). Available at https://ekumbh.aicte-india.org/allbook.php

Web links:

1. https://nptel.ac.in/courses/106106182 (The joy of computing using Python)
2. https://nptel.ac.in/courses/106106212 (Python for Data Science)
3. https://nptel.ac.in/courses/106107220 (Data Analytics with Python)
4. https://nptel.ac.in/courses/115104095 (Computational Science and Engineering Using Python)

Course Outcomes:

At the successful completion of the course, the student shall have the ability to:

CO1 Develop Python programs using fundamental programming constructs.

CO2 Apply numerical methods and mathematical libraries for engineering calculations.

CO3 Analyze and visualize engineering data using scientific computing tools.

CO4 Solve basic mechanical engineering problems using Python-based simulations and computational techniques.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**
CO1	3	2	1	-	3	-	-	-	1	-	2	2	1
CO2	3	3	2	2	3	-	-	-	1	-	2	3	1
CO3	3	3	2	3	3	1	-	-	2	-	2	3	2
CO4	3	3	3	3	3	1	-	-	1	1	2	3	3

Contribution to SDGs:

The course primarily focuses on **SDG 4** (Quality Education) by building computational competencies and **SDG 9** (Industry, Innovation and Infrastructure) by enabling engineering modelling, simulation, data analytics, and digital transformation in mechanical engineering. It also supports sustainable industrial practices through **SDG 8** and **SDG 12**.