Pimpri Chinchwad Education Trust's

PIMPRI CHINCHWAD COLLEGE OF ENGINEERING

SECTOR NO. 26, PRADHIKARAN, NIGDI, PUNE 411044

(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

Curriculum Structure and Syllabus

of

Second Year B. Tech. Mechanical Engineering
(Regulation 2023)

Updated with minor changes Effective from Academic Year 2025-26

Institute Vision

To be one of the top 100 Engineering Institutes of India in coming five years by offering exemplarily Ethical, Sustainable and Value Added Quality Education through a matching ecosystem for building successful careers.

Institute Mission

1. Serving the needs of the society at large through establishment of a state-of-art Engineering Institute.
2. Imparting right Attitude, Skills, Knowledge for self-sustenance through Quality Education.
3. Creating globally competent and Sensible engineers, researchers and entrepreneurs with an ability to think and act independently in demanding situations.

EOMS Policy

"We at PCCOE are committed to offer exemplarily Ethical, Sustainable and Value Added Quality Education to satisfy the applicable requirements, needs and expectations of the Students and Stakeholders.

We shall strive for technical development of students by creating globally competent and sensible engineers, researchers and entrepreneurs through Quality Education.

We are committed for Institute's social responsibilities and managing Intellectual property.

We shall achieve this by establishing and strengthening state-of-the-art Engineering Institute through continual improvement in effective implementation of Educational Organizations Management Systems (EOMS)."

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Course Approval Summary

Board of Studies - Department of Mechanical Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Engineering Materials	BME23PC02	15	
2.	Strength of Materials	BME23PC03	17	
3.	Material Testing Lab	BME23PC04	19	
4.	Strength of Materials Lab	BME23PC05	22	
5.	Community Engagement Project	BME23EL01	49	
6.	Fluid Mechanics	BME24PC06	51	
7.	Theory of Machines	BME24PC07	53	
8.	Fluid Mechanics Lab	BME24PC08	55	
9.	Theory of Machines Lab	BME24PC09	59	
10.	Geometric Dimensioning & Tolerancing	BME24VS03	84	
11.	Computer Aided Machine Drawing	BME24VS04	86	

Board of Studies - Department of Applied Science and Humanities

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Business studies for engineers	BSH23EM01	44	
2.	Universal Human Values	BSH23VE01	46	
3.	Applied Mathematics	BSH23OE01	23	
4.	Computational Techniques	BSH23OE02	25	
5.	Applied Mathematics	BSH23OE03	27	
6.	Computational Techniques	BSH23OE07	29	
7.	Mathematical Optimization	BSH24OE08	31	
8.	Neural Network and Fuzzy Logic Controller	BSH23OE06	37	
9.	Professional Development Training	BSH24AE05	81	
10.	Constitution of India	BSH24VE02	82	
11.	Statistical Data Analysis using R	BSH24OE04	68	

12.	Advanced Materials and Characterization	BSH24OE05	69	
13.	Designing Thinking & Innovation Management	BSH24EM02	73	
14.	Project Management	BSH24EM03	75	
15.	Fostering Entrepreneurship and Startups	BSH24EM04	79	
16.	Business finance for engineers	BSH24EM05	79	

Board of Studies - Department of Civil Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Total Quality Management	BCI23OE02	39	
2.	Building Services and Maintenance	BCI23OE03	40	
3.	E-Waste Management	BCI23OE01/ BCI24OE01	71	

Board of Studies - Department of Computer Engineering

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Fundamentals of Database Management Systems	BCE23OE01	41	
2.	Principles of Software Engineering	BCE23OE02	42	
3.	Android App Development with Kotlin	BCE23OE03	43	

Board of Studies - Department of Computer Science Engineering (AIML)

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	AI for Financial Modelling	BCS23OE01	34	
2.	Data Science	BCS24OE02	65	

Board of Studies - Department of Information Technology

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Cyber Security: Understanding Cyber Crimes and Legal Perspectives	BIT23OE02	35	
2.	Operating System's Administration	BIT24OE01	67	

Board of Studies - Department of Electronics and Telecommunication

Sr. No.	Name of the Course	Course Code	Page number	Signature and stamp of BoS chairman
1.	Biology for Engineers	BET23OE03	32	
2.	Electrical Machines	BET24OE01	61	
3.	Introduction to Signals and Systems	BET24OE02	63	

Approved by Academic Council:

Chairman, Academic Council
Pimpri Chinchwad College of Engineering

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INDEX

Sr. No.	Content	Page No.
1	Curriculum Framework	07
2	Curriculum Structure – SY B Tech.	09
3	List of Courses – Open Elective Courses Mathematics	11
4	List of Courses – Open Elective Courses Department Specific	11
5	List of Courses – Open Elective Courses Engineering Science	13
6	List of Courses – EEM Courses	13
7	Curriculum Semester III	14-49
8	Curriculum Semester IV	50-87
9	Vision and Mission of Mechanical Engineering Department	88

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CURRICULUM FRAMEWORK
(2023 Course)

LIST OF ABBREVIATIONS

Sr. No.	Abbreviation	Type of Course
1	BSC	Basic Science Course
2	ESC	Engineering Science Course
3	PCC	Programme Core Course
4	PEC	Programme Elective Course
5	MDM	Multidisciplinary Minor
6	OEC	Open Elective Course
7	VSEC	Vocational and Skill Enhancement Course
8	AEC	Ability Enhancement Course
9	EEM	Entrepreneurship/Economics/Management Course
10	IKS	Indian Knowledge System
11	VEC	Value Education Course
12	ELC	Experiential Learning Courses
13	LLC	Liberal Learning Courses

COURSE WISE CREDIT DISTRIBUTION

Sr. No.	Type of Course	No. of Courses	Total Credits	
			NO.	%
1	Basic Science Course	**8**	**14**	**8.75**
2	Engineering Science Course	**6**	**14**	**8.75**
3	Programme Core Course	**23**	**45**	**28.13**
4	Programme Elective Course	**9**	**19**	**11.88**
5	Multidisciplinary Minor	**6**	**14**	**8.75**
6	Open Elective	**3**	**6**	**3.75**
7	Vocational and Skill Enhancement Course	**8**	**8**	**5**
8	Ability Enhancement Course	**2**	**4**	**2.5**
9	Entrepreneurship/Economics/Management Course	**2**	**4**	**2.5**
10	Indian Knowledge System	**1**	**2**	**1.25**
11	Value Education Course	**2**	**4**	**2.5**
12	Experiential Learning Courses	**4**	**22**	**13.75**
13	Liberal Learning Courses	**2**	**4**	**2.5**
	Total	**76**	**160**	**100**

SEMESTER-WISE COURSE DISTRIBUTION

Course Distribution: Semester Wise										
Sr. No.	Type of Course	No. of Courses / Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course	4	4							8
2.	Engineering Science Course	2	4							6
3.	Programme Core Course	1		4	4	6	4	4		23
4.	Programme Elective Course					2	4	2	1	9
5.	Multidisciplinary Minor			1	1	2	1	1		6
6.	Open Elective			2	1					3
7.	Vocational and Skill Enhancement Course	2	2		2		2			8
8.	Ability Enhancement Course	1			1					2
9.	Entrepreneurship/Economics/Management Course			1	1					2
10.	Indian Knowledge System		1							1
11.	Value Education Course			1	1					2
12.	Experiential Learning Courses			1				1	2	4
13.	Liberal Learning Courses	1	1							2
Total		11	12	10	11	10	11	8	3	76

SEMESTER-WISE CREDIT DISTRIBUTION

Credit Distribution: Semester Wise										
Sr. No.	Type of Course	No. of Credits / Semester								Total
		1	2	3	4	5	6	7	8	
1.	Basic Science Course	7	7							14
2.	Engineering Science Course	5	7							12
3.	Programme Core Course	2		8	8	11	8	8		45
4.	Programme Elective Course					4	8	4	3	19
5.	Multidisciplinary Minor			2	2	4	2	4		14
6.	Open Elective			4	2	2				8
7.	Vocational and Skill Enhancement Course	1	2		2		2			7
8.	Ability Enhancement Course	3			2					5
9.	Entrepreneurship/Economics/Management Course			2	2					4
10.	Indian Knowledge System		2							2
11.	Value Education Course			2	2					4
12.	Experiential Learning Courses			2				4	16	22
13.	Liberal Learning Courses	2	2							4
Total		20	20	20	20	21	20	20	19	160

Curriculum Structure
Second Year B. Tech.
Mechanical Engineering
Semester III

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CURRICULUM STRUCTURE SECOND YEAR B. TECH. (MECHANICAL ENGINEERING) Semester – III

Second Year B. Tech Mechanical Engineering (Academic Regulations 2023)																		
(With effect from Academic Year 2025-26)																		
Semester III																		
Course Type	Course Code	Course Name	Credit Scheme				Teaching Scheme (Hrs./Week)					Evaluation Scheme and Marks						
			L	P	T	Total	L	P	T	O	Total	FA		SA	TW	PR	OR	Total
												FA1	FA2					
PCC	BME23 PC02	Engineering Materials	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	50
PCC	BME23 PC03	Strength of Materials	2	-	1	3	2	-	1	1	4	20	20	60	-	-	-	100
PCC	BME23 PC04	Material Testing Lab	-	2	-	2	-	4	-	-	4	-	-	-	50	-	50	100
PCC	BME23 PC05	Strength of Materials Lab	-	1	-	1	-	2	-	-	2	-	-	-	-	-	50	50
MDM	BME23 MD01	Multi-Disciplinary Minor 1 #	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
OEC		Open Elective (Mathematics)	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
OEC		Open Elective (Department Specific)	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
EEM	BSH23 EM01	Business studies for engineers (EEM-I)	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
VEC	BSH23 VE01	Universal Human Values	2	-	-	2	2	-	-	-	2	25	25	-	-	-	-	50
ELC	BME23 EL01	Community Engagement / Field Project	-	2	-	2	-	4	-	-	4	-	-	-	100	-	-	100
		Total	**14**	**05**	**01**	**20**	**14**	**10**	**01**	**02**	**27**	**90**	**100**	**210**	**150**	**-**	**100**	**650**

L-Lecture, **P**-Practical, **T**-Tutorial, **O**- Other i.e. self-directed learning, (self- study), FA-Formative Assessment, **SA**-Summative Assessment, **TW**-Term Work, **OR**-Oral, **PR**-Practical

Refer separate booklet for multidisciplinary minor (MDM) courses

OPEN ELECTIVE (Mathematics) COURSES

Course Code	Course Name	Offered by	Remark
BSH23OE01	Applied Mathematics (OE Maths Suggested for Mechanical)	AS&H	Choose any one
BSH23OE02	Computational Techniques (OE Maths Suggested for E&Tc)	AS&H	
BSH23OE03	Applied Mathematics (OE Maths Suggested for Civil branch)	AS&H	
BSH23OE07	Computational Techniques (OE Maths Suggested for Comp/IT branch)	AS&H	
BSH24OE08	Optimization Techniques (OE Maths Suggested for AIML branch)	AS&H	

OPEN ELECTIVE (Department Specific) COURSES

Course Code	Course Name	Offered by	Remark
BET23OE03	Biology for Engineers	E&TC	Choose any one
BCS23OE01	AI for Financial Modelling	CSE(AI&ML)	
BIT23OE02	Cyber Security : Understanding Cyber Crimes and Legal Perspectives	IT	
BSH23OE06	Neural Network & Fuzzy Logic Controller	AS&H	
BCI23OE02	Total Quality Management	Civil Engineering	
BCI23OE03	Building Services and Maintenance	Civil Engineering	
BCE23OE01	Fundamentals of Database Management System	Computer Engineering	
BCE23OE02	Principles of Software Engineering	Computer Engineering	
BCE23OE03	Android Application Development with Kotlin	Computer Engineering	

CURRICULUM STRUCTURE SECOND YEAR B. TECH. (MECHANICAL ENGINEERING)
Semester – IV

Second Year B. Tech Mechanical Engineering (Academic Regulations 2023)																	
(With effect from Academic Year 2025-26)																	
Semester IV																	
Course Type	**Course Code**	**Course Name**	**Credit Scheme**				**Teaching Scheme (Hrs./Week)**					**Evaluation Scheme and Marks**					
			L	**P**	**T**	**Total**	**L**	**P**	**T**	**O**	**Total**	**FA**		**SA**	**TW**	**PR**	**OR**	**Total**
												FA1	**FA2**					
PCC	BME24PC06	Fluid Mechanics	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	50
PCC	BME24PC07	Theory of Machines	2	-	-	2	2	-	-	1	3	10	10	30	-	-	-	50
PCC	BME24PC08	Fluid Mechanics Lab	-	2	-	2	-	4	-	-	4	-	-	-	50	-	50	100
PCC	BME24PC09	Theory of Machines Lab	-	2	-	2	-	4	-	-	4	-	-	-	50	-	50	100
MDM		Multi-Disciplinary Minor 2 #	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
OEC		Open Elective (Engg. Science)	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
EEM		Entrepreneurship Economics and Management (EEM-II)	2	-	-	2	2	-	-	-	2	10	10	30	-	-	-	50
AEC	BSH24AE05	Professional Development Training*	-	2	-	2	-	4	-	-	4	-	-	-	100	-	-	100
VEC	BSH24VE02	Constitution of India	2	-	-	2	2	-	-	-	2	25	25	-	-	-	-	50
VSEC	BME24VS03	Geometric Dimensioning & Tolerancing	-	1	-	1	-	2	-	-	2	-	-	-	50	-	-	50
VSEC	BME24VS04	Computer Aided Machine Drawing	-	1	-	1	-	2	-	-	2	-	-	-	50	-	-	50
		Total	**12**	**08**	**00**	**20**	**12**	**16**	**00**	**02**	**30**	**70**	**80**	**150**	**300**	**00**	**100**	**700**

Refer separate booklet for multidisciplinary minor (MDM) courses
*****Practical will be held division wise and not batch wise.
Note: Refer separate document Exit Policy (If required)

L-Lecture, **P**-Practical, **T**-Tutorial, **FA**-Formative Assessment, **SA**-Summative Assessment, **TW**-Term Work, **OR**-Oral, **PR**-Practical

OPEN ELECTIVE (Engineering Science) COURSES

Course Code	Course Name	Offered by	Remark
BET24OE01	Electrical Machines	E&TC	Choose any one
BET24OE02	Introduction to Signals and Systems	E&TC	
BCS24OE02	Data Science	CSE(AI&ML)	
BIT24OE01	Operating System's Administration	IT	
BSH24OE04	Statistical Data Analysis using R	AS&H	
BSH24OE05	Advanced Materials & Characterizations	AS&H	
BCI23OE01/ BCI24OE01	E-Waste Management	Civil Engineering	

EEM II COURSES

Course Code	Course Name	Offered by AS&H
BSH24EM02	Designing Thinking & Innovation Management	EEM II Choose any one
BSH24EM03	Project Management	
BSH24EM04	Fostering Entrepreneurship and Startups	
BSH24EM05	Business finance for engineers	

Curriculum
Semester III
Second Year B. Tech.
Mechanical Engineering

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Program:	B. Tech. (Mechanical Engineering)						Semester : III	
Course :	Engineering Materials						Code: BME23PC02	
Credit	Teaching Scheme (Hrs. per Week)				Evaluation Scheme			
2	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
	2	--	-	1	10	10	30	50

Prior knowledge of Broad Classification of Materials is essential

Course Objectives:

1. To relate structure and properties of materials.
2. To comprehend effect of thermo-mechanical processing on structure and properties.
3. To explore capabilities of Powder Metallurgy as a manufacturing process for advanced materials and application.

Course Outcomes:

The Students will be able to,

Sr. No.	Course Outcome statement
CO1	**Correlate** structure and properties and mechanical behavior of metals, polymers and ceramics.
CO2	**Select** appropriate ferrous alloy for given application based on its microstructure, amount of phases and properties.
CO3	**Select** appropriate non-ferrous alloy for given application based on its structure and properties.
CO4	**Select** appropriate heat treatment for given application.

Detailed Syllabus:

Unit	Description	Duration (H)
1.	**Introduction to materials** Classification of materials, structure of metals, polymers and ceramics, crystal imperfection, structure & property relationship, Introduction to composites and their properties.	**6** (CO1)
2.	**Ferrous metals and alloys** Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, application of lever rule, structure & property relationship, classification and application of steels. Cast Irons: Classification, Manufacturing, Composition, Properties and Applications of cast iron, effect of various parameters on structure and properties of cast irons. Classification of alloy steels and effect of alloying elements. Specifications of ferrous alloys (IS and Unified Standard).	**8** (CO2)
3.	**Nonferrous metals and alloys** Classification of nonferrous metals. Importance of nonferrous metals in engineering applications & compositions, study of different mechanical properties: Cu & Cu based alloys, Al and Al based alloys, Ni and Ni based alloys, Co and Co based alloys, Titanium & its alloys, Tin & Lead base alloys, Bearing materials: important properties & applications. Specifications of non-ferrous alloys (IS and Unified Standard).	**8** (CO3)

4.	**Heat treatment cycle and their applications** Heat treatment of steels: Transformation product of austenite with non-equilibrium cooling, TTT and CCT diagrams, Annealing, Normalizing, Hardening & Tempering, Subzero treatment. Age hardening for nonferrous alloys, Defects due to heat treatment and remedial measures. Surface hardening heat treatments.	**8** (CO4)
	Total	**30**

Text Books:

1. Material Science and Metallurgy, Dr. V. D. Kodgire, Everest publishing house, 45th Edition, 2021.
2. Introduction to Material Science and Engineering, W. D. Callister, John Wiley, 10th Edition, 2019.

Reference Books:

1. Mechanical Metallurgy, George E. Dieter, McGraw-Hill, 3rd Edition, 2017.
2. Material Science and Engineering A First Course, V. Raghavan, Prentice Hall India, 6th Edition, 2015.
3. Materials for Engineering, John Martin, Woodhead Publishing Limited, CRC Press, 3rd Edition, 2006.
4. The Science of Engineering Material, Charles O. Smith, Prentice Hall, 1977.

Online Courses:

NPTEL Course : Nature and properties of materials (https://onlinecourses.nptel.ac.in/noc20_me13/course)

NPTEL Course : Properties of materials (https://onlinecourses.nptel.ac.in/noc20_mm13/course)

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Program :	B Tech Mechanical Engineering						Semester: III	
Course :	Strength of Materials						Code :	BME23PC03
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
3	2	-	1	1	20	20	60	100

Prior knowledge of

a. Fundamentals of engineering mechanics
b. Analysis of forces and moments
c. Laws of motion, kinetics, kinematics
d. Centre of gravity and Moment of inertia is essential**.**

Course Objectives:

This course aims at enabling students,

1. To acquire basic knowledge of stress, strain due to various types of loading.
2. To apply the concept of Principal Stresses and Theories of Failure.
3. To draw Shear Force and Bending Moment Diagram for transverse loading.
4. To determine Bending, Shear stress, Slope and Deflection on Beam.
5. To solve problems of Torsional shear stress for shaft and Buckling for the column

Course Outcomes:

After learning the course, the students should be able to:

Sr. No.	Course Outcome statement
CO1	**Differentiate** the mechanical behavior of engineering materials.
CO2	**Apply** the theories of elastic failure.
CO3	**Determine** the shear force and bending moment distribution of the beam and locate the point of contra flexure.
CO4	**Calculate** stresses in beams for various boundary conditions.
CO5	**Determine** the slope and deflection of the beam for various boundary conditions.
CO6	**Compute** the torsion for the circular shaft and find the crippling load and equivalent length of the column.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
1.	**Stress and Deformation of Solids:** Stress, strain, Hooke's law, Poisson's ratio, Stress-strain diagram for brittle and ductile materials, Modulus of Elasticity, Modulus of Rigidity, Bulk Modulus. Interrelation between elastic constants, Deformation of simple and compound bars. Temperature stresses in simple members. Strain energy due to axial load (gradual, sudden and impact).	8
2.	**Principal planes and stresses:** Principal planes and stresses on oblique planes, expression for principal stresses & maximum shear stress, orientation of principal planes and planes of maximum shear. Graphical solution using Mohr's circle. **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory theirapplications and limitations	8

3.	**Shear Force and Bending Moment Diagrams: [Tutorial treatment]** Shear force and bending moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple, Relationship between rate of loading, shear force and bending moment. Maximum bending moment and position of points of contra flexure.	**7**
4.	**Stresses in Beams:** Bending stresses: Theory of simple bending: Flexural formula, bending stress distribution diagrams forcommon cross sections (rectangular, I,T,C), moment of resistance and section modulus. Shear stresses: Shear stress distribution in beams, shear stress distribution diagrams for commonsymmetrical sections, maximum and average shears stresses.	**8**
5.	**Slope and deflection of beams: [Tutorial treatment]** Relation between bending moment and slope, slope and deflection of determinate beams for standardcases with double integration method (Macaulay's method).	**7**
6.	**Torsion:** Stresses, strain and deformations in determinate shafts of solid and hollow subjected to twisting moment,torsion equation. **Buckling of columns:** Theory of columns – Long column and short column - Euler's formula – Rankine's formula	**7**
	Total	**45**

Text Books:

1. Strength of material - S. Ramamurtham - Dhanpat Rai Publication, 20th edition Jan 2020.
2. Strength of Materials -R. K. Bansal - Laxmi Publication 6th edition, Jan 2018

Reference Books:

1. Mechanics of Materials - R. C. Hibbeler - Prentice Hall Publication, 10th edition 2022
2. Strength of Materials - Timoshenko and Young - CBS Publication 3rd edition July 2021.
3. Mechanics of Materials - E.P. Popov - Pearson Publication 2nd edition, Dec. 2015.
4. Mechanics of Materials – Beer and Johnston - McGraw-Hill Publication 7th edition Feb. 2014.
5. Strength of Material – S. S. Rattan - Tata McGraw Hill Publication Co. Ltd. S, 3rd edition July 2017

e-sources:

NPTEL Web course material - Prof. S.K. Bhattacharyya, IIT Kharagpur https://drive.google.com/file/d/1N2Eyv9ofPimIT2OSMZeMrSxe68Ulclei/view?usp=sharing

Program:	B. Tech. (Mechanical)						Semester: III	
Course:	Material Testing Lab						Code:	BME23PC04
Credits	Teaching Scheme (Hrs. /Week)				Evaluation Scheme and Marks			
	Theory	Practical	Tutorial	Other	TW	OR	PR	Total
2	-	4	-	-	50	-	50	100

Prior knowledge of Type of materials, Basic structure and properties of materials **is essential.**

Course Objectives:

Students are expected to study,

1. Significance of various material characterization techniques.
2. The use of various material testing standards and methods.

Course Outcomes:

After completion of this course, the students will be able to,

Sr. No.	Course Outcome statement
CO1	**Perform** destructive testing referring appropriate material testing standards and **analyze** the data.
CO2	**Inspection and analysis for defects.**
CO3	**Prepare specimen, observe** and **analyze** microstructure
CO4	**Measure** and **analyze** effect of heat treatment on properties of materials.
CO5	**Perform** powder characterization.
CO6	**Select appropriate material** for part under consideration

Detailed Syllabus

Expt. No.	Suggested List of Experiments	Duration Hrs.
1	**Hardness test** i. Study working principles and test standards of Brinell, Poldi, Vickers and Rockwell hardness test etc. ii. Select appropriate hardness test for given materials based on capability of hardness test. iii. Prepare test specimens according to selected standards. iv. Perform hardness test by applying appropriate test standards and necessary safety precautions. v. Determine the hardness number of various materials and compare with available literature. vi. Compare given materials based on their hardness number and identify their applications. vii. Prepare a detailed report including error graphs and conclusions drawn.	6
2	**Impact Test** i. Study need, factors affecting impact strength, working principles and test standards of Izod and Charpy Impact test. ii. Prepare test specimens according to selected standards. iii. Perform Izod and Charpy impact test at different temperatures by applying appropriate test standard and necessary safety precautions. iv. Determine the impact toughness/dynamic toughness of mild steel, brass and aluminum. v. Compare given materials based on their toughness property at different temperatures and identify their applications.	4
3	**Non-destructive testing of materials** i. Study working principles and test standards of Dye penetrant, Magnaflux, Ultrasonic and Eddy current test.	4

	ii. Select appropriate non-destructive test (NDT) for given part based on capability of test. iii. Perform non-destructive test by applying appropriate test standard and necessary safety precautions. iv. Inspect the quality (presence of defect) of given material/part. v. Compare the various NDT methods.	
4	**Study of Microscopy Techniques** i. Study working principle, construction, working and capabilities of optical microscope and electron microscopes. ii. Hands on practice of optical metallurgical microscope. iii. Demonstration of SEM and TEM through lab or industrial facility visit. iv. Review of literature on scanning electron microscopy and transmission electron microscopy.	**8**
5	**Specimen preparation for microscopic study** i. Understand the relevance of various steps involved in specimen preparation. ii. Prepare steel, cast iron, brass and aluminum etc. samples to study their microstructure. iii. Observe and analyze microstructure of prepared samples. iv. Study grain shape, size, and grain distribution, identify various phases and correlate the properties of prepared samples.	**6**
6	**Microstructure observation and analysis of ferrous and non-ferrous materials.** i. Observe grain shape, size, and grain distribution, identify various phases and predict the properties of various ferrous and non-ferrous alloys. ii. Analyze and compare microstructure of low carbon steel, medium carbon steel, high carbon steel, white cast iron, gray cast iron, nodular cast iron and mottled cast iron. iii. Analyze and compare microstructure of brass, bronze and nickel alloy. iv. Compare obtained microstructure with available literature.	**6**
7	**Heat treatment of steel** i. Study transformation of austenite to pearlite, bainite and martensite. ii. Study working principle, heat treatment standards and process of Annealing, Normalizing, Hardening and Tempering. iii. Perform annealing, normalizing, hardening and tempering by applying appropriate test standard and necessary safety precautions. v. Study the effect of annealing, normalizing, hardening and tempering on microstructure and hardness property of steel under various heat treatments by Performing hardness test before and after heat treatment. v. Compare obtained results with available literature.	**8**
8	**Hardenability test** i. Study concept of hardenability. ii. Understand the Jominy End Quench test standards and procedure. iii. Perform heat treatment on oil hardened non shrinking steel and high carbon high chromium steel, prepare specimen for hardness test (surface grinding), measure hardness. Applying appropriate standard and necessary safety precautions during each stage of test. iv. Obtain hardness vs distance from quench end plot, analyze the data and determine hardenability of test specimens. v. Compare the hardenability behavior of given test specimens with available literature.	**6**
9	**Powder Metallurgy** i. Introduction to powder metallurgy technic. ii. Study various powder characterization techniques.	**6**

	iii. Prepare or collect powder sample for characterization (Ball Milling) iv. Determine particle size, size distribution, apparent density, tap density of powder. v. Correlate these properties with forming and sintering characteristics.	
10	**Selection of material for application under consideration** i. Define or choose application or component and identify essential and desirable properties. ii. Calculation of performance index iii. Use of Ashby chart iv. Preparation of material comparison matrix consisting of mechanical, physical, chemical, magnetic, electric properties, cost, manufacturability, recyclability, environmental effects etc. v. Suggest the most suitable material using it's IS or Unified designation.	**8**

References:

1. ASM Handbook: Mechanical Testing and Evaluation. (Other details from library)
2. Handbook of Materials Selection for Engineering Application, G. T. Murray, CRC Press.
3. Material Science and Metallurgy, Dr. V. D. Kodgire, Everest publishing house, 45th Edition, 2021.

Online Resources:

https://www.vlab.co.in/broad-area-mechanical-engineering

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Program:	B. Tech. (Mechanical)						Semester: III	
Course:	Strength of Materials Lab						Code:	BME23PC05
Credits	Teaching Scheme (Hrs. /Week)				Evaluation Scheme and Marks			
	Theory	Practical	Tutorial	Other	TW	OR	PR	Total
1	-	2	-	-	-	50	-	50

Prior knowledge of

a. Type of materials

b. Properties of materials **is essential.**

Course Objectives:

1. To impart practical skills in investigating the mechanical behavior of materials.
2. To demonstrate the importance of testing standards in the determination of mechanical properties

Course Outcomes:

After completion of this course, the students will be able to,

Sr. No.	Course Outcome statement
CO1	**Examine** the mechanical behavior of ferrous materials.
CO2	**Examine** the mechanical behavior of non-ferrous materials (plastics / composites).
CO3	**Perform** torsion test on long rods to verify torsional formula.

Detailed Syllabus

Expt. No.	Suggested List of Experiments
	Part A - Practical:
1	Tension test on ductile material for determining Young's modulus of materials using Universal Testing Machine
2	Compression test on Brittle material materials using Universal Testing Machine
3	Shear test on ductile material materials using Universal Testing Machine
4	Bending of Simple supported beam/Cantilever [Bending (flexural) formula]
5	Torsion of circular bar to find out modulus of rigidity.
6	Tension test on Plastic/Composite [Tensile Testing m/c (low load capacity)]
	Part B- Assignment
7	Interpretation of any two cases of structural analysis identified from literature

References:

1. ASTM Handbook: Mechanical Testing and Evaluation volume 8- H. Kuhn and D. Medlin, 2000.
2. Strength of Materials - Timoshenko and Young - CBS Publication 3rd edition July 2021.
3. Mechanics of Materials - R. C. Hibbeler - Prentice Hall Publication, 10th edition 2022.
4. Strength of material - S. Ramamurtham - Dhanpat Rai Publication, 20th edition Jan 2020

Program:	B. Tech. (Mechanical)						Semester: III	
Course:	Applied Mathematics (Suggested for Mechanical branch)						Code:	BSH23OE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	--	--	--	10	10	30	50

Prior knowledge of: Univariate Calculus, Multivariate Calculus

Course Objectives: After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques and Probability theory for Data Analysis.
2. Partial differential equations applied to mechanical engineering problems such as mechanical vibrations and heat transfer.
3. Laplace Transform and Inverse Laplace Transform applied to solve linear differential equations.

Course Outcomes: After learning the course, the students should be able to:

CO1: **Apply** descriptive statistical techniques for measures of variability of numerical data, Curve fitting, Correlation and Regression.

CO2: **Make predictions** for the numerical data using probability theory and hypothesis testing.

CO3: **Apply** variable separation method to solve wave, transport, one and two-dimensional heat flow equations.

CO4: **Solve** the mass spring system and similar problems using Laplace and Inverse Laplace Transform.

Detailed Syllabus

Unit	Description	Duration [Hrs.]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	**7**
II	**Probability Distributions:** Probability, Theorems on Probability, Mathematical Expectation, Binomial, Poisson, and Normal Distributions. **Hypothesis Test:** z-test, t-test, Chi-Square test, ANOVA Test.	**8**
III	**Applications of Partial Differential Equations:** Solution to One dimensional Wave, Heat and Transport equation, Two-dimensional heat flow equation using Method of separation of variables.	**7**
IV	**Laplace Transform:** Introduction, Laplace Transform of some standard and special functions, Region of convergence and Properties, properties and theorems of Laplace Transformation. Inverse Laplace Transform, Application of Laplace Transform to solve LDE.	**8**
	Total	**30**

Text Books:

1. Peter O'Neil, "Advanced Engineering Mathematics", Thomson Learning, 7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics" Wiley Eastern Ltd.,10 Edition, ISBN 13: 9780470458365.
2. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320.
4. H.K. Das, "Advanced Engineering Mathematics", S Chand & Company Ltd, 22 edition, ISBN 9352533836.

e-sources: NPTEL Course lectures links:

1. https://nptel.ac.in/courses/111/105/111105038/ (P.D.E)
2. https://onlinecourses.nptel.ac.in/noc20_ma13/ (Advanced Engineering Mathematics)

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Program :	B. Tech. (Mechanical)					Semester: III		
Course :	Computational Techniques (OE Maths Suggested for E&Tc)					Code :	BSH23OE02	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge:

1 Univariate Calculus

2 Multivariate Calculus is essential

Course Objectives: After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory, and hypothesis techniques.
2. Numerical techniques to approximate solutions for interpolation, integration and ordinary differential equations.

Course Outcomes: After learning the course, the students should be able to:

Sr. No	Course Outcome statement
CO1	**Apply** statistical methods like variability, curve fitting, correlation and regression analysis for prediction of a given data
CO2	**Analyze** the data using probability theory and distributions.
CO3	**Make predictions** for the numerical data using hypothesis testing.
CO4	**Compute** approximate solution for interpolation, integration and ordinary differential equations using numerical methods.

Detailed Syllabus:

Unit	Description	Duration [Hrs]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	7
II	**Probability Distributions:** Probability, Theorems on Probability, Random Variable, Probability mass function, Mathematical Expectation, Probability distributions: Binomial, Poisson, and Normal.	8
III	**Sampling Distribution:** Introduction and Types, Population vs Sample **Hypothesis Tests:** Level of significance, Confidence interval, p-Test, z-test, t-test, Chi-Square test, ANOVA Test.	7
IV	**Numerical Methods:** **Interpolation:** Finite Differences, Newton's and Lagrange's interpolation formula. **Numerical Integration:** Trapezoidal and Simpson's rule **Ordinary differential equations:** Euler's, Modified Euler's and Runge-Kutta fourth order methods	8
	Total	**30**

Text Books:

1. Peter V. Neil, “Advanced Engineering Mathematics”, Thomson Learning, 7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. M. D. Greenberg, “Advanced Engineering Mathematics”, Pearson Education, 2 Edition, ISBN 13:9780486492797.
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal, “ A textbook of Engineering Mathematics”, 9th Edition, ISBN 16:978-8131808320
4. H. K. Das, “Advanced Engineering Mathematics”, S Chand & Company Ltd., 22 edition, ISBN 9352533836.

e-sources:

NPTEL Course lectures links:

1. Probability Theory for Data Science - Course (nptel.ac.in) (Statistics, Probability and Hypothesis testing)
2. Numerical methods - Course (nptel.ac.in) (Numerical Methods)

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Program :	B. Tech. (Mechanical)					Semester: III		
Course :	Applied Mathematics (OE Maths Suggested for Civil branch)					Code :	BSH23OE03	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge:

1. Univariate Calculus
2. Multivariate Calculus is essential

Course Objectives: After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory, and hypothesis techniques.
2. Higher level mathematics and their applications in E&TC Engineering.

Course Outcomes: After learning the course, the students should be able to:

1. **Apply** descriptive statistical techniques for measures of variability of numerical data, Curve fitting, Correlation and Regression.
2. **Make predictions** for the numerical data using probability theory and hypothesis testing.
3. **Compute** approximate solution for interpolation, integration and ordinary differential equations using numerical methods.
4. **Examine** the vector fields using concepts of vector differentiation and Integration.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Statistics:** Measures of Variability, Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting, Correlation and Regression.	7
II	**Probability Distributions:** Probability, Theorems on Probability, Mathematical Expectation, Binomial, Poisson and Normal Distribution. **Hypothesis Test:** z-test, t-test, Chi-Square test, ANOVA Test.	8
III	**Numerical Methods:** **Interpolation:** Finite Differences, Newton's and Lagrange's interpolation formula **Numerical Integration:** Trapezoidal and Simpson's rule. **Ordinary differential equations:** Euler's, Modified Euler's and Runge-Kutta fourth order methods.	7
IV	**Vector Differentiation:** Introduction, Vector differential operators, Gradient, Divergent, Curl, Directional Derivatives, Solenoidal and Irrotational fields, Scalar Potential. **Vector Integration and Applications:** Introduction to Line, Surface and Volume Integration of Vectors, Work-done, Green's Lemma, Gauss's Divergence theorem, Stoke's theorem.	8
	Total	30

Text Books:

1. Peter V. Neil, "Advanced Engineering Mathematics", Thomson Learning ,7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana , "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. M. D. Greenberg , "Advanced Engineering Mathematics", Pearson Education, 2 Edition, ISBN 13: 9780486492797
2. S.R.K. Iyengar, Rajendra K. Jain, "Advanced Engineering Mathematics", Alpha Science International, Ltd,4
3. Edition, ISBN 13: 9781842658468
4. B. S. Grewal , "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13: .9788174091955
5. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320

e-sources:

1. **NPTEL Course lectures links:**
   https://nptel.ac.in/courses/111/105/111105090/ (Probability)

   https://onlinecourses.nptel.ac.in/noc20_ma13/ (Advanced Engineering Mathematics)
2. **V-lab (IIT-Bombay) link: http://vlabs.iitb.ac.in/vlabs-dev/labs/numerical_lab/labs/explist.php**

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Program :	B. Tech. Mechanical						Semester: III	
Course :	Computational Techniques (OE Maths Suggested for Comp/IT branch)						Code :	BSH23OE07
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge of

1. Univariate Calculus
2. Multivariate Calculus **is essential.**

Course Objectives: After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Statistical techniques, Probability theory, and hypothesis techniques.
2. Different mathematical approaches for optimization.

Course Outcomes: After learning the course, the students should be able to:

1. **Apply** statistical methods like variability, curve fitting, correlation and regression analysis for prediction of a given data.
2. **Analyze** the data using probability theory and distributions.
3. **Make predictions** for the numerical data using hypothesis testing.
4. **Solve** transportation and assignment problems using optimization techniques.

Detailed Syllabus:

Unit	Description	Duration [Hrs]
I	**Statistics:** Measures of Variability: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Curve fitting (line, parabola & exponential curves), Correlation and Linear Regression	7
II	**Probability Distributions:** Probability, Theorems on Probability, Random Variable, Probability mass function, Mathematical Expectation, Probability distributions: Binomial, Poisson, and Normal	8
III	**Sampling Distribution:** Introduction and Types, Population vs Sample **Hypothesis Tests:** Level of significance, Confidence interval, p-Test, z-test, t-test, Chi-Square test, ANOVA Test.	7
IV	**Transportation Problems:** Introduction, Mathematical model of transportation problem, Methods of finding initial solutions: North-west Corner rule, least cost method, VOGEL"s approximation method, Optimality of initial solution using MODI Method. **Assignment Problems:** Introduction, Mathematical model of Assignment problem, solutions to Assignment problems using Hungarian method.	8
	Total	**30**

Text Books:

1. Peter O'Neil, "Advanced Engineering Mathematics", Thomson Learning, 7 Edition, ISBN 13:9781337274524.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill, 34 edition, ISBN 13:9780070634190.

Reference Books:

1. M. D. Greenberg, "Advanced Engineering Mathematics", Pearson Education, 2 Edition, ISBN 13:9780486492797.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publication, 42 Edition, ISBN 13:9788174091955.
3. N. P. Bali, Manish Goyal, " A textbook of Engineering Mathematics", 9th Edition, ISBN 16:978-8131808320
4. H.K. Das, "Advanced Engineering Mathematics", S Chand & Company Ltd, 22 edition, ISBN 9352533836

e-sources:

NPTEL Course lectures links:

Probability Theory for Data Science - Course (nptel.ac.in) (Statistics, Probability and Hypothesis testing)

https://nptel.ac.in/courses/110/106/110106059/(Transportation&AssignmentsProblems)

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Program:	B. Tech. CSE (AI&ML).						Semester: IV	
Course:	Mathematical Optimization (OE-Mathematics Suggested for AI & ML branch)						Code:	BSH24OE08
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	0	30	50

Prior knowledge of: Univariate Calculus, Multivariate Calculus is essential.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of mathematical principles related to:

1. Different mathematical approaches for optimization.
2. Commonly used tools and techniques in network analysis

Course Outcomes:

After learning the course, the students should be able to:

1. **Formulate** and solve linear programming models using graphical, Simplex method.
2. **Solve** transportation and assignment problems using optimization techniques.
3. **Analyze** the project network problems and their solutions using critical path method to optimize models.
4. **Apply** variants of numerical methods to find optimal solutions for constrained, unconstrained problems.

Detailed Syllabus

Unit	Description	Duration [Hrs.]
I	**Linear Programming (LP):** Introduction, formulation of Linear Programming problems, Graphical solution method, multiple optimal solutions, Unbounded solutions, Infeasible solutions, Simplex Method.	8
II	**Transportation Problems:** Introduction, Mathematical model of transportation problem, methods of finding initial solutions: North-west Corner rule, Least cost method, VOGEL"s approximation method, Optimality of initial solution using MODI Method. **Assignment Problems:** Introduction, Mathematical model of Assignment problem, solutions to Assignment problems using Hungarian method.	7
III	**Network Analysis:** Network Diagram, Project Management: PERT and CPM, Critical path analysis, Project scheduling with uncertain activity time, and Project time-cost	8
IV	**Unconstrained optimization:** One-dimensional search methods, Gradient-based methods, Conjugate direction and quasi-Newton methods, **Constrained Optimization:** Lagrange theorem	7
	Total	30

Text Books:

1 .Rao S. S., Engineering Optimization Theory and Practice, Willy Eastern Ltd.4th Edition, ISBN: 978-0-470- 18352-6

2.Taha Hamdy ,Operation Research: An Introduction, Pearson Education, 9thEdition, ISBN:0134444019

Reference Books:

1. Sharma S.D .Operation Research, Kedarnath Ramnath & Co.Edition, ISBN:9380803389
2. Peter. O' Neil,"Advanced Engineering Mathematics,"Thomson Learning,7 Edition, ISBN13: 9781337274524
3. Hira Gupta," Operation Research,"S.Chand Publication, ISBN(13):9788121909686.
4. Sharma J.K."Operations Research-Theory and Applications," Trinity Press,6 Edition ISBN:9789385935145

e-sources:

NPTEL Course lectures links:

1. https://nptel.ac.in/courses/111/102/111102012/(LPP)
2. https://nptel.ac.in/courses/110/106/110106059/(Transportation&AssignmentsProblems)

Program:	B. Tech. (Mechanical)						Semester:	III
Course :	**Biology for Engineers** (OE DS Offered by E&Tc)						Code :	BET23OE03
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Theory	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Pre-requisite: Basics of Human Anatomy and physiology
Basics of Electronics Engineering

Objectives:

1. To introduce biological engineering principles, procedures needed to solve real-world problems.
2. To provide an overview of human anatomy and physiology in order to support biomedical engineering solutions.
3. To introduce biomedical sensors, signal processing and diagnostic systems.
4. To provide a basic knowledge of the applications of biological systems in relevant industries.

Outcomes:

After completing the course the students should be able :

1. To understand basics of human physiological system and its cell functioning
2. To understand human immune system and significance of microbiology
3. To map role of biology in designing industrial applications
4. To understand biomedical sensors, its interfacing and related to measurement systems.

Detailed Syllabus:

Unit	Description	Duration (Hrs)
I	**CELL PHYSIOLOGY:** Introduction to the cell biology – Cell size and shape - Chemical composition - Classification of cell and its properties, Cell cycle; Cell signalling, Transport across cell membrane; Introduction to Human physiology – Circulatory system - Respiratory system - Excretory system - Nervous system.	08
II	**IMMUNOLOGICAL SCIENCE:** Immune system and its types; Functional properties of antibodies; Helper T cells and T cell activation; Importance of Microbiology.	07
III	**BIOLOGY AND ITS INDUSTRIAL APPLICATION:** Introduction : Bioreactors, biocontrol, bio filters, biopolymers, bioenergy, biomaterials, biochips, Nano-Biomolecules and its various types: Principles and Application of Biosensor; Basics of Biochips – Bio fertilizer – Bioinformatics – Bio fuel.	07
IV	**INTRODUCTION TO BIOMEDICAL INSTRUMENTATION:** Need and Challenges in measurement of the parameters in living systems, Source of bioelectric potential: Resting and action potential, propagation of action potential, depolarization and re-polarization. Introduction to few important bio-potential such as Electrocardiogram (ECG), Electroencephalogram (EEG) and Electromyogram (EMG).	08
	Total	30

Text Books:

1. Dr. Sohini Singh and Dr. Tanu Allen, "Biology for Engineers", Vayu Education Of India, New Delhi, 2014.
2. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, 2nd edition, Prentice Hall of India

Reference Books:

1. Arthur T. Johnson, "Biology for Engineers" CRC Press, 2011.
2. Goldsby RA, Kindt TK, Osborne BA and Kuby J (2003) Immunology, 5th Edition, W.H. Freeman and Company, New York.
3. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
4. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012
5. John G. Webster(Editor), Amit J. Nimunkar (Editor), Medical Instrumentation: Application and Design,5th edition Wiley publication
6. Joseph H. Carr, John M. Brown, Introduction to Biomedical equipment Technology, 4edition , Pearson publication

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Program:	B. Tech. (Mechanical)						Semester:	III
Course :	**AI for Financial Modelling** (OE DS Offered by CSE(AI&ML)						Code :	BCS23OE01
Credit	Teaching Scheme (Hrs./week)				Evaluation Scheme			
	Theory	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Pre-requisite: Artificial Intelligence, Machine Learning is essential.

Objectives:

1. To understand the essentials of financial modeling
2. To learn to build a simple financial model.
3. To perform the analyses of financial models and Apply AI/ML methods for forecasting.
4. To use AI enabled platforms for finance tasks.

Outcomes:

5. After learning the course, the students will be able to :
6. Learn the essentials of financial modeling
7. Understand core AI and machine learning concepts and algorithms relevant to finance.
8. Apply AI/ML methods for financial forecasting.
9. Use AI enabled tools and platforms for finance tasks

Detailed Syllabus:

Unit	Description	Duration (Hrs.)
I	**Introduction to Financial Modelling**: Importance and Applications in Finance, Key Financial Statements (Income Statement, Balance Sheet, Cash Flow), Basic Excel Techniques for Financial Modelling, Overview of Financial Ratios and KPIs, Limitations of Traditional Modelling Techniques.	7
II	**Basics of Artificial Intelligence and Machine Learning**: Introduction to AI and Machine Learning, Types of Machine Learning (Supervised, Unsupervised), Common Algorithms in Finance: Linear Regression, Decision Trees, Clustering, Introduction to Python for AI (basics, IDEs, libraries: NumPy, Pandas), Data Preprocessing for Financial Datasets.	8
III	**AI Applications in Financial Modelling**: AI for Forecasting Revenue and Expenses, AI for Credit Risk Assessment across financial applications, AI in Fraud Detection, Portfolio Optimization Basics, Predictive Analytics in Budgeting and Planning.	8
IV	**Tools, Ethics, and Future Trends**: AI Tools for Finance: Power BI/Tableau, AutoML Platforms, Introduction to FinTech and Robo-Advisors, Ethical Considerations: Data Privacy, Bias, Model Interpretability. Case Studies of AI in Financial Services	7
	Total	**30**

Text Books:

1. Yves Hilpisch, “Artificial Intelligence in Finance: A Python-Based Guide”, O’Reilly Media Inc., July 2019, ISBN: 9781492055433
2. Jannes Klaas, “Machine Learning for Finance”, Packt Publishing, 2019, ISBN: 9781789136364

Reference Books:

1. Edward P.K. Tsang, “AI for Finance”, Routledge Taylor and Francis, 1st Edition, 2023, ISBN 9781032384436.

e-sources:

1. https://www.udemy.com/course/python-and-machine-learning-in-financial-analysis/
2. https://www.udemy.com/course/ai-for-finance/

Program	B. Tech. (Mechanical)						Semester	III
Course	Cyber Security: Understanding Cyber Crimes and Legal Perspectives (OE DS Offered By IT Department)						Code	BIT23OE02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA 1	FA 2		
2	2	-	-	-	10	10	30	50

Prior knowledge of: Fundamentals of the Internet **is essential.**

Course Objectives:

1. To learn the concepts of cyber security for understanding and addressing digital threats effectively.
2. To learn about legal frameworks governing information technology and cyber law.

Course Outcomes:

After learning the course, the students will be able to:

1. Explain the principles and necessity of cyber security
2. Categorize various cyber threats, cybercrimes, and cyber legal frameworks.
3. Apply cyber forensic techniques to identify criminal activities.
4. Use preventative measures to stop social engineering scams.

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1.	**Introduction to Cyber Security** Cyber Security – History of Internet– Impact of Internet; Reason for Cyber Crime – Need for Cyber Security; History of Cyber Crime, Cyber Security Concepts: Introduction to cyber security, Types of cyber security, Information Assurance Fundamentals, Attacker Techniques and Motivations, Cyber security Challenges, Incident response process, Security policy, Risk Analysis and Management, CIA Triad	**8**
2.	**Cyber Crime and Law** Cybercriminals – Classification of Cybercrimes – A Global Perspective on Cyber Crimes, Planning cyber-attacks by cybercriminals, Careers in Cyber Security. Cyber Laws—The Indian IT Act—Cyber Crime and Punishment. Types of Threats, Types of Hacker, Hacking and Cracking, Hacking: Ethical issues, Ethical Hacking.	**8**
3.	**Cyber Forensics** Introduction to Cyber Forensics: Cyber forensics investigation process, digital evidence, challenges in cyber forensics; Types of forensics, Anti- forensics practices, Anti-forensics detection techniques. Email Forensics: e-mail Protocols, email crimes, email forensics;	**7**
4.	**Social Engineering** Introduction of social engineering and cyber security, Evolution of Social Engineering, Social Engineering Ethics, Purpose , Prevention methods, Insider attacks, defining social engineering-categories, Phases, attack spiral model, Attack Vendors-social approach, socio-technical approach. Identity Theft, Preventing Insider Threats,	**7**
	Total	**30**

Text Books:

1. Nina Godbole and Sunil Belapure. Cyber Security: Understanding Cyber Crimes, Computer Forensics, and Legal Perspectives, Wiley INDIA. ISBN 978-81-265-2179-1.
2. Niranjan Reddy, Practical Cyber Forensics an Incident-Based Approach to Forensic Investigations. Apress, ISBN-13: 978-1-4842-4459-3
3. William Stallings, “Cryptography and Network Security: Principles and Practice”. Pearson Publication.

Reference Books:

1. William Stallings, Computer Security: Principles and Practices, Pearson, 6th Ed., ISBN: 978- 0- 13-335469-0
2. Bernard Menezes, Network Security and Cryptography, Cengage Learning, ISBN-978-81- 315-1349- 1
3. Dr. V.K. Pachghare, Cryptography and Information security, PHI, Second edition, ISBN 978- 81- 203-5082-3

E-sources:

1. https://www.udemy.com/course/certified-secure-netizen/
2. https://www.coursera.org/professional-certificates/google-cybersecurity

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Program:	**B. Tech. (Mechanical)**						**Semester: III**	
Course :	**Neural Network and Fuzzy Logic Control** (OE DS offered by AS&H)						**Code :**	BSH23OE06
Credits	**Teaching Scheme (Hrs./Week)**				**Evaluation Scheme and Marks**			
	Lecture	**Practical**	**Tutorial**	**Other**	**FA**		**SA**	**Total**
					FA1	**FA2**		
2	**2**	-	**-**	**-**	**10**	**10**	**30**	**50**

Prior Knowledge: Nil

Course Objectives:

This course aims to enable students to get acquainted with,

1. Knowledge of Neural Networks and its use for controlling real-time systems.
2. Knowledge about fuzzy set theory to solve various engineering problems.

Course Outcomes:

After learning the course, the students will be able to:

1. Compute feed forward Artificial Neural Network output using basic concepts related to Artificial Neural Network.
2. **Apply** back propagation and optimizer algorithms to update weights of Neural Networks and application-based problem-solving.
3. Find fuzzification and de-fuzzification of crisp function using basic Fuzzy set theory concepts.
4. Apply a fuzzy logic control system to handle uncertainty and some engineering problems.

Detailed Syllabus

Unit	**Description**	**Duration [Hrs]**
I	**Architecture of Neural Network:** Introduction, Biological Neural Network, Artificial Neural Network The architecture of Artificial Neural Networks- Bias, Activation Function, Learning Methods, Learning rules, Types of Neural Networks: Single-layer, multi-layer, feed-forward, and recurrent neural networks.	**7**
II	**Neural Networks For Control:** Loss function, Weight initialization, Optimizers algorithms, Back propagation Algorithm, Associative Memory Networks and their types, Discrete-time hop field networks	**8**
III	**Fundamental of Fuzzy Logic:** Fundamental of Fuzzy Logic: Classical sets, Fuzzy Sets, Membership function, Cardinality of fuzzy set, Fuzzy complement, Fuzzy Composition, properties and operation on Fuzzy sets, Fuzzy Relation, Fuzzification, De-fuzzification	**7**
IV	**Fuzzy Logic Control:** Fuzzy Rule, Decision-making Logic, Linguistic variables Fuzzy Inference System: Mamdani FIS, Sugeno FIS Design of fuzzy controller, fuzzy optimization, applications of FIS to some real-life problem	**8**
	Total	**30**

Text Books:

1. Kosko, B, "Neural Networks and Fuzzy Systems: A Dynamical Approach to Machine Intelligence", Prentice Hall, New Delhi, 2004.
2. Ross T. J., "Fuzzy logic with engineering applications (Vol. 2)", New York: Wiley, 2004, ISBN: 9783030375478

Reference Books:

1. Jack M. Zurada, “Introduction to Artificial Neural Systems,” PWS Publishing Co., Boston, 2002.
2. Zimmerman H.J., “Fuzzy set theory and its Applications,” Kluwer Academic Publishers Dordrecht, 2001.
3. Driankov, Hellendroonb, “Introduction to fuzzy control,” Narosa Publishers, 2001.
4. G Klir, B Yuan, “Fuzzy sets and fuzzy logic: Theory and application,” PHI, ISBN:
5. Laurance Fausett, Englewood Cliffs, N.J., “Fundamentals of Neural Networks,” Pearson Education, New Delhi, 2008.
6. B Yegnanarayana: Artificial Neural Networks for pattern recognition, PHI Learning Pvt. Ltd., 14-Jan-2009

e-sources:

Online course “Fuzzy Logic and Neural Network” by Prof. Dilip Kumar Pratihar,

IIT Kharagpur. https://nptel.ac.in/courses/127/105/127105006/

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Program:	B. Tech. (Civil Engineering)					Semester :	III
Course:	**Total Quality Management** (OE DS offered by Civil Engg)					Code:	BCI23OE02
Credits	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	FA		SA	Total
				FA1	FA2		
2	2	-	-	10	10	30	50

Prior Knowledge: Basic definitions of Quality and importance of Quality in industry for safety and durability.

Course Objectives:
After Completing this course, student will have adequate background :
1. To understand the importance of Quality in construction.
2. To understand the need of Total Quality management & its tools.
3. To understand role of ISO in quality management.

Course Outcomes:
After learning the course, the students should be able to:
1. Articulate quality and quality ideas as presented by many gurus and philosophers after learning.
2. Illustrate different quality control tools.
3. Apply ISO concepts and the cost of quality to quality assurance.
4. Analyze various techniques of TQM.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Unit I: Quality in Construction** a) Quality – Various definitions and interpretation. Importance of quality on a project in the context of global challenges, Factors affecting quality, Reasons for poor quality & measures to overcome, Contribution of various Quality Gurus (Juran, Deming, Crossby, Ishikawa), b) Evolution of TQM- QC, TQC, QA, QMS, TQM.	7
2	**Unit II: TQM, Six Sigma and QC tools** a) TQM – Necessity, advantages, Quality Function Deployment (QFD), b) Six sigma – Importance, levels, Application of 6 Sigma, c) Implementation of 7 QC tools through case study.	8
3	**Unit III: Cost of Quality and ISO** a) Categories of cost of Quality, b) Study of ISO 9001 principles. Quality manual – Importance, contents, documentation, Corrective and Preventive actions, Conformity and NC reports.	7
4	**Unit IV: Techniques in TQM Implementation** a) Benchmarking in TQM, Kaizen in TQM, b) '5-S_techniques, Zero Defects, c) Quality Circle Concept and applications through Quality Circle Formation.	8
	Total	30

Text Books:
1. Total Quality Management-- Dr. Gunmala Suri and Dr. Puja Chhabra Sharma—Biztantra.
2. Quality Control and Total Quality Management by P.L.Jain- Tata McGraw Hill Publ.
3. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar—Biztantra.
4. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

Reference Books:
1. Juran's Quality Handbook – Juran Publication. (2016 Edition)
2. Management –Principal, process and practices by Bhat – Oxford University Press.(2008)
3. Financial management by Shrivastava- Oxford University Press (6th Edition 2022)
4. Management Information Systems – Gordon B. Davis, Margrethe H. Olson – Tata McGraw Hill Publ. Co. (2022)
5. Total Project Management – The Indian Context - P.K.Joy Macmillan India Ltd.

Program:	B. Tech. (Mechanical)						Semester:	III
Course:	Building Services and Maintenance (OE DS offered by Civil Engg.)						Code:	BCI23OE03
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior Knowledge: NA

Course Objectives:

This course aims at enabling students,

1. To impart knowledge about the building services
2. To examine the purpose and type of building maintenance.

Course Outcomes:

After learning the course, the students should be able to:

1. Understand different building services provisions.
2. Interpret the fundamental concepts relevant to functional requirement of building.
3. Relate the knowledge of Acoustic and Fire Protection.
4. Choose diverse maintenance methodologies applicable to building and infrastructure services.

Detailed Syllabus

Unit	Description	Duration (H)
1	**Introduction to Building Services:** Definitions, Objective and uses of services, different types of building, Classification of based on Occupancy, FSI, Carpet area, built-up area, Standard of Accommodation, Classification of building services, Types of services and selection of appropriate services for given project**,** case studies.	7
2	**Escalator and Plumbing-** Classification of different types of escalators, Lift codes and Rules, Design Features of Escalator, Plumbing- Common Sanitary Fixtures, Layout of Sanitary Fixtures, Water Pipe Sizing in Buildings, Building Services Detailing, Rain Water Harvesting, Sanitation in buildings.	8
3	**Acoustics and Ventilation-** Material properties, acoustical design of assembly halls and buildings, noise and its control, measuring equipment, Ventilation- Ventilation systems, health and comfort ventilation, Fire protection and National Building Codes 2016- requirements, equipment and their applications, security systems.	8
4	**Building Maintenance:** Role of maintenance in durability and serviceability of structures, Economic aspects of maintenance, Different types of maintenance and audits process. **Infrastructures services:** Different types of structures, infrastructure services, case studies.	7
	Total	**30**

Text Books:

1. Building Construction Dr. B. C. Punmia, Laxmi Publications (P) Ltd., New Delhi
2. Building Construction P. C. Varghese PHI Learning (P) Ltd., New Delhi
3. Building repair and Maintenance Management P. S. Gahlot CBS Publishers & Distribution(P) Ltd.

Reference Books:

1. Building Science & Planning by S.V. Deodhar, Khanna Publishers.
2. Design and Practical Hand Book on Plumbing by C.R Mohan, Vivek Anand, Standard Publishers Distributors.
3. Hand book of Designing and Installation of Services in High Rise Building Complexes, by V.K. Jain, Khanna Publications

Program:	B. Tech. (Mechanical)						Semester:	III
Course:	Fundamentals of Database Management System (OE DS Offered by Computer Engineering)						Code:	BCE23OE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior Knowledge: basics Mathematics is essential

Course Objectives:

1. To make students understand the fundamental concepts of database management.
2. To provide a foundation in database concepts.
3. To make students familiar with building database design.
4. To make students understand SQL queries and concepts.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand the fundamental concepts of database management systems.
2. Design E-R Model for given requirements and convert the same into database tables.
3. Design schema in appropriate normal form considering requirements.
4. Use SQL to write queries for given requirements.

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1	Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, View of Data, Database System Structure.	6
2	Data Models, Database Design, Entity Relationship Model, ER Diagram, Extended ER diagram, converting E-R and Extended ER diagram into tables.	8
3	Relational Model: Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities Database Design: Features of Good Relational Designs, Normalization, Atomic Domains, and First Normal Form, 2NF, 3NF, BCNF.	8
4	SQL Language commands DDL, DML, DCL SQL: Characteristics and advantages, SQL Data Types, SQL Operators, Tables: Creating, Modifying, Deleting, Updating, DML Queries: SELECT Query and clauses, SQL - Ordering of Tuples, Aggregate Functions, SQL Functions, Sub queries	8
	Total	**30**

Text Books:

1. Silberschatz A., Korth H., Sudarshan S., "Database System Concepts", McGraw Hill Publishers, 7th Edition, 2020, ISBN 978-0-07-802215-9.
2. Ivan Bayross, "SQL, PL/SQL the Programming Language of Oracle", BPB Publications, 2014 ISBN: 9788176569644.
3. Connally T, Begg C., "Database Systems- A Practical Approach to Design, Implementation and Management", Pearson Education, 5th Edition, 2010, ISBN 81-7808-861-4.

Reference Books:

1. Coronel, C. and S. Morris, ―Database Systems: Design, Implementation, & Management,‖ 12th edition, Cengage, 2016
2. S. K. Singh, "Database Systems: Concepts, Design and Application", Pearson Education, 2009, ISBN 9788177585674

e-sources: http://w3schools.org/

Program:	B. Tech. (Mechanical)						Semester:	III
Course:	Principles of Software Engineering (OE Department Specific Offered by Computer Engineering)						Code:	BCE23OE02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior Knowledge: problem-solving skills is essential.

Course Objectives:

1. To introduce the fundamental phases of the Software Development Life-cycle (SDLC).
2. To make students understand the methods for capturing, specifying, and analyzing software requirements.
3. To make students understand the concept of UML Diagrams for software project development.
4. To provide the fundamental understanding of the agile process model.

Course Outcomes:

After learning the course, the students will be able to:

1. Compare and Select appropriate Software Development Life-cycle (SDLC) Process Model.
2. Comprehend methods for capturing, specifying, and analyzing software requirements.
3. Design UML Diagrams for software project development.
4. Comprehend the basics of agile process model for the development of software projects.

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1	**Introduction to Software Engineering** Definition of Software, Software Application Domains, Software engineering layers, Software engineering practice, The Essence of Practice, General Principles, Software Development Life Cycle (SDLC) Models: Waterfall Model, V Model, Incremental Process Model, Evolutionary Process Models, Unified Process, Phases of the Unified Process. Case Study: Safe Home	8
2	**Requirements Analysis** Requirement Engineering, Requirements engineering tasks, Establishing the Groundwork- Eliciting Requirements, Collaborative Requirements Gathering, Quality Function Deployment, Usage Scenarios, Elicitation Work Products, Developing use cases, Software requirements document. Case Study: Safe Home	7
3	**Software Design & Modeling Concepts** Design Concepts, Design Process and Design Quality, Design Models, Modeling Concepts and Diagrams, Introduction to UML, Use Case Diagrams, Class Diagrams, Activity Diagrams, Deployment Diagrams.	8
4	**Agile development Process** Agile Process- Extreme Programming in agile development, Agile software development process Models, SCRUM – process flow, scrum roles, scrum cycle description, product backlog, sprint planning meeting, sprint backlog, sprint execution, daily scrum meeting.	7
	Total	30

Text Books:

1. Roger S Pressman, "Software Engineering – A Practitioner's Approach", Pearson Education, 9th Edition, ISBN 9789355325044, 2023.
2. Ian Sommerville, "Software Engineering", 10th edition, ISBN-13: 9780137503148, 2021.
3. Unified Modeling Language User Guide, The (2nd Edition) (Addison-Wesley Object Technology Series), ISBN:978-0-321-26797-9, May 2005.

Reference Books:

1. Carlo Ghezzi, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 10: 0133056996, 2002.
2. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India, ISBN 13: 978-8120348981, 2014.
3. Pankaj Jalote, "An Integrated Approach to Software Engineering", Springer, ISBN 13: 9788173192715, 2010.

e-sources: http://w3schools.org/

Program:	B. Tech. (Mechanical)						Semester:	III
Course:	Android App Development with Kotlin (OE DS Offered by Computer Engineering)						Code:	BCE23OE03
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior Knowledge: Basic programming knowledge is essential

Course Objectives:

1. To explore Kotlin programming language features.
2. To familiarize with the concepts of Kotlin.
3. To get acquainted with Android features, networks, and data handling techniques.
4. To develop an Android app with testing.

Course Outcomes:

After learning the course, the students will be able to:

1. Explore object-oriented programming with Kotlin.
2. Illustrate the concept of Kotlin fundamentals
3. Apply the network handling and Android UI techniques.
4. Deploy the Android application with testing

Detailed Syllabus

Unit	Description	Duration (Hrs.)
1	**Introduction to Kotlin programming language** Introduction to Kotlin programming language, Setting up Android Studio development environment, Basics of Kotlin syntax and basic programming concepts, Variables, data types, and operators in Kotlin.	6
2	**Kotlin fundamentals** Conditional statements, Loops, Functions, parameters, Kotlin collections, Classes and objects, Properties, fields, and methods, Inheritance, polymorphism, and interfaces, Data classes and sealed classes.	9
3	**Android architecture, Android UI and Networking** Android Architecture, Activities and life cycle, Views, View groups, fragments and lifecycle, Working with RESTful APIs and JSON data, Using Retrofit and OkHttp for network communication, Implementing LiveData and ViewModel, Asynchronous programming.	9
4	**Android App Development and Testing** Case study: Picture gallery, Developing an App, Unit testing and UI testing with Junit and Espresso, Preparing and publishing app to Google Play store	6
	Total	30

Text Books:

1. Laurence PO, Hinchman-Dominguez A, G. Blake Meike, Dunn M. “Programming Android with Kotlin”, O’Reilly Media, Inc.; 2021. ISBN:9781492063001
2. Lim G. “Beginning Android Development With Kotlin” Greg Lim; 2020. ISBN:9811477973, 9789811477973

Reference Books:

1. Trivedi Hardik. “Android application development with Kotlin”, BPB Publications; 2020.
2. Fazio M. “Kotlin and Android Development featuring Jetpack”, Pragmatic Bookshelf; 2021.

e-sources: . https://developer.android.com/

Program:	B. Tech. (Mechanical)						Semester: III	
Course:	Business Studies for Engineers (Offered by AS&H)						Code:	BSH23EM01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
02	02	-	-	-	10	10	30	50

Prior knowledge of: NA

Course Objectives:

This course aims at enabling students:

1. To help the students to gain understanding of various perspectives in the field of Strategic Management
2. To enable the students to pursue the modern management practices in business.
3. To provide the students an understanding about tools and techniques of economic principles in business management.

Course Outcomes:

After learning the course, the students will be able to:

1. **Explain** the concept of Management and Strategic Management with their implications.
2. **Illustrate** the Management Trends and Practices implied in Global Work Culture.
3. **Apply** the economic variables in general business atmosphere.
4. **Analyze** the business expansion strategies abroad and key issues related to their operations.

Detailed Syllabus

Unit	Description	Duration [Hrs.]
I	**Introduction to Management & Strategic Management: Journey towards Goals** Concepts of Management, Definition of Management, Functions of Management, Levels of Management, Concept of Strategic Management, Strategic Management Process- Vision, Mission, Goals, Objectives, Hierarchy of Objectives, Situational Analysis / Internal and External Analysis Organizational Goals, Planning Through MBO- Practical Insights, Michael Porter 5 Forces Analysis, Balanced Score Card (BSC), BSC v/s MBO. Case Studies: Starbucks Corporation, TATA Steel	7
II	**Management Trends and Practices - Let Us Explore** Comparative Management Styles and Approaches, Japanese Management Practices, Organizational Creativity and Innovation, Management of Innovation, Entrepreneurial Management, Benchmarking, Best Management Practices across the world, Management of Diversity, Selected cases of Domestic & International Corporations.	8
III	**Business Economics – The Road Map** Concept and Definition of Micro Economics and Macro Economics, Nature & Scope of Micro Economics and Macro Economics, Demand, Supply and Market equilibrium: Individual demand, Market demand, Individual supply, Market supply, Market equilibrium; Elasticity is of demand and supply; Price elasticity of demand, Income elasticity of demand, Cross price elasticity of demand, Elasticity of supply, Business cycle, Demographic Profile of Indian Population and Market, Urbanization.	7
IV	**International Business –Let Us Go Global** Basic concept of International Business, Decision framework, Analyzing marketing opportunities – collection and analysis of marketing information, Modes of entering overseas markets, International Marketing process and techniques – direct exporting, Indirect exporting, counter trade, Licensing, Sub- contracting, Joint – ventures, Organization and control of international marketing operations, International tendering, Procurement for export; Export information system, Global Business Environment, Innovation and International management, managing multinational market, Research Methods in International Business (RMIB).	8
	Total	**30**

Text Books:

1. George R. Terry, Stephen G. Franklin; Principles of Management, A.I.T.B.S. Publishers
2 Wendrila Biswas, Debarun Chakraborty, and Soumya Kanti Dhara.;"Recent Trends in Management"
3. Nyagucha Oresi Samwel ; Micro and Macro Economics; Understanding the Basics of Economics (English, Paperback)
4. Dr.P.Subba Rao, International Business (Text and Cases)

Reference Books:

1. Dinesh Madan, Strategic Management A Complete Reference, Aldine CA
2. Nadar .E.Narayanan Vijayan S,, Managerial Economics, PHI learning
3. Charles W. L. Hill, International Business, Mc,Graw Hill.

e-sources:

https://openstax.org/books/principles-management/pages/references

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Program:	B. Tech. (Mechanical)						Semester:	III
Course:	VEC-I- Universal Human Values						Code:	BSH23VE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	25	25	-	50

Course Objectives:

This course aims at enabling students,

1. To appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings.
2. To facilitate the development of a holistic perspective among students to lead their personal and professional lives in an ethical way.
3. To highlight plausible implications of such a holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour, and mutually enriching interaction with nature..

Course Outcomes:

After learning the course, the students should be able to:

1. **Explain** the relevance of 'Universal Human Values'
2. **Develop** an understanding about human being as co-existence of 'Self' & 'Body'
3. **Apply** the sense of harmony in family and society
4. **Take part** in ensuring coexistence with nature by integrating Universal Human Values into personal and professional lives.

Detailed Syllabus

Unit	Description	Duration [Hrs.]
I	**Introduction to Value Education:** ● Understanding Value Education ● Self-exploration as the Process for Value Education ● Continuous Happiness and Prosperity ● Right Understanding ● Current Scenario ● Method to fulfil the Basic Human Aspirations	4
	Practice Session: ● Sharing about Oneself ● Exploring Human Consciousness ● Exploring Natural Acceptance **Experiential Learning** ● Seva Activity	3
II	**Harmony in the Human Being:** ● Human being: the Co-existence of the Self and the Body ● Needs of the Self and the Body ● The Body as an Instrument of the Self ● Understanding Harmony in the Self ● Harmony of the Self with the Body ● Programme to Ensure Self-Regulation and Health	4

	Practice Session: ● Exploring the Difference between Needs of Self and Body ● Exploring Sources of Imagination in the Self ● Exploring Harmony of Self with the Body **Experiential Learning** ● Seva Activity ● Health Awareness Programme	4
III	**Harmony in the Family and in Society:** ● Harmony in the Family ● 'Trust'—the Foundational Value in Relationship ● 'Respect'—the Right Evaluation ● Other feelings (Values) in Human-to-Human Relationship ● Understanding Harmony in Society ● Vision for the Universal Human Order ● Five Dimensions of Human Order	4
	Practice Session: ● Exploring the Feeling of Trust ● Exploring the Feeling of Respect and Exploring Systems to ● Fulfil Human Goal **Experiential Learning** ● Seva Activity	3
IV	**Harmony in Nature/Existence:** ● Understanding Harmony in Nature, ● Realising Existence as Coexistence at All Levels ● The Holistic Perception of Harmony in Existence **Implications of Holistic Understanding: A Look at Professional Ethics:** ● Definitiveness of (Ethical) Human Conduct ● Humanistic Constitution and Universal Human Order ● Competence in Professional Ethics ● Holistic Technologies, Production Systems and Management Models-Typical Case Studies ● Strategies for Transitioning towards Value-Based Life and Profession.	4
	Practice Session: ● Exploring the Four Orders of Nature ● Exploring Co-existence in Existence ● Exploring Ethical Human Conduct ● Exploring Humanistic Models in Education ● Exploring Steps of Transition towards Universal Human Order **Experiential Learning Activity** ● Health Awareness Programme /Waste Management Programme (Hospital Waste/Pharmaceutical Industrial Waste/Reduce Plastic Waste/ E-Waste Management)	4
	Total	**30**

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2019, A Foundation Course in HUMAN VALUES and Professional Ethics- Presenting a universal approach to value education through self-exploration, Excel Books

Reference Books: P.L. Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.

1. A. Nagaraj, 1999, JeevanVidya: EkParichaya, JeevanVidyaPrakashan, Amarkantak,
2. A. N. Tripathy, 2003, Human Values, New Age International Publishers.
3. E. G. Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
4. M. Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics and Human Values, Eastern Economy Edition, Prentice Hall of India Ltd.
5. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
6. B. L. Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

e-sources:

1. http://madhyasth-darshan.info/postulations/knowledge/knowledge-of-humane-conduct/
2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
3. https://youtu.be/OgdNx0X923I

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Program: B. Tech. (Mechanical)							**Semester: III**	
Course: Community Engagement Project							**Code:**	**BME23EL01**
Credits	**Teaching Scheme (Hrs. /Week)**				**Evaluation Scheme and Marks**			
	Theory	**Practical**	**Tutorial**	**Other**	**TW**	**OR**	**PR**	**Total**
2	-	4	-	-	100	-	-	100

Prior knowledge of … is essential

Course Objectives:

1. To provide an opportunity to work for community
2. To encourage students to observe and work on the socio-economic issues in society
3. To participate in field based learning/projects under the supervision of faculty members/ Industry mentor

Course Outcomes:

After completion of this course, the students will be able to,

1. Identify and plan a project related to contemporary societal issues
2. Execute the field/ Community engagement project
3. Demonstrate the finding of the project

Detailed Syllabus

Sr. No.	**Description**	**Duration (Hr)**
1	**Project Definition** Students Exposure to the community by frequently visiting the nearby places. Field survey and data collection, identifying and formulating the problem for the finalization of project topic, its objective and methodology.	**20**
2	**Analysis and Solution(s)** Study and detailed analysis of the identified contemporary community problem, to find the alternative solutions with the help of technical/ social/ economical/ cultural tools	**20**
3	**Demonstration of Solutions** Discussion, demonstration/recommendation/implementation of the solutions among the stakeholder and feedback/results/view points of the impact of the solutions. Project Report writing.	**20**
	Total	**60**

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Curriculum
Semester IV
Second Year B. Tech.
Mechanical Engineering

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Program :	B Tech Mechanical Engineering						Semester: IV	
Course :	Fluid Mechanics						Code :	BME24PC06
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior knowledge of

a. Mathematical concepts of vector, tensor and differential equation.
b. Fundamental concepts and laws/governing equations of physics **is essential.**

Course Objectives:

This course aims at enabling students,

1. To understand the fundamentals of fluid statics and kinematics.
2. To understand the assumptions and importance of governing equations of fluid dynamics in the analysis of various fluid systems.
3. To understand the laminar and turbulent flow through a pipe section.
4. To understand the physics of boundary layer phenomenon.

Course Outcomes:

After learning the course, the students should be able to:

1. Apply the fundamentals of fluid statics and kinematics to solve simple fluid flow problems.
2. Apply the governing equations of fluid dynamics to various fluid flow domains.
3. Analyze the laminar and turbulent flow through a pipe section and study the effect of variation in parameters on the flow type and pattern.
4. Analyze the physics of boundary layer phenomenon.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Fluid Fundamentals and statics** **Introduction:** Types of fluid & Rheological diagram. **Fluid statics:** Pressure, Pascal's law, Hydrostatic forces on surfaces **Fluid Kinematics:** Eulerian and Lagragian approach, Types of flows, Streamlines, streak lines, and path lines, Velocity and acceleration fields, Material and control volume approaches, Continuity equation, Concept of fluid rotation, vorticity. Stream function & velocity potential function and circulation.	8
II	**Governing Equations of Fluid Dynamics** **Introduction to Integral Analysis for a Control Volume: Introduction to** Reynolds Transport Theorem (RTT) for conservation of mass, linear and angular momentum (No derivation): Significance and importance. Navier-Stokes equations, Euler equations, Bernoulli's equation.	7
III	**Internal Flows / Flow within enclosed surfaces** Steady Laminar Flow through parallel plates, through circular pipe, Couttee Flow Fully developed laminar flow, Turbulent flow in pipe, Pipes in parallel and concept of equivalent pipe, Moody's diagram, Siphons, Transmission of power.	7
IV	**External Flows** The Boundary layer concept, Laminar boundary layers – flat plate, Momentum integral equation, Boundary layer thickness – displacement, momentum and energy, Boundary layer separation and methods of controlling Boundary layer. **Dimensional Analysis** Buckingham Pi theorem, Dimensionless groups and similarity laws, Applications of dimensional analysis in fluid mechanics	8
	Total	30

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines–S K Som and G Biswas-TATA McGraw–Hill, 3rd edition, 2017.
2. Hydraulics and Fluid Mechanics-Modi P.N. and Seth S.M-Standard Book House, 22nd edition, 2019.

Reference Books:

1. Mechanics of Fluids- Merle C. Potter, David C. Wiggert and Bassem Ramadan–Cengage Learning, 2016.
2. Fundamentals of Fluid Mechanics-Munson, Young and Okiishi – Wiley India, 2016.
3. Fluid Mechanics,-Cengel & Cimbla-TATA McGraw–Hill, 2019.
4. Fluid Mechanics –F.M. White -TATA McGraw-Hill, 2022.
5. Introduction to Fluid Mechanics, Robert W. Fox, Alan T. McDonald, John W. Mitchell, John Wiley, 2020.

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Program :	B Tech Mechanical Engineering						Semester: IV	
Course :	Theory of Machines						Code :	BME24PC07
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	1	10	10	30	50

Prior knowledge of

a. Fundamentals of mechanics

b. Types of Motion is **essential.**

Course Objectives:

This course aims at enabling students,

1. To identify mechanisms from real-life applications and perform kinematic analysis.
2. To predict friction in clutches and brakes
3. To apply the principles of the Governor and Gyroscope to control speed.
4. To understand & apply the principles of gear theory.

Course Outcomes:

After learning the course, the students should be able to:

1. **Examine** the kinematic behavior of planar mechanisms.
2. **Compute** the Frictional torque and Power in Clutch and Brake for given application.
3. **Determine** the gyroscopic effect.
4. **Analyze** the kinematics of Gear and Gear Train.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Kinematics of Mechanisms** Kinematic link, kinematic pair, Kinematic chain, Mechanisms, Grashoff's law, Degree of freedom, Kutzbach equation, Grubler's equation.	7
II	**Clutches and Brakes** Uniform pressure and uniform wear theory, Friction clutches: single plate and multi plate: friction torque transmission capacity. Brakes Internal expanding shoe (drum) brake and disc brake: braking torque analysis.	8
III	**Gyroscope** Gyroscope: Gyroscopic Principle, Gyroscopic effect on Four wheeler vehicle, and ships. Gyro control devices.	7
IV	**Gears and Gear Train** Fundamental law of gearing and Spur gear contact ratio and interference, methods to avoid interference – Minimum number of teeth. Kinematics of simple, Compound and Epicyclic gear train (limited to spur gear trains only)	8
	Total	**30**

Text Books:

1. Theory of Machines and Mechanisms, J. J. Uicker, G. R. Pennock, J. E. Shigley, International Student Edition, Oxford Higher education, 6th edition, October 2023.
2. Theory of Machines, S. S. Rattan, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 5th Edition, July 2019.

Reference Books:

1. Machines & Mechanisms: Applied Kinematic Analysis, David H. Myszka**,** Prentice Hall, 4th edition, 2012
2. Kinematics and Dynamics of Machinery, R. L. Norton, McGraw Hill Education (India) P Ltd., Special Indian Edition, 2017.
3. Mechanisms and Mechanical Devices Sourcebook, Neil Sclater, Tata McGraw Hill Publication, 5th edition, 2011.
4. Theory of Mechanism and Machines, Ghosh Malik, East-West Pvt. Ltd. 3rd edition, January 2008.
5. Mechanism and Machine Theory, G. Ambekar, PHI, 1st edition, 2007.

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Program:	**B. Tech. (Mechanical)**						**Semester: III**	
Course:	**Fluid Mechanics Lab**						**Code:**	**BME24PC08**
Credits	**Teaching Scheme (Hrs. /Week)**				**Evaluation Scheme and Marks**			
	Theory	**Practical**	**Tutorial**	**Other**	**TW**	**OR**	**PR**	**Total**
2	**-**	**4**	**-**	**-**	**50**	**50**	**-**	**100**

Prior knowledge of

a. Mathematical concepts of vector, tensor and differential equation.
b. Fundamental concepts and laws/governing equations of physics **is essential.**

Course Objectives:

1. To use various instruments related to measurement of Pressure, Temperature, Velocity, Flow rate etc.
2. To experimentally verify the fundamentals and principles of Fluid Mechanics.
3. To estimate the losses in internal flow domains.
4. To find the non-dimensional numbers for various fluid flow applications

Course Outcomes:

After completion of this course, the students will be able to,

1. Estimate the fluid flow parameters and properties like Pressure, Temperature, Velocity, Flow rate etc .
2. Identify and validate the types of flows.
3. Estimate the flow rate across various flow domains using flow measurement devices.
4. Estimate the major and minor losses through pipe sections of various materials.

Detailed Syllabus

Expt. No.	**Suggested List of Experiments**	**Contents**	**Hrs.**
1	Study and experimentation on various pressure measuring devices.	a) Study of construction and working of various pressure measuring devices. b) Experimental investigation of pressure across flow domain using various types of manometers, pressure gauge, vacuum gauge, pressure sensor. c) Uncertainty analysis	4
2	Determination of kinematic viscosity of various liquids using redwood viscometer	a) Study of fluid properties: density, specific weight, relative density and viscosity. b)Newton's law of viscosity: Statement and derivation c) Experimental investigation of kinematic viscosity of various liquids using redwood viscometer at various temperatures and its comparison. d) Study of effect of variation of temperature on viscosity of various liquids. e) Plotting of relationship between viscosity and temperature. f)Uncertainty analysis	4
3	Investigation and analysis of cavitation process in fluid domain at different flow rates and pressures.	a)Study of vapors pressure and cavitation b)Effect of cavitation on performance of various fluid systems/machines c) Experimental investigation of cavitation factor d) Experimental investigation of effect of variation of flow rate and pressure on cavitation.	4

		e) Estimation of noise at various flow rates and pressures. e) Uncertainty analysis	
4	Determination of metacentric height of a cargo ship.	a) Study of buoyancy, law of buoyancy, stability of floating body, metacenter, metacentric height and stability of submerged body. b)Physics of ships/boats: An introduction b) Estimation of metacentric height of a floating body c) Uncertainty analysis	4
5	Experimental validation of laminar, transient and turbulent flow through a pipe section.	a) Study of laminar, transition and turbulent flow characteristics and Reynold's number b) Visualization of laminar, transition and turbulent flow through a pipe section at various flow conditions. c) Estimation of Reynolds number at various flow rates to validate the observed flow patter. d) Effect of variation of velocity on Reynolds number and flow pattern. e)Estimation of noise at various velocities and pressures.	4
6	Study and analysis of laminar and turbulent boundary layers on flat plates with rough and smooth surfaces.	a)Controlling the flow velocity and Visualization of laminar/turbulent flow b) Effect of variation of surface roughness on flow type , pattern and boundary layer formation and separation c) Estimation of noise at various velocities and pressures.	4
7	Verification of modified Bernoulli's equation.	a)Bernoulli's equation: significance and limitations b) Modified Bernoulli's equation for power producing and power absorbing devices. c) Estimation of total head at various sections of diffuser experimentally. d)Estimation of loss of head and plotting relationship between various types of head and tube area e) Uncertainty analysis	4
8	Determination of coefficient of discharge for Orifice meter/ Venturimeter.	a) Study of construction and working of Orifice meter/ Venturimeter and derivation of expression of discharge and coefficient of discharge. b) Estimation of discharge and coefficient of discharge experimentally. c) Plotting of variation of actual and theoretical discharge and estimation of coefficient of discharge d)Uncertainty analysis	4
9	Determination of coefficient of V-notch	a) Study of construction and working of V notch and rectangular notch and	2

		derivation of expression of discharge and coefficient of discharge. b) Estimation of discharge and coefficient of discharge experimentally. c) Plotting of variation of actual and theoretical discharge and estimation of coefficient of discharge d)Uncertainty analysis	
10	Determination of Major losses through pipes.	a) Study and derivation of Darcy - weisbatch equation to estimate frictional losses. b)Experimental estimation of frictional losses through the pipes of various materials c)To understand the effect of variation of velocity on frictional losses d) Estimation of coefficient of friction for pipes of various materials e)Plotting relationship between velocity ,loss of head and coefficient of friction. f) Uncertainty analysis	4
11	Determination of minor losses through pipes.	a) Study of minor losses and its expressions(no derivation) b) Estimation of head loss in a pipe section due to sudden change in cross-sections and pipe fittings. c)Uncertainty analysis	2
12	Measurement of static pressure distribution, lift and drag around an aero foil using wind tunnel apparatus.	a) Study of lift and drag forces, its importance, wall friction, skin friction coefficient, streamline body, bluff body. b) Physics/dynamics of flight: An introduction c) Construction and working of wind tunnel d) Estimation of static pressure distribution and lift and drag forces around an aero foil.	4
13	Determination of dimensionless numbers for various fluid applications.	a)Importance of dimensional analysis and non-dimensional numbers b) Derivation of dimensionless numbers: Reynolds number, Froude's number. /Mach number, Euler's number, Weber's number. c) Calculation of Reynolds no/Froude's no. /Mach no/Euler's no in any fluid flow domain (any two) and prepare a case study report of the same.	4
14	Case study presentation by students on 'Model Testing'	To understand the methodology of model performance testing.	6
15	Case study presentation by students on' Fluid mechanics in medical applications'.	To create awareness about use of fluid fundamentals in the design of medical equipment and for various parametric measurements .e.g. Fluid mechanics of heart valves, Cardiovascular and respiratory systems, Color Doppler	6
			60

Text Books:

1. Introduction to Fluid Mechanics and Fluid Machines–S K Som and G Biswas-TATA McGraw–Hill, 3rd edition, 2017.
2. Hydraulics and Fluid Mechanics-Modi P.N. and Seth S.M-Standard Book House, 22nd edition, 2019.

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2. Fundamentals of Fluid Mechanics-Munson, Young and Okiishi – Wiley India, 2016.
3. Fluid Mechanics - Cengel & Cimbla-TATA McGraw–Hill, 2019.
4. Fluid Mechanics –F.M. White -TATA McGraw-Hill, 2022.
5. Introduction to Fluid Mechanics, Robert W.Fox, Alan T. McDonald, John W. Mitchell, JohnWiley, 2020.

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Program:	B. Tech. (Mechanical)						Semester: IV	
Course:	Theory of Machines Lab						Code:	BME24PC09
Credits	Teaching Scheme (Hrs. /Week)				Evaluation Scheme and Marks			
	Theory	Practical	Tutorial	Other	TW	OR	PR	Total
2	-	4	-	-	50	50	-	100

Prior knowledge of

1. Fundamentals of mechanics
2. Types of Motion is essential.

Course Objectives:

Students are expected to study,

1. To impart practical skills in analyzing mechanisms applied to real-life applications.
2. To develop the competency to analyze the Static and Dynamic behavior of the Mechanism.
3. To synthesize the cams.
4. To perform kinematic analysis of gear trains.
5. To apply the principles of the Governor and Gyroscope to control speed.

Course Outcomes:

After completion of this course, the students will be able to,

1. **Build** the mechanisms and perform kinematic **analysis-** experimental and numerical.
2. **Analyze** the **static and dynamic forces** on the mechanisms using **simulation tools**
3. **Analyze** the Epicyclic Gear Train for torques.
4. **Determine** the characteristics of speed control devices
5. **Synthesize** Cam for a given application using the simulation tool

Detailed Syllabus

Expt. No.	Suggested List of Experiments	Duration Hrs.
I	**Kinematic Analysis of Mechanism** **Part A:** Building mechanisms using a mechanism building kit and study motion conversions and inversions **Part B**: Perform kinematic analysis with parametric variation- **Part C:** Kinematic analysis of four bar and slider crank mechanism (Software Simulation) Model the four bar and slider crank mechanism Model the mechanism built in Part A Vary link lengths and observe the impact on output motion. Simulate kinematic motion, varying input parameters like link lengths and angular velocities. Analyze resulting motion data, focusing on displacement, velocity, and acceleration profiles	**20**
II	**Static and Dynamic analysis of Mechanism (Software Simulation)** Static and dynamic analysis of four bar and slider crank mechanism Model the four-bar and slider crank mechanism Model the mechanism built in Experiment I Part A Perform static analysis to determine forces and torques in static equilibrium for the mechanism Dynamic analysis for the four-bar mechanism, considering mass, accelerations, velocities, and forces during motion. Varying parameters such as link lengths or/ and input velocities to observe changes in static and dynamic behavior.	**14**
III	**Speed and torque analysis of Epicyclic gear train to determine holding torque** Kinematic analysis (speed ratio) of Epicyclic gear set Analyze the relationship between input speed, output speed, and torque using experimental setup Compare theoretical values with experimental results.	**04**

IV	**To verify the gyroscopic principle**	**02**
V	**Characteristics comparison of a gravity-loaded and Spring-loaded governor and evaluate governing parameters**. Effect of controlling parameters with weight. Analyze the speed response characteristics of each governor type. Measure the power consumption of the motor for different governor settings.	**06**
VI	**Part A: To simulate Cam profiles for various follower motion and comparison for different performance parameters** - study cam size, pressure angle and effect of change in base circle diameter. Effect of different cam sizes and pressure angles on follower motion Plot graphs illustrating the relationships between cam size, pressure angle, and follower performance parameters. **Part B: Synthesize cam for automation requirement**	**10**
VII	**Kinematic analysis of different types of gearbox– Case study Based**	**04**
		60

References:

1. Theory of Machines and Mechanisms, J. J. Uicker, G. R. Pennock, J. E. Shigley, International Student Edition, Oxford Higher education, 6th edition, October 2023.
2. Theory of Machines, S. S. Rattan, McGraw Hill Education (India) Pvt. Ltd., New Delhi, 5th Edition, July 2019
3. Machines & Mechanisms: Applied Kinematic Analysis, David H. Myszka**,** Prentice Hall, 4th edition, 2012
4. Kinematics and Dynamics of Machinery, R. L. Norton, McGraw Hill Education (India) P Ltd., Special Indian Edition, 2017.
5. Mechanisms and Mechanical Devices Sourcebook, Neil Sclater, Tata McGraw Hill Publication, 5th edition, 2011.
6. Theory of Mechanism and Machines, Ghosh Malik, East-West Pvt. Ltd. 3rd edition, January 2008.
7. Mechanism and Machine Theory, G. Ambekar, PHI, 1st edition, 2007.

e-Resources:

https://www.vlab.co.in/broad-area-mechanical-engineering

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Program :	B. Tech. (Mechanical)						Semester: IV	
Course :	Electrical Machine (Open Elective Engineering Science offered by E&TC)						Code :	BET24OE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge of Fundamental knowledge of electromagnetism & electrical parameters **is essential.**

Course Objectives:

This course aims at enabling students,

1. To impart basic knowledge for conceptual understanding of DC machines.
2. To explore the construction and performance characteristics of three phase AC machines.
3. To explore the construction and performance characteristics of single-phase AC machines.
4. To relate the applications of electrical machines to practical and industrial scenarios.

Course Outcomes:

After learning the course, the students should be able to:

1. Describe the constructional features and working principles of DC Machines.
2. Explain the constructional features and operation of three phase induction motors
3. Explain the constructional features and operation single phase induction motors
4. Relate the applications of electrical machines to their respective fields of study and industrial applications.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Introduction to Electrical Machines:** Overview of electrical machines and their significance, Classification of electrical machines, Fundamental principles: Faraday's Law, Lenz's Law, and Electromagnetic Induction. **DC Machines** Working principle of DC machine as a generator and a motor; Types and constructional features; EMF equation of generator, DC motor working principle; Back EMF and its significance, torque equation; Types of D.C. motors, characteristics, Necessity of a starter for DC motor, Speed control methods of DC shunt and DC series motor and industrial applications.	8
II	**Three phase induction motor** – constructional features, working principle, Rotating magnetic field, and slip ring and cage types. Slip, phasor diagram, expression for mechanical power and torque, torque-slip characteristics, starting torque, full load and pull-out torque, equivalent circuit. Industrial applications.	7
III	**Single phase induction motors:** Construction of single-phase induction motor, double field revolving theory. Types of single-phase induction motors: Split phase and shaded pole type induction motors, applications. Specifications of induction motors (KW rating, rated voltage, current rating, frequency, speed, class of insulation)	8
IV	**Special Purpose Motors:** Construction, principle of working, characteristics ratings and applications of Brush less D.C. motors, Stepper motors (permanent magnet and variable reluctance type only), Permanent Magnet motor (A.C. & D.C.), SRM Switch reluctance motor.	7
	Total	**30**

Text Books:

1. V. N. Mittal and Arvind Mittal, “Basic Electrical Engineering” , 2nd Edition. (McGraw-Hill),2010
2. D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010

Reference Books:

1. J.B. Gupta, "Theory and Performance of Electrical Machines," S.K. Kataria & Sons.
2. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electric Machinery," McGraw-Hill Education.
3. D. C. Kulshreshtha, “Basic Electrical Engineering" , 1st Edition (Tata McGraw hill),2009
4. B. L. Theraja and A. K. Theraja S. Chand & Co. Pvt. Ltd. New Delhi, “A textbook of Electrical Technology Vol II”,2020

e-sources:

1. Electrical Machines – I-https://onlinecourses.nptel.ac.in/noc20_ee60/preview
2. Electrical Machines – I-https://archive.nptel.ac.in/courses/108/105/108105017/

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Program :	B. Tech. (Mechanical)						Semester: IV	
Course :	Introductions to Signals and System (Open Elective Engineering Science Offered by E&TC)						Code :	BET24OE02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge of Linear Algebra & Differential Calculus **is essential.**

Course Objectives:

This course aims at enabling students,

1. To develop an understanding of students related to signal representation, classification, and operations.
2. To build the understanding of analyzing and classifying the systems and their applications
3. To apply the basic concept of Fourier transform and Laplace transform to the systems

Course Outcomes:

After learning the course, the students should be able to:

1. Represent, classify, and perform the operation on signals
2. Classify the system and utilize convolution for system analysis
3. Apply the basics of Fourier transform to analyze the signal in frequency domain
4. Apply the basics of the Laplace transform to analyze the signal in a complex frequency domain.

Detailed Syllabus:

Unit	Description	Duration [H]
I	**Introduction to Signals**: Representation of Standard signals, Classification of signals: Continuous-time and discrete-time signals, Periodic Signals and non-periodic, Operations on signals: Time shifting, Time reversal, Time scaling, Amplitude scaling, Signal addition, Subtraction, Signal multiplication.	07
II	**Introduction to System**: System Definition and Application, Classification of Systems: Continuous-time and Discrete-time systems, Linear and Non-Linear systems, Time variant and Time-invariant systems, Stable and Unstable systems, Causal systems, and non-causal systems. Convolution sum using graphical method.	07
III	**Fourier Transform**: Fourier Transform (FT) representation of aperiodic continuous time (CT) signals, Evaluation of magnitude and phase response, FT of standard CT signals, Application of Fourier transform	08
IV	**Laplace Transform and Z Transform**: Definition of Laplace Transform (LT), ROC, Laplace transform of standard periodic and aperiodic functions, Inverse Laplace transform, Application of Laplace transforms.	08
	Total	30

Text Books:

1. A.V. Oppenheim, A.S. Willsky ―Signals and systems‖, Prentice-Hall signal processing series. 2nd Edition, 2015

2. A. Nagoor Kanni ―Signals and Systems‖, McGraw Hill, 2nd Edition, 2017

Reference Books:

1. B P Lathi ―Linear Systems and Signals‖, Oxford University Press, Third Edition, 2017

2. Simon Haykins and Barry Van Veen ―Signals and Systems‖, Wiley India, 2nd Edition. 2017

3. M.J. Roberts ―Signal and Systems‖, Tata McGraw Hill, Third Edition, 2019.

4. Charles Phillips ―Signals, Systems and Transforms‖, Pearson Education, 4th Edition. 2013

5. R. J. Beerends, H. G. ter Morsche ―Fourier and Laplace Transforms‖ Cambridge University Press, 2003.

6. Shaila Dinkar Apte, Signals and System, Cambridge University Press, Edition 1, 2018

Online courses Links:

1. https://onlinecourses.nptel.ac.in/noc23_ee14/preview
2. https://www.classcentral.com/course/engineering-iitbombay-signals-and-systems-part-1-2679

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Program :	B. Tech. (Mechanical)						Semester: IV	
Course :	Data Science (Open Elective Engineering Science Offered by CSE(AI&ML)						Code :	BCS24OE02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge of

Course Objectives:

This course aims at enabling students,

1. To demonstrate the use of mathematical techniques in the field of data science.
2. To explain the theory of statistics for its use in statistical inference.
3. To perform the data preprocessing operations.
4. To demonstrate the use of data visualization and data analytics techniques.

Course Outcomes:

After learning the course, the students will be able to:

1. Understand data science life cycle phases and analyze the need of data preprocessing
2. Analyze the need for data visualization and apply descriptive/inferential statistics for data analysis.
3. Solve the regression/classification problem for data analysis and apply the model evaluation techniques using different performance measures.
4. Apply data science in various domains.

Detailed Syllabus:

Unit	Description	Duration [H]
I	**Introduction to Data Science and Data Preprocessing:** Introduction to Data Science: Data Science Life Cycle, Data Analytics and Types, Key performance indicators of data science projects. Data Preprocessing: Need, preprocessing techniques for: handling redundant data, data transformation, replacing or handling missing data, and handling data inconsistency.	8
II	**Data Visualization and Hypothesis Testing:** Data Visualization: Introduction, need, Data visualization techniques: line plot, scatter plot, histogram, density plot, box plot, bar plot, pie chart, heat map, etc. Statistics and Inference – Measures of central tendency, Measures of variability: standard deviation, variance, quartiles, Interquartile range. Skewness and Kurtosis. Sampling and Inference - Sampling: Introduction, types of sampling. Hypothesis testing, types of errors, level of significance, and test of hypothesis: t-test, z-test, Correlation analysis: Pearson's correlation coefficient.	8
III	**Model Evaluation for Regression and Classification :** Performing a linear Regression: Linear function, Fitting the line, residual errors, coefficient of determination. Performing a logistic Regression: Logistic function, fitting the curve, understanding the log-odds, R-Squared. Performing classification: Naive Bayes classifier. Model Evaluation and Selection: holdout method, random sub-sampling, cross-validation. Model's parameter tuning and optimization. Performance metrics for evaluation of model, confusion matrix, AUC-ROC analysis	8
IV	**Applications of Data Science:** Case study on Smart cities: the role of Internet of Things and machine learning, Energy consumption: Machine Learning models for energy consumption forecasting , Supply Chain: Supply chain optimization using machine learning , Finance : Fraud detection and prevention in finance, Healthcare: Machine learning for Breast cancer prediction	6
	Total	30

Text Books:

1. Thomas Nield, “Essential Math for Data Science”, O'Reilly Media Inc., October 2022, ISBN: 9781098102869.
2. Data Science and Big Data Analytics, EMC education services, Wiley publication, 2015, ISBN: 9781118876138.

Reference Books:

1. Peter Bruce, Andrew Bruce, Peter Gedeck, “Practical Statistics for Data Scientists”, O'Reilly Media, 2nd edition, May 2020, ISBN: 9781492072942.
2. Norman Matloff ,“Probability and Statistics for Data Science”, CRC Press, 2019, ISBN:9780429687112

e-sources:

1. NPTEL Course on “Python for Data Science” :https://onlinecourses.nptel.ac.in/noc22_cs74/preview
2. NPTEL Course on “Data Science for Engineers” :https://onlinecourses.nptel.ac.in/noc22_cs72/preview

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Program:	B. Tech. (Mechanical)						Semester:	IV
Course:	Operating System's Administration (Open Elective Engineering Science Offered by IT Department)						Code:	BIT24OE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA 1	FA 2		
2	2	-	-	-	10	10	30	50

Prior knowledge of: Computer Programming **is essential**

Course Objectives:

1. To learn and understand basics of Operating Systems including Boot process.
2. To learn and understand Shells, Scripts and File System
3. To introduce the administrative features of Operating System

Course Outcomes:

After learning the course, the students will be able to:

1. Explain basic knowledge of Unix /Linux Operating System
2. Write basic shell script and Admin commands
3. Make use of process controlling and monitoring commands and network monitoring
4. Experiment the administrative features of Linux Operating System

Detailed Syllabus

Unit	Description	Duration (H)
I	**Introduction to Operating System** General Overview: History of Linux/Unix, System Structure, User perspective, Operating system Services, Assumptions about Hardware Introduction to Kernel: Architecture of Unix operating system, Introduction to the system concepts, Kernel data structure, System Administration	6
II	**Booting and Shut Down, Shell Scripting** Bootstrapping, Booting PCs, GRUB, Booting with single user mode, Rebooting and Shutting down. Shell Basics, bash scripting, Scripting Best Practices, Working with Startup Scripts.	8
III	**Access Control and Controlling Processes** Components of a process, the lifecycle of a process, Signals, Kill, Process states, nice and renice, ps, Dynamic monitoring with top, prstat and topas, the /proc file system Network Administration: Network Monitoring, Network Management	8
IV	**Adding New Users and Storage** The /etc/passwd file, The /etc/shadow and /etc/security/passwd files, /etc/group file, Adding users, Adding users with useradd Storage: Adding a hard Disk, Storage Hardware, Storage hardware Interfaces, Software aspects of storage, Formatting, Disk Partitioning, RAID Linux File System: The ext family, file system terminology, file system polymorphism, mkfs, fsck, file system mounting, setup for automatic mounting, USB drive mounting	8
	Total	**30**

Text Books:

1. Maurice J. Bach. The Design of the UNIX Operating System. Prentice-Hall
2. Evi Nemeth, Garth Snyder, Tren Hein, Ben Whaley. UNIX and Linux System Administration Handbook. Fourth Edition, 2011.

Reference Books:

1. Sumitabha Das. UNIX: Concepts and Applications. 4th Edition, McGraw Hill Education, 2017.

E-resources:

1. https://www.coursera.org/learn/system-administration-it-infrastructure-services

Program :	B. Tech. (Mechanical)					Semester: IV		
Course :	Statistical Data Analysis Using R (Open Elective Engineering Science Offered by AS&H)					Code :	BSH24OE04	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge of: Basics of Statistics and Probability **is essential.**

Course Objectives: After completion of the course,
Students will have an adequate background, conceptual clarity, and knowledge of mathematical principles related to data, pre-processing techniques for data visualization, and statistical techniques for prediction and decision-making.

Course Outcomes:
After learning the course, the students should be able to:
1. **Understand** the data and different R packages related to data science and its access.
2. **Make use of** data pre-processing methods and generate quality data for analysis.
3. **Apply** different data visualization techniques to understand the data.
4. **Analyze** the data for decision-making using statistical methods.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Fundamentals of R Software for Data** Introduction to Data: Definition, Types and Properties, R Packages for Data Science, Importing and Exporting Data in R Software, Accessing Databases with R Software.	**7**
II	**Data Wrangling** Pre-processing Data in R Software, Dealing with Missing Values in R Software, Data Formatting in R Software, Data Normalization in R Software, Binning in R Software, and Conversion of type of data	**7**
III	**Data Visualization** Data visualization for various data categories like Categorical, Numerical, or both using plots like Histogram, Bar/ Line Chart, Box Plots (including group-by option), Scatter Plots, Mosaic Plot, etc., and their interpretations	**8**
IV	**Data Analysis** Sampling, Descriptive Statistics, Linear regression and Multiple linear regression. Model evaluation using visualization, prediction, and decision-making.	**8**
	Total	**30**

Reference Books:

1. Montgomery and Runger, “Applied Statistics and Probability for Engineers”, Wiley, India, 6 Edition, ISBN: 9788126562947.
2. R. Johnson, “Probability and Statistics for Engineers”, Prentice India Ltd, 8 Edition, ISBN 13:978-8120342132.
3. S.P. Gupta, “Statistical Methods”, Paperback publication, 43 edition, ISBN: 9788180549892, 8180549895.
4. Victor A. Bloomfield, “Using R for Numerical Analysis in Science and Engineering”, CRC Press, First Edition, ISBN: 9781315360492

e-sources:
NPTEL Course lectures links:
1. https://www.youtube.com/watch?v=VVYLpmKRfQ8&list=PL6C92B335BD4238AB (Probability)
2. https://nptel.ac.in/courses/111104100 (Introduction to R software)
3. https://www.youtube.com/watch?v=WbKiJe5OkUU&list=PLFW6lRTa1g83jjpIOte7RuEYCwOJa-6Gz (Descriptive statistics using R software)

Program :	B. Tech. (Mechanical)						Semester: IV	
Course :	Advanced Materials and Characterizations (Open Elective Engineering Science offered by AS&H)						Code :	BSH24OE05
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
02	02	-	-	-	10	10	30	50

Prior knowledge of basic physics, chemistry and nanotechnology is essential**.**

Course Objectives:

This course aims at enabling students,

1. To learn the principles of advanced materials, technologies and characterizations.
2. To undertake research projects with applications of advanced materials.

Course Outcomes:

After learning the course, the students should be able to:

1. Interpret structure, properties and applications of advance engineering materials.
2. Explain the properties and requirements of materials for some advanced applications
3. Analyze structural, optical, elemental & morphological properties of the materials
4. Interpret electrochemical & thermal properties of the materials

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Engineering Materials** Polymer Composite e.g. fiber- reinforced polymer (FRP) composites Advanced carbon materials e.g. Grapheme & CNT Alloys: a] Nano alloy e.g. Cu-Ni nano- alloy b] Memory alloy-Nitinol CdSe Thin films for solar cells.	7
II	**Materials for Special applications** Battery and Super capacitor: working principles, components, Superconductors, material requirement and properties of electrodes, electrolytes and spacers, metallic, nonmetallic and ceramic superconductors, Applications, Gas Sensing: working principle and required material properties. Substrate Materials for quantum computer, Invar and Elinvar Materials: properties and applications, 2D materials: properties and their applications	7
III	**Structural, Optical, Elemental & Morphological Characterizations** X-Ray Diffraction and phase identification, indexing lattice parameter determination, Grain size analysis, EDAX, Electron microscopy, scanning electron microscopy, Transmission electron microscopy (TEM), Fourier Transform Infrared Spectroscopy, Band gap measurements-UV Vis- IR Spectroscopy	8
IV	**Electrochemical Characterization** Cyclic voltammetry: Instrumentation, current-potential relation applicable for Linear Sweep Voltammetry (LSV) and Cyclic Voltammetry (CV), interpretation of cyclic voltammograms, charging-discharging behaviors of super capacitor and batteries. **Thermal Analysis techniques:** Thermo-gravimetric analysis (TGA), Differential thermal analysis (DTA) analysis, Thermal expansion measurements, Thermal conductivity measurements, Ionic conductivity measurements. Specific heat capacity measurements, Debye temperature measurements	8
	Total	**30**

Reference Books:

1. Elements of X-ray Diffraction, B.D. Culity and S.R. Stock, Pearson Publication, Third edition 2014.
2. Introduction to Fuel Cells, Electrochemistry and Materials, San Ping Jiang, Qingfeng Li, Springer Publication, 2022.
3. Solid State Physics, S.O. Pilli, New age, International Publication Tenth edition 2022.
4. Introduction to Solid State Physics, C. Kittle, 8th edition Wiley, 2005.
5. Introduction to Superconductivity, Michael Tinkham, 2nd edition, Dover Publication 2004.
6. Electrochemical super capacitors, B. E. Conway, Springer, 1999.
7. Spectroscopy, G.R. Chatwal and S.K. Ananad, Himalaya Publications, 2016.
8. Introduction to Thermal Analysis, M.E. Brown, Kluwer academic Publishers, 2nd edition 2001.
9. Electrochemical Methods: Fundamentals and Applications, A, J Bard, Allen J. Bard, Larry R. Faulkner, Henry S. White, John Wiley & Sons, 31 May 2022.
10. Microscopy: A Very Short Introduction by Srivastava, Oxford University Press, 2015.
11. Practical Guide to materials Characterization, Khalid Sultan, Wiley-VCH, 2023
12. Engineering Chemistry by Wiley India Pvt. Ltd, First edition 2011.
13. Introduction to Nanotechnology by Charles P. Poole, Frank Owens, John Wiley & Sons (2003)

e-sources:

1. https://archive.nptel.ac.in/courses/113/106/113106034/

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Program:	B. Tech. (Mechanical)						Semester:	III / IV
Course:	E-waste Management (Open Elective Engineering Science Offered by Civil Department)						Code:	BCI23OE01 / BCI24OE01
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA 1	FA 2		
2	2	-	-	-	10	10	30	50

Prior Knowledge:
1. Fundamentals of environmental science.
2. Fundamentals of sustainable development.

Course Objectives: This course aims at enabling students,
1. To impart the knowledge of issues and challenges of e-waste management.
2. To create awareness of potential health effects and risk associated with e-waste.
3. To build knowledge of e-waste legislation (policy and guidelines) and circular economy.
4. To get acquainted with recycling, recovering and disposal techniques.

Course Outcomes: After learning the course, the students should be able to:
1. Identify the issues and challenges of e-waste management for a sustainable environment.
2. Analyze potential health effects and risk assessment.
3. Illustrate e-waste laws and guidelines and apply a circular economy road map for an e-waste sustainable future.
4. Identify the e-waste recycling, recovery and disposal techniques and its significance for a sustainable future.

Detailed Syllabus

Unit	Description	Duration (H)
I	**Electronic Waste Management – Issues and Challenges:** Introduction to E-Waste, classification and composition, need to manage / recycle, E-Waste generation in India and comparison with world scenario; facts & figures, estimation of waste electronic and electrical equipment (WEEE), economic assessment of E-Waste (Rare earth minerals, precious metals), effluents (solid, liquid and gas) generated during recycling, quantification of health hazard due to informal recycling of E-Waste,(Case study-based learning)	7
II	**E-Waste-Environmental and Public Health Issue:** Characteristics of Hazardous Substances, toxicity concerns, potential health effects and symptoms of long-term exposure, case study of heavy metal contamination due to E-Waste recycling, Introduction to risk assessment, epidemiologic data analysis and parameter for determining exposure and disease (numerical), classification of potential carcinogens, dose-response assessment, Potency Factor for Carcinogens (numerical), Hazard Index (HI) and Hazard Quotient (HQ) (numerical)	8
III	**E-Waste (Management & Handling) Rules / Guidelines and Circular Economy:** Regulatory frameworks in India, objectives of e-waste rules 2016,2018,2022 and 2024, hazardous and other wastes (Management and Trans boundary Movement) Rules, application of rules to stakeholders, India's stand on liberalizing import rules, UN Sustainable Development Goals (SDGs) and E-Waste, circular economy startup in India with a case study.	7
IV	**Recycling and Recovery of Metals from Electronic Waste and Disposal Techniques:** E-Waste recycling machineries, recycling process of E-Waste, existing E-Waste recycling Techniques, case study/ examples (metal recovery process), mechanism of extraction of precious metal from leaching solution, recovery of precious metals from solutions by solvent extraction, extraction of precious and rare earth metals from End-of- Life (EOL) electronic products, disposal techniques, role and responsibility of extended producers' responsibility (EPR), E-Waste economy in the organized and unorganized sector, Case study on recycling and precious metal recovery from E-Waste.	8
	Total	**30**

Text Books:
1. E-Waste management challenges and opportunities in India, Varsha Bhagat Ganguly, Rout ledge India,

1st edition 2021.
2. E-Waste Management and procurement of Environment, Dr. Suresh Kumar and Dr. Jitendra Kumar Pradhan, Author press, 2021 edition.
3. E-Waste in India: Management, challenges and opportunities (Volume I & II), Dr. Suresh Kumar, Authors press, September, 2021 edition.

Reference Books:

1. Fowler B, Electronic Waste – 1st Edition (Toxicology and Public Health Issues), 2017 Elsevier
2. Johri R., E-waste: implications, regulations, and management in India and current global best practices, The Energy and Resources Institute (TERI)TERI Press, New Delhi, 2008.
3. The Complete Technology Book on E-Waste Recycling (Printed Circuit Board, LCD, Cell Phone, Battery, Computers), ASIA PACIFIC BUSINESS PRESS Inc., 2015.

e-Resources

1. https://cpcb.nic.in/e-waste/
2. https://courses.iid.org.in/course/e-waste-recycling-business
3. https://www.suritex.co.in/
4. http://greenscape-eco.com/
5. https://onlinecourses.nptel.ac.in/noc20_ce12/preview
6. https://nielit.gov.in/gangtok/content/paid-course-e-waste-management
7. https://www.semanticscholar.org/paper/Electronic-waste-management-Hester Harrison/bc34471b0f9d94b0656b43df6b322116f2a7175c

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Program :	B. Tech (Mechanical)						Semester: IV	
Course :	Designing Thinking & Innovation Management (Offered by Department of Applied Sciences & Humanities)						Code :	BSH24EM02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge : NIL

Course Objectives: This course aims at enabling students :

1. To introduce the students to the concept of Design Thinking and its relevance in innovation
2. To equip students with the core concepts, frameworks, and techniques of Innovation management and its Applications.
3. To help students to understand design thinking as a creative problem-solving approach

Course Outcomes:

After learning the course, the students will be able to:

1. **Explain** the concept **of** Design Thinking and Opportunity Assessment in Business
2. **Demonstrate** strategic foresight for the business models
3. **Apply** the concept of Innovation Management in for business growth.
4. **Apply** the techniques of Internet Business Design for business growth

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Introduction to Design Thinking:** Meaning of Design Thinking, Design thinking for competitive advantage, The Need for Creative and Design, why design needs entrepreneurial mindset, combining entrepreneurial and design thinking, Opportunity Assessment - "How do we source and identify opportunities?" and "Which opportunities should we invest time and money in?" Three dimensions of Opportunity Assessment -Product-Market fit, Product-Company fit, and Product-Business fit. "Go/No-Go" recommendation to invest and initiate.	7
2	**Business Challenges and Design Thinking Solutions Paradigm Shift:** The seven steps of design thinking, Tools of Design Thinking, First Mover and late mover Advantage, Five Cs of Opportunity Storytelling, Strategic Foresight, Sensing, Value Redefinition, Experience Design, Humanization, Prototyping, Business Model Design	8
3	**Innovation Management:** Concept of Innovation, Characteristics of innovation, Sources of innovation, Types of innovation, Levels of Innovation, Evolution of innovation management, Organizations and Innovation Process, Diffusion of Innovation, Effective innovation management, Performance evaluation, Risk Management in Innovation. Case Studies based on Innovation management	7
4	**Internet Business Design:** Digital/Internet Business Model, Design of Services and Customer Experience. Service sector – IDEO, Lego, E-commerce market players design thinking strategies. Design Thinking and IoT Toward Sustainable Design Thinking. Managing Future Technologies, and minimizing risk of failure.	8
	Total	30

Text Books:

1. Robert Curedale, Design Thinking Process and Methods,5th Edition

2. Shalini Rahul Tiwari, Rohit Rajendra 0Swarup: Design Thinking: A Comprehensive Textbook

3. Dr. Jalumedi Babu, Dr. Madhu Sudana Reddy G, Ar. Parichita Mohapatra : Innovation and Design Thinking (Paperback.)

Reference Books:

1. Walter Brenner, Falk Uebernickel, Design Thinking for Innovation, Springer Link, 2016.
2. Christian Müller-Roterberg, Handbook of Design Thinking, Kindle Direct Publishing, ISBN: 978-1790435371
3. Anuja Agarwal, Design Thinking: A framework for applying Design Thinking in Problem Solving, CL India

e-sources:

1. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.
2. https://www.designdisciplin.com/the-story-of-design-thinking/
3. https://online.hbs.edu/blog/post/what-is-design-thinking

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Program :	B. Tech (Mechanical)					Semester: IV		
Course :	Project Management (Offered by Department of Applied Sciences & Humanities)					Code :	BSH24EM03	
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge : Nil

Course Objectives:

This course aims at enabling students:

1. To help the students gain an understanding regarding the concept of projects and Project Management
2. To enable the students to know the key components of project management including time cost & risk.
3. To develop analytical and decision-making skills through case studies, simulations and project-based learning.

Course Outcomes:

After learning the course, the students will be able to:

1. **Explain** different stages of project and their significance.
2. **Demonstrate** the triple constraints concepts in project management.
3. **Apply** appropriate approaches to plan execute and evaluate projects through case studies.
4. **Analyze** to mitigate the risk associated with projects.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Introduction to Project Management :** Introduction to Project Management: Concept and Definition of Project, Characteristics of Project, Concept and definition of Project Management, Functions of Project Management, Importance of Project Management, Who is a Project Manager, Roles & Responsibilities of Project Manager. Understanding the Phases in the Life cycle of Projects and their Significance, Different types of Projects: Industrial, Telecommunication, Research and more, Project Selection Methods: Agile method, Waterfall Methods, Scrum Model & Kanban Model, Jira Model.	7
II	**The Triple Constraint in Project Management:** The concept of the Triple Constraint in Project Management : Scope, Cost and Time, Project Cost Management: Concept, Consideration, Five types of Costs involved in a project, Cost Management process, Project Time Management and methods of Time estimation, Communications Management in Project , Work Breakdown Structure (WBS). Case studies based on Mega Projects of the World.	8

III	**Planning and Execution of Project:** Developing a Mission, Vision, Goals of the project. Concept and definition of Project Planning. Importance of Project Planning. Concept of Project Execution, Phases of Project Execution, Project Evaluation; The Review Technique – Planning and Scheduling of Activity, Networks - Concept of PERT/CPM(Time Estimation in Network Analysis), Assumptions in PERT Modeling – Time cost, Trade-offs, HRM issues in Project Management & How they can be tackled, Reasons for Failures of Project ,Case Study with respect to different Domains	**7**
IV	**Project Monitoring and Risk Management :** Concept of Project Monitoring, How to Building a Suitable Monitoring; Control System, Concept of Conflict Management, Concept & Definition of Risk and Risk Management, Concept of Risk Matrix Analysis ,Strategies to Manage Risks ,An Overview of Useful Techniques and Tools Used in Project Management. Case Studies with respect to different Domains.	**8**
	Total	**30**

Text Books:

1. Joseph Heagney, Fundamentals of Project Management, American Management Association, 2012

Reference Books:

1. Erik W Larson, Clifford Gray, Rohit Joshi; Project Management-The managerial process, MacGraw Hill Publication, 2021
2. Punmia, Project Management with CPM /PERT, Laxmi Publications, 2001
3. Robert L Kimmons, Project Management Basics, Taylor & Francis Ltd, 2018
4. N. D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

e-sources:

1. https://www.entrepreneur.com/
2. http://dst.gov.in/scientific-programme/t-d-tdb.htm
3. https://www.youtube.com/

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Program :	B. Tech (Mechanical)						Semester: IV	
Course :	Fostering Entrepreneurship and Startups (Offered by Department of Applied Sciences & Humanities)						Code :	BSH24EM04
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge : Nil

Course Objectives:

This course aims at enabling students:

1. To inculcate an entrepreneurial mindset into the minds of young professionals
2. To enable the students to evaluate challenges relating to new ventures.
3. To provide the students an understanding about different skills for founding, leading & managing startups

Course Outcomes :

After learning the course, the students will be able to:

1. Explain the concepts and role of entrepreneurship.
2. Identify new venture opportunities in today's Business world.
3. Analyze strategic choices in relation to the growth of new ventures
4. Correlate the Startup opportunities and key factors supporting the Start- up Culture.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**The Entrepreneurial Perspective :** Why to become entrepreneur ,Characteristics of an Entrepreneur, Functions of an Entrepreneur, Types of Entrepreneurs , Distinction between Entrepreneur and Manager The entrepreneurial decision process, Role of entrepreneur in economic development, future of entrepreneurs, Concept of Business Opportunity, Business Opportunities Identification Process..	7
2	**Creating & Starting Ventures** : Concept of business idea, Sources of new idea generation, Methods of Idea generation, Creative problem solving, Product planning and development, Business Structure, Creating a Business Plan, Market Size Analysis, Legal issues and Regulations to set up a business, Business Patents, Trademarks, Copy rights, Trade secrets, Licensing.	8
3	**Managing and Growing a New Business Venture :** Attractiveness of a new entry opportunity- Entry strategy for new entry exploitation- risk reduction strategies for new entry exploitation, Growth Strategies – economic implications of growth, overcoming pressures on existing financial resources, human resources, management of employees and entrepreneur's time, Sustaining a Business turbulence, Government incentives & Schemes.	7
4	**The Startup Ecosystem in India :** Meaning of Startup, Types of Start-ups, The Rise of The Startup Economy, Startup Policy, Startup opportunities, and Financial support for Start ups. Recent initiatives including Start up India, Make in India, Digital India, and Policies for technology Start-ups, E- commerce Startups, Tech Support and Proto type Development centers. Start-up Infrastructures: Co – Working Space, Market development initiatives..	8
	Total	**30**

Text Books:

1. C. B. Gupta and N. P. Srinivasan, Entrepreneurial Development, Sultan Chand & Sons, New Delhi, 2008

Reference Books:

1. Kathleen R Allen, Launching New Ventures, an Entrepreneurial Approach, Cengage Learning, 2016.
2. Peter F. Drucker, Innovation and Entrepreneurship.
3. Satish Taneja, S.L. Gupta, Entrepreneurship Development New Venture Creation
4. Donald F Kuratko, Jeffrey S. Hornsby, New Venture Management: The Entrepreneur's Road Map, 2e, Routledge
5. Vasant Desai, Dynamics of Entrepreneurship Development**,**

e-sources:

1. https://www.entrepreneur.com/
2. http://dst.gov.in/scientific-programme/t-d-tdb.htm

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Program :	B. Tech (All Branches)				Semester: IV			
Course :	Business Finance for Engineers (Offered by Department of Applied Sciences & Humanities)				Code :	BSH24EM05		
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-	-	-	10	10	30	50

Prior knowledge : NIL

Course Objectives:

This course aims at enabling students

1. The inculcate the knowledge of the core concepts of business finance and its importance in managing a business
2. To improve students 'understanding of the time value of money concept and the role of finance in the Current competitive business scenario.

Course Outcomes:

After learning the course, the students will be able to :

1. **Explain** the concept of Business Finance and financial planning.
2. **Illustrate** the concept of capitalization in Business Organizations.
3. **Analyze** Financial markets and the role of financial institutions in Business Development.
4. **Evaluate** the role of Financial System in Business.

Detailed Syllabus:

Unit	Description	Duration [Hrs.]
I	**Business Finance:** Concept of Business Finance, Objective and Scope, Significance of Finance, principles of business finance, Finance Function, Business finance v/s Corporate finance, Source of Finance. Meaning of financial planning, steps in financial planning, significance of financial planning, essential features of a good financial plan, Personal financial planning, Types of financial plan.	7
2	**Capitalization :** Introduction to capitalization, Amount of Capitalization, Over Capitalization, Under Capitalization, Venture Capital - Meaning of Venture Capital, Method of Venture Financing ,Venture Capital Funds, Policies and Procedures adopted by Venture Capitalists, Venture Capital in India, Guidelines for Venture Funds.	8
3	**Financial Markets, Institutions and Instruments:** Introductions to Financial Markets: Nature, Functions and Types of Financial markets, Different Financial Instruments, Sources of financing: Shares, Debentures, Term Loans, Retained Earnings, Public Deposits, Bonds, Trade Credit, Mutual Funds - Definition, Types of Mutual Funds, Significance of Mutual Funds; Case Studies on Financial Markets.	7
4	**Constituents of the Financial System and Regulatory Institutions :** Classification: Fund Based, Non Fund Based and Modern Services, Hire Purchasing, Leasing: Lease Financing - Essential Elements of Leasing, Types of Leases, Merits and Demerits of Lease Financing, Merchant Banking - Role; Functions of Merchant Banking, Factoring. Debt management, Portfolio Management. RBI - Organization, objectives, role and functions, monetary policy of RBI, NABARD, SEBI - Organization and Objectives	8
	Total	**30**

Text Books:

1. Srivastava, R.M. Essentials of Business Finance, Himalaya Publishing House, Kalyani Publications
2. Chandra, Prasanna. Financial Management, Mc Graw Hill, New Delhi.

Reference Books:

1. Gordon, E. & Natarajan, K. Financial Markets and Institutions, Himalaya Publishing House.
2. Khan and Jain, Financial Management, Tata McGraw Hill, 2008
3. Singh, Preeti. Investment Management. Himalaya Publishing House,
4. Kale, N.G. Business Organization. Manisha Publications.

e-sources:

1. https://www.youtube.com/watch?v=TgF2XvjquUU&list=PLLy_2iUCG87CXY2B6fPex1SOIqxzzD5Wj
2. https://www.youtube.com/watch?v=CCQwz_Gwo6o
3. https://www.youtube.com/watch?v=OT5RdoJAkhY&list=PLPjSqITyvDeUTeAOGhip_ubjN3y8oqT13

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Program:	B. Tech. (Mechanical)						Semester: IV	
Course:	Professional Development Training (Offered by AS&H)						Code:	BSH24AE05
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Others	TW	PR	OR	Total
02	-	4	-	-	100	-	-	100

Prior knowledge of: Basic Mathematics & English

Course Objectives:

This course aims at enabling students:

1. To enhance the logical reasoning skills of the students and improve the problem-solving abilities.
2. To improve the overall professional development of students.

Course Outcomes:

After learning the course, the students will be able to:

1. 1. Apply mathematical concepts to solve diverse numerical problems encountered in engineering, spanning arithmetic, algebra, geometry, and statistics.
2. Employ deductive reasoning, interpret data, and discern patterns to navigate complex logical puzzles and analytical challenges typical of engineering aptitude tests and professional scenarios.
3. Identify grammatical nuances, enhancing their verbal and written communication prowess essential for effective engineering discourse.

Detailed Syllabus

Unit	Description	Duration [Hrs.]
I	**Numerical Ability-I** HCF & LCM and Number System, Geometry, Ages, Allegations and Mixtures, Averages, Clocks and Calendars, Equations, Percentages, Profit and Loss, Ratios and Proportion, Series and Progressions, Time, Speed and Distance, Time and Work.	18
II	**Numerical Ability-II** Permutations and Combinations, Probability, Mean, Median, Mode, Standard Deviation, and Variance, Data Interpretation, Graphical Data Interpretation, Pie Charts, Tabular Data Interpretation, Simple Arithmetic Operations, Interest and Compound Interest, Linear equations, Quadratic equations, Triplets, Trigonometry	12
III	**Logical Reasoning** Clocks and Calendar, Direction sense, Family tree, Syllogism, Seating arrangement, Team formation, Coding and Decoding, Number Series and Letter Series, Ranking and Arrangements, Game-Based Aptitude.	12
IV	**Verbal Ability & Reading Comprehension** Subject-Verb Agreement, Articles and Other Determiners, Prepositions, Tenses, Parts of Speech, Active and Passive Voice, Direct and Indirect Speech, Conjunctions, Sentence Selection, Contextual Vocabulary, Error Spotting and Sentence Correction, Sentence Completion, Synonyms and Antonyms, Reading Comprehension, Jumble words & sentences. SMART Goal Setting & Career Road-map, Resume Writing & Linked-in Profile Building, Mock Interviews. Programming Language: Problem-solving & coding practice, Mock coding interviews	18
	Total	**60**

Text Books:

1. Arun Sharma, Quantitative Aptitude, 2016, 7th Edition, McGraw Hill Education Pvt. Ltd.
2. ETHNUS, Aptimithra, 2013, 1stEdition, McGraw-Hill Education Pvt.Ltd

Reference Books:

1. R S Aggarwal, Quantitative Aptitude For Competitive Examinations, 2017, 3rd Edition, S. Chand Publishing, Delhi.
2. M. Tyra, Quicker Maths, 2018, 5th edition, 2018, BSC publishing company Pvt. Ltd

Program:	B. Tech. (Mechanical)						Semester: IV	
Course:	Constitution of India						Code:	BSH24VE02
Credits	Teaching Scheme (Hrs./Week)				Evaluation Scheme and Marks			
	Lecture	Practical	Tutorial	Other	FA		SA	Total
					FA1	FA2		
2	2	-		-	25	25	-	50

Prior knowledge of: Nil

Course Objectives:

1. Provide an overview of the historical context leading to the framing of the Indian Constitution.
2. Study the fundamental rights enshrined in the Constitution and their application.
3. Study the structure and functions of key constitutional institutions like the President, Parliament, and Judiciary.

Course Outcomes:

After learning the course, the students will be able to

1. **Comprehend** Fundamentals of Indian Constitution.
2. **Review** Constitutional Institutions
3. **Evaluate** Constitutional Amendments
4. **Analyze** Contemporary Issues and Challenges

Detailed Syllabus

Unit	Description:	Duration [Hrs]
I	**Fundamentals of Indian Constitution** ● Introduction to the Indian Constitution: Historical background, making of the Constitution, and its significance ● Preamble: Understanding the importance and interpretation of the Preamble to the Constitution · Fundamental Rights, Directive Principles of State Policy ● Analyze the salient features of the Indian Constitution	**7**
II	**Structure and Functioning of Government** ● Union Executive: Study of the President, Vice-President, Prime Minister, and Council of Ministers, along with their powers and functions ● Parliament: Understanding the composition, powers, and functioning of the Lok Sabha and Rajya Sabha ● Judiciary: Analysis of the structure, independence, and functioning of the Supreme Court and High Courts ● Federalism: Examination of the division of powers between the Union and States, along with the role of institutions like Governors and State Legislatures	**8**
III	**Constitutional Amendments and Legal Framework** ● Amendment Process: Understanding the procedure for amending the Constitution and significant amendments ● Constitutional Bodies: Study of institutions like the Election Commission, Comptroller and Auditor General, and their constitutional roles ● Emergency Provisions: Analysis of the provisions related to national emergency, state emergency, and financial emergency ● Constitutional Remedies: Detailed study of writs, judicial review, and other constitutional remedies available to citizens	**7**

IV	**Contemporary Issues and Challenges** ● Judicial Activism: Analysis of the role of the judiciary in addressing contemporary issues and ensuring constitutional principles ● Constitutional Governance: Examination of challenges to constitutional governance, including federalism, secularism, and social justice ● Constitutional Amendments: Critique of recent constitutional amendments and their implications on democracy and governance ● Comparative Constitutional Law: Comparison of the Indian Constitution with other constitutions to understand global constitutional trends and best practices	**8**
Total		**30**

Text Books:

1. E 1. Durga Das Basu, ―Introduction to the Constitution of India ―, Prentice Hall of India, New Delhi,24th edition, 2020, ISBN-109388548868
2. Clarendon Press, Subhash C, Kashyap, ― Our Constitution: An Introduction to India‘s Constitution and constitutional Law‖, NBT, 5th edition, 2014, ISBN-9781107034624

Reference Books:

1. Maciver and Page, ―Society: An Introduction Analysis ―, Laxmi Publications, 4th edition, 2007, ISBN 100333916166
2. PM Bhakshi, ―The constitution of India‖, Universal Law Publishing - An imprint of Lexis Nexis, 14th edition, 2017, ISBN-108131262375
3. Indian Constitution by Subhash C. Kashyap, National Book Trust, New Delhi.
4. Constitution of India and Professional Ethics, Dr. G. B. Reddy & Mohd. Suhaib, Dreamtech Press.

e-sources:

1. https://legalaffairs.nalsar.ac.in/

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Program:	B. Tech. (Mechanical)					Semester: IV	
Course:	Geometric Dimensioning and Tolerancing					Code:	BME24VS03
Credits	Teaching Scheme (Hrs. /Week)			Evaluation Scheme and Marks			
	Theory	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior knowledge of

1. Engineering drawing, dimensioning.
2. Conventional manufacturing processes is essential.

Course Objectives:

Students are expected to study,

1. To get acquainted with relevant industrial standards and best practices related to GD and T
2. Learn GD and T symbols, annotations and their applications in design and manufacturing.

Course Outcomes:

After completion of this course, the students will be able to,

1. **Understand** and represent IS conventions of machine components
2. **Interpret** the production drawing using GD and T Principles.
3. **Determine** dimensional Tolerances to achieve desired functional requirements
4. **Generate** production drawing using CAD tools and **apply** GD and T principles to assemblies

Detailed Syllabus

Expt. No.	Suggested List of Experiments	Duration Hrs.
I	Principles of drawing and various IS Standards and sign conventions of machine elements, Surface finish grades and symbols, Welding symbols, Study of drawing sheet layout, Bill of Material.	6
II	Dimensional Tolerancing- Limits, Fits and Tolerances (a) Terminology, Maximum and Minimum Material conditions, Features, Rules for GD and T, Datum Control. (b) Calculation of Tolerances based on Type of Fits in Assembly (c) Selection from standard charts.	8
III	Geometrical Tolerancing- (a) Form, Orientation, Profile and Location Tolerances. (b) Datum selection. (c) Measurement of form tolerances	6
IV	Read, Interpret and generate Industrial Production Drawing by applying GD and T concepts Read and Interpret existing Industrial Production Drawing Generate Production drawing for any 2 assemblies.	10
		30

Assignments	
1	Drawing sheet on various conventional representations of machine components, materials, surface finish and joints.
2	Determination of dimensional tolerances for real life functional assemblies.
3	Reading Industrial Drawing and Interpretation of geometrical tolerances. (Any two)
4	Generation of production drawing for given parts and assembly by applying required GD and T symbol using CAD software. (Any two)

References:

1. Standards: ASME Y14.5 – 2018
2. Machine Drawing, Narayana, K. L., Kannaiah, P., Venkata Reddy, K., New Age International Publishers, New Delhi, (2016), 2nd edition,
3. Machine Drawing, Bhatt, N. D. and Panchal, V. M., (2014), Charotar Publishing House Pvt.
4. Ltd, Anand, India,
5. Geometric Dimensioning and Tolerancing for Mechanical Design, Cogorno, G. R., (2020), 3rd edition, McGraw-Hill Education.
6. Geometric Dimensioning and Tolerancing: A Complete Guide, Blokdyk, Gerardus, (2019), 2020 Edition", 5STARCooks.
7. Standards: ISO/TR 23605:2018, ISO 1101:2017, SP 46, IS 15054(2001)

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Program:	B. Tech. (Mechanical)					Semester: IV	
Course:	Computer Aided Machine Drawing					Code:	BME24VS04
Credits	Teaching Scheme (Hrs. /Week)			Evaluation Scheme and Marks			
	Theory	Practical	Tutorial	TW	OR	PR	Total
1	-	2	-	50	-	-	50

Prior knowledge of
Engineering drawing, dimensioning, Conventional manufacturing processes Engineering 2D drawings, Machine elements used in mechanical engineering is essential.

Course Objectives: Students are expected to study,

1. To develop parametric and feature based parts along with assembly models of simple mechanisms/machines.
2. To develop surface models for mechanical components.
3. To develop 2D drafting from 3D models

Course Outcomes: After completion of this course, the students will be able to,

1. Model 3D machine components used in interdisciplinary applications.
2. Draft engineering
3. parts and assembly using CAD tools.

Detailed Syllabus

Expt. No.	Suggested List of Experiments	Duration Hrs.
I	**Sketching** Introduction to Graphical User Interface (GUI) of solid modeling software, 2-D sketching with geometrical and dimensional constraints.	6
II	**Parametric solid modeling** Fundamentals, apply/modify constraints and dimensions, transform the parametric 2-D sketch into a 3D solid, feature operations.	8
III	**Assembly modeling** Defining relationship between various parts of machine, creation of constraints, and generation of exploded view.	8
IV	**Introduction to surface modeling** Introduction to Surface Design, Creating Wireframe Geometry, Shape Design Common Tools, Creating Surfaces, Understanding operations toolbar. Drafting Generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning.	8
	Total	30

List of Assignments

1	Assignment on parametric solid modeling of a machine component using various commands and features of the software.
2	Assignment on assembly modeling of the mechanisms/machine parts modeled in assignment 1 using proper constraints and generation of exploded view. (min. 5 components)
3	Assignment on generation of production drawings of the parts and assembly.
4	Assignment on surface modeling of a machine components
5	A group mini project on industrial assembly of any mechanisms/machine with drafting

References:

1. CATIA for Engineers & Designers V5-R2023, Sham Tickoo, 21st Edition, 2023.
2. Machine Drawing, Ajeet Singh, McGraw Hill Publications, New Delhi, 2012.
3. Machine Drawing, Bhatt, N. D. and Panchal, V. M., (2014), Charotar Publishing House Pvt.
4. Mastering CADCAM, Ibrahim Zeid, McGraw-Hill, 2007.

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DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To be the department of sustainable academic excellence, fostering innovation, skill development, and work ethics leading to globally competent mechanical engineers.

जागतिक स्तरावर सक्षम यांत्रिक अभियंत्यांना मार्गदर्शन करणारा नावीन्य, कौशल्य विकास आणि कामाच्या नैतिकतेला चालना देणारा शाश्वत शैक्षणिक उत्कृष्टतेचा विभाग बनणे.

MISSION

1. **Nurture cohesive learning environment and develop matching ecosystem.**

   एकसंध शिक्षण वातावरण जोपासणे आणि जुळणारी परिसंस्था विकसित करणे.

2. **Cultivate excellent work ethics and right attitude among students by imparting essential skills and knowledge.**

   आवश्यक कौशल्ये आणि ज्ञान देऊन विद्यार्थ्यांमध्ये उत्कृष्ट कार्य नैतिकता आणि योग्य दृष्टिकोन विकसित करणे.

3. **Instill a sense of creativity, social responsibility and environmental awareness among students.**

   विद्यार्थ्यांमध्ये सर्जनशीलता, सामाजिक जबाबदारी, आणि पर्यावरण विषयक जागरुकता निर्माण करणे.

DEPARTMENT OF MECHANICAL ENGINEERING

Program Educational Objectives

1. To cultivate knowledge and skills in formulating, analyzing, and solving interdisciplinary engineering problems among the mechanical engineering graduates.
2. To inculcate right attitude and awareness about codes of professional practice, social commitment, and life-long learning among the mechanical engineering graduates.
3. To enhance professional competence for catering to the needs and expectations of society as a profound Mechanical Engineer.

Program Specific Outcomes

1. Conceptualize, design, model, simulate, and analyze mechanical components, systems and processes in complex interdisciplinary applications.
2. Develop sustainable solutions to real-life mechanical engineering problems in products and process industries.
3. To practice professional codes and conducts, safety norms, industrial engineering and management principles while working in the industry or as an entrepreneur.