RN SHETTY TRUST ®

RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi
Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade
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ESTD.: 2001
An Institute with a Difference



Dr. R N Shetty
Founder



25 RNSIT

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF ENGINEERING

Scheme and Syllabus of III & IV Semesters

2025 SCHEME

INSTITUTION'S INNOVATION COUNCIL

www.rnsit.ac.in

Scheme and Syllabus
Batch 2025 - 2029

(As per NEP-2020)
(Effective from the academic year 2024 – 25)

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About RNSIT

RNS Institute of Technology, familiar as RNSIT was established in the year 2001. It is the brainchild of Dr. R. N. Shetty, well known industrialist, and a great philanthropist. The institution was established with a sole purpose of imparting quality education in Engineering, Technology and Management. Being one of the premier engineering colleges in the country RNSIT is marching towards placing itself in the global map by excelling in academics and placements.

Lush green campus, state of the art infrastructure, well equipped laboratories, hundreds of activities, numerous new initiatives, consistent VTU ranks, path breaking placements, cultural extravaganza, Sports events, 4000 + students and 300 + faculty – with all these RNSIT has become dream destination for engineering aspirants across the country.

Vision

Building RNSIT into a World Class Institution

Mission

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality Students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class Professionals with social responsibility
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research & Development
- Providing freedom of action and choice for all the Stakeholders with better visibility

About Mechanical Engineering Department

The department of Mechanical Engineering was started in the year 2011. It provides an outstanding learning environment and it is a regular practice to invite people from industry & academia by arranging guest lectures/ seminars in order to provide an exposure of practical aspects of Mechanical Engineering.

Department has been consistently achieving 95-90% results in VTU examination. Yantra is a department student forum under which technical & cultural activities are conducted annually. In our department students are nurtured to become best engineering professionals in Industry ready. The department regularly organizes workshops and FDP's. The department is fully equipped for effective delivery of courses and Laboratories. The Department organizes regularly Industrial visits and guest lectures by experts in the field of Mechanical engineering. The Department has MoUs with various industries. Many students from our department will make indelible mark nationally and internationally in the field of Mechanical Engineering and make us proud. We have dynamic faculty, whose expertise spans the range of disciplines in design, thermal and production streams. The Department believes in building careers, enriching that lasts a lifetime.

Vision

To excel in mechanical engineering education and nurture technically skilled and socially responsible engineers.

Mission

M-1: To provide state-of-the-art infrastructure facilities with a team of dedicated, experienced faculty by providing ample teaching, learning and research skills.

M-2: To teach the basics of mechanical engineering by using modern tools to solve a variety of problems and do engineering analysis.

M-3: To prepare students for successful careers in India and around the world, meeting the needs of the industry by cultivating skilled graduates.

M-4: To cultivate problem-solving and collaborative abilities in students through their participation in interdisciplinary projects that need teamwork.

M-5: To equip students for lifelong learning by familiarizing them with professional ethics and sustainable development.

Programme Educational Objectives

A Graduate of Mechanical Engineering will be able to:

PEO-1: Mechanical engineering graduates are technical and managerial leaders in design, manufacturing, materials, thermal, automation, and management domains.

PEO-2: Mechanical engineering graduates demonstrate leadership qualities, possess strong communication skills, and are capable of working both collaboratively and independently.

PEO-3: Mechanical engineering graduates engage in professional practices that meet societal needs and environmental concerns while committing to lifelong learning.

Program Outcomes (Revised)

1. **PO1: Engineering Knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
2. **PO2: Problem Analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
3. **PO3: Design/Development of Solutions**: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
4. **PO4: Conduct Investigations of Complex Problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK9).
5. **PO5: Engineering Tool Usage**: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
6. **PO6: The Engineer and The World**: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).
7. **PO7: Ethics**: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
8. **PO9: Individual and Collaborative Teamwork**: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
9. **PO9: Communication**: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

10. **PO10: Project Management and Finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
11. **PO11: Life-Long Learning**: Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK9)

Programme Specific Outcomes (PSOs)

The Mechanical Engineering graduates will have

PSO-1: To apply specific program principles to design, fabricate, test, operate, or document the basic mechanical systems or processes.

PSO-2: To develop and test the products for quality and functionality as needed by the society from time to time.

PSO-3: To engage in manufacturing or processing such quality products with utmost environment safety and committed for sale of products and provide good service to customer.

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3rd Semester (Mechanical Engineering)

Sl. No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)		Teaching & Learning Scheme					Examination				Credits
						CI		LI	TW & SL	# TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P	SL						
1	ASC	25BMETH301	Transforms and Probability	TD /PSB: Mathematics		45	30	0	45	120	3	50	50	100	4
2	IPCC	25BMEIC302	Manufacturing Technology	TD/PSB: Mechanical Engineering		45	0	30	45	120	3	50	50	100	4
3	IPCC	25BMEIC303	Fundamentals of Material Engineering	TD/PSB: Mechanical Engineering		45	0	30	45	120	3	50	50	100	4
4	PCC	25BMETH304	Principles of Energy & Thermodynamics	TD/PSB: Mechanical Engineering		45	0	0	45	90	3	50	50	100	3
5	PCC	25BMETH305	Mechanics of Materials	TD/PSB: Mechanical Engineering		45	0	0	45	90	3	50	50	100	3
6	PCCL	25BMELB306	Digital Design and Machine Drawing	TD/PSB: Mechanical Engineering		0	0	30	00	30	3	50	50	100	1
7	AEC	25BMEAE307x	Ability Enhancement Course (Laboratory)	TD/PSB: Mechanical Engineering		0	0	30	00	30	3	50	50	100	1
8	SDC	25BCBPR308	Community Project (Project-Based Learning) / Societal Project	Respective Engineering Dept.		0	0	0	30	30	3	50	50	100	1
9	NCMC	25BNSSP309	National Service Scheme (NSS)	Campus	NSS coordinator	0	0	0	30	30	--	100	--	100	PP
		25BPEDU309	Physical Education (PE) (Sports and Athletics)		Physical Education Director										
		25BYOGA309	Yoga		Yoga Teacher										
		25BMUSK309	Music		Music Teacher										
Total										**660**		**500**	**400**	**900**	**21**
10	NCMC	25BMADP310	Mathematics course for Lateral Entry Students	TD /PSB: Mathematics		14	0	0	14	28	3	100	---	100	PP
Total										**688**		**600**	**400**	**1000**	**21**

Ability Enhancement Course (Laboratory) 25BMEAE307x			
25BMEAE307A	Spreadsheet for Engineers	25BMEAE307C	Experiential Learning and Makers Lab
25BMEAE307B	Basics of Python Programming	25BMEAE307D	Fundamentals of Drone Technology

 # TH/S- Total Hours per Semester, TW & SL- Term Work & Self Learning.

Sl. No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW & SL	# TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
11	SKLAB	25BMESL001	Additive Manufacturing & 3d Printing Skill Lab	TD/PSB: Mechanical Engineering	0	0	30	0	30	3	50	50	100	1

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4th Semester (Mechanical Engineering)

Sl. No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)		Teaching & Learning Scheme					Examination				Credits
						CI		LI	TW & SL	# TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
						L	T	P	SL						
1	ASC	25BMETH401	Mathematical Methods for Mechanical Engineering	TD/PSB: Mathematics		45	30	0	45	120	3	50	50	100	4
2	IPCC	25BMEIC402	Machining Science and Metrology	TD/PSB: Mechanical Engineering		45	0	30	45	120	3	50	50	100	4
3	PCC	25BMETH403	Applications of Energy Conversion & Thermodynamics	TD/PSB: Mechanical Engineering		45	30	0	45	120	3	50	50	100	4
4	PCC	25BMETH404	Kinematics of Machines	TD/PSB: Mechanical Engineering		45	30	0	45	120	3	50	50	100	4
5	PCCL	25BMELB405	Machine Shop lab	TD/PSB: Mechanical Engineering		0	0	30	00	30	3	50	50	100	1
6	AEC	25BMEAE406x	Ability Enhancement Course (Laboratory)	TD/PSB: Mechanical Engineering		0	0	30	00	30	3	50	50	100	1
7	BSC	25BFETH407	Biology for Engineers	TD/PSB: Chemistry/BioTech		30	0	0	30	60	2	50	50	100	2
8	SDC	25BESPR408	Environmental Science Project	Respective Engineering Dept.		0	0	0	30	30	3	50	50	100	1
9	NCMC	25BNSSP409	National Service Scheme(NSS)	Campus	NSS coordinator	0	0	0	30	30	--	100	--	100	PP
		25BPEDU409	Physical Education (PE) (Sports and Athletics)		Physical Education Director										
		25 BYOGA409	Yoga		Yoga Teacher										
		25BMUSK409	Music		Music Teacher										
					Total					660		500	400	900	21
10	NCMC	1BMADP410	Mathematics course for Lateral Entry Students	TD/PSB: Mathematics		14	0	0	14	28	3	100	---	100	PP
					Total					**688**		**600**	**400**	**1000**	**21**

Ability Enhancement Course (Laboratory) 25BMEAE406x			
25BMEAE406A	Advanced Python Programming	25BMEAE406C	Industry Supported Lab
25BMEAE406B	IoT Lab	25BMEAE406D	Introduction to Data Analytics

 # TH/S- Total Hours per Semester, TW & SL- Term Work & Self Learning.

Sl. No	Course	Course Code	Course Title	Teaching Department (TD)and Question Paper setting Board (PSB)	Teaching & Learning Scheme					Examination				Credits
					CI		LI	TW & SL	# TH/S	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	SL						
11	SKLAB	25BMESL002	Virtual Product Skill Lab	TD/PSB: Mechanical Engineering	0	0	30	0	30	3	50	50	100	1

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CORE COURSES
III SEMESTER

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B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Transforms and Probability Distributions**		
Course Code:	**25BMETH301**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:2:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- **Understand and apply** Laplace and Inverse Laplace Transforms, along with their properties, to solve ordinary differential equations.
- **Analyze** periodic physical phenomena using Fourier series and apply Fourier transform techniques to convert functions between the time and frequency domains.
- **Develop** the knowledge of probability laws and distribution of discrete and continuous random variables.

MODULE – 1	**9 Hours**
Laplace Transform: Definition and Laplace transform of elementary functions (statements only). Problems on Laplace transform of $e^{at}f(t), t^n f(t), \frac{f(t)}{t}$ Laplace transforms of derivatives and integrals. Laplace Transform of periodic functions (statement only) and unit-step function – Problems.	
MODULE – 2	**9 Hours**
Inverse Laplace Transform: Definition, properties, evaluation using different methods, convolution theorem (without proof), problems, and applications to solve ordinary differential equations.	
MODULE – 3	**9 Hours**
Fourier Series: Periodic functions. Fourier series of functions over the period from $(0, 2\pi)$ *and* $(-\pi, \pi)$, Half-range Fourier series. Complex Fourier series. Practical harmonic analysis.	
MODULE – 4	**9 Hours**
Fourier Transform: Infinite Fourier transform– Problems. Inverse Fourier Transform-Problems, Convolution theorem statement only	
MODULE – 5	**9 Hours**
Probability distribution: Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass and density functions. Mathematical expectation, mean and variance. Binomial, Poisson and normal distributions- problems (derivations for mean and standard deviation for Binomial and Poisson distributions only)-Illustrative examples. Exponential distribution (definition only).	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Solve first order differential equations arising in engineering problems using single-step
CO2	and multi-step methods.
CO3	Apply inverse Laplace techniques to find functions from given transforms.
CO4	Apply Fourier series techniques to express periodic waveforms—such as rectangular, sawtooth, and half-wave rectified signals—in both standard and half-range functional domains.
CO5	Apply the Fourier sine and cosine transform (and their inverses) for continuous signals, and compute discrete.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

Text Books

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2018.

Reference Books

1. B.V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11thEdition, 2017
2. N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Edition, 2022.
3. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw–Hill Book Co., New York, 6thEd., 2017.

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU e-Shikshana Program
5. VTU EDUSAT Program.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Programming Assignment
2. Tool/Software Exploration
3. Problem-Based Learning (PBL)
4. Assignments

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Manufacturing Technology**		
Course Code:	**25BMEIC302**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:0:2)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Impart fundamental understanding of various casting, welding and forming processes
- To provide in-depth knowledge on metallurgical aspects during solidification of metal and alloys
- Discuss design methodology and process parameters involve in obtaining defect free component

MODULE – 1 **9 Hours**

Introduction & Basic materials used in Foundry: Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry-classification, factors that determine the selection of a casting alloy. Introduction to casting process & steps involved – (Brief Introduction)-Not for SEE Patterns: Definition, classification, materials used for pattern, various pattern allowances and their importance.

Sand Moulding: Types of base sand, requirement of base sand. Binder, Additive's definition, need and types; preparation of sand moulds. Moulding machines- Jolt type, squeeze type and Sand slinger. important moulding process: Green sand, core sand, dry sand, sweep mould, CO2mould, shell mould, investment mould, plaster mould, cement bonded mould. Cores: Definition, need, types. Concept of gating (top, bottom, parting line, horn gate) and risers (open, blind)

Teaching Learning Process: Chalk and Talk / PPT / Field Visits /videos

MODULE – 2 **9 Hours**

Melting Furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace. **Casting using Metal Moulds:** Gravity die casting, pressure die casting, stir casting, centrifugal casting, squeeze casting, slush casting, thixo casting, and continuous casting processes. Casting defects, their causes and remedies. Solidification.

Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos

MODULE – 3 **9 Hours**

Metal Working Processes: Fundamentals of metal working, Analysis of bulk forming processes like forging, rolling, extrusion, wire drawing by slab method, Other sheet metal processes: Sheet metal forming processes (Die and punch assembly, Blanking, piercing, bending etc., Compound and Progressive die).

Economic Strip Layout: Numerical on pressed components (for CIE only). High Energy rate forming processes/Powder Metallurgy: Basic steps in Powder metallurgy brief description of methods of production of metal powders, conditioning and blending powders, compaction and sintering application of powder metallurgy components, advantages and limitations.

Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos

MODULE – 4	**9 Hours**
Joining Processes: Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; **Welding Processes:** Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding. Thermit welding. **Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos**	
MODULE – 5	**9 Hours**
Weldability and Thermal Aspects: Concept of weldability of materials; Thermal Effects in Welding (Distortion, shrinkage and residual stresses in welded structures); Welding defects and remedies. Heat affected zone. **Allied Processes:** Brazing and adhesive bonding, Resistance welding processes, friction stir welding (FSW). ***Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos***	

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)	
Sl. No	**Experiments**
1.	Studying the effect of the clay and moisture content on sand mould properties
2.	Preparation of sand specimens and conduction of the following tests: 1. Compression, Shear and Tensile tests on Universal Sand Testing Machine.
3.	To determine permeability number of green sand, core sand and raw sand
4.	To determine AFS fineness no. and distribution coefficient of given sand sample.
5.	Preparing minimum three forged models involving upsetting, drawing and bending operations
6.	Sheet metal punch/die design and layout optimization
Demo experiments for CIE	
7.	To study the defects of Cast and Welded components using Non-destructive tests like: a) Ultrasonic flaw detection b) Magnetic crack detection c) Dye penetration testing
8.	Mould preparation of varieties of patterns, including demonstration

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Select appropriate primary manufacturing process and related parameters for obtaining initial shape and size of components.
CO2	Design and develop adequate tooling linked with casting, welding and forming operations
CO3	Appreciate the effect of process parameters on quality of manufactured components Demonstrate various skills in preparation of moulding sand for conducting tensile, shear and compression tests using Universal sand testing machine.
CO4	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.
CO5	Mould preparation of various pattern materials.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	**30**	**12**	**Marks of Tests and Assignments awarded for a maximum of 30.**
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	**20**	**8**	**Marks of Experiments, Record and Test awarded for a maximum of 20 marks.**
CIE: Theory + Practical (A + B + C)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks.**
SEE (D)	**50**	**18**	**SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE+SEE (A+B+C+D)	**100**	**40**	**Final marks shall be the sum of marks scored in Components A, B, C and D**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.

Suggested Learning Resources:

Books

1. Ghosh, A. and Mallik, A. K., (2017), Manufacturing Science, East-West Press.
2. Parmar R. S., (2007), Welding Processes and Technology, Khanna Publishers.
3. Little R. L. – 'Welding and Welding Technology' – Tata McGraw Hill Publishing Company Limited, New Delhi – 1999
4. Grong O. – 'Metallurgical Modelling of Welding' – The Institute of Materials – 1997 – 2nd Edition
5. Kou S. – 'Welding Metallurgy' – John Wiley Publications, New York – 2003 – 2nd Edition.

6. Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' Prentice Hall – 2013 – 7th Edition
7. Principles of foundry technology, 4th edition, P L Jain, Tata McGraw Hill, 200
8. Advanced Welding Processes technology and process control, John Norrish, Wood Head Publishing, 2006

Web links and Video Lectures (e-Resources):

1. (Link:http://www.springer.com/us/book/9791447151794http://nptel.ac.in/courses/112 105127/)
2. http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm
3. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.h tm
4. MOOCs: http://nptel.ac.in/courses/112105126/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Metal Casting: Design pattern/core for a given component drawing and develop a sand mould with optimum gating and riser system for ferrous and non-ferrous materials. Melting and casting, inspection for macroscopic casting defects.
2. Welding: TIG and MIG welding processes – design weld joints – welding practice –weld quality inspection.
3. Metal Forming: Press working operation – hydraulic and mechanical press -load calculation: blanking, bending and drawing operations – sheet metal layout design

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B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Fundamentals of Material Engineering**		
Course Code:	**25BMEIC303**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:0:2)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Explain the basic concepts of geometrical crystallography, crystal structure and imperfections in Solids
- Construct the phase diagrams to know the phase transformations and concept of diffusion in solids.
- Identify the heat treatment, cooling method for controlling the microstructure and plastic deformation to modify their properties.
- Explain the powder metallurgy process, types and surface modifications
- Apply the method of materials selection, material data, properties and knowledge sources for computer-aided selection of materials.

MODULE – 1 **9 Hours**

Structure of Materials: Introduction: Classification of materials, crystalline and non-crystalline solids, atomic bonding: Ionic Bonding and Metallic bonding. **Imperfections in Solids:** Types of imperfections, Point defects: vacancies, interstitials, line defects, 2-D and 3D-defects, Plastic deformation of single crystal by slip, dislocation and twinning.

Crystal Structure & Diffusion: Crystal Lattice, Unit Cell, Planes and directions in a lattice, Atomic Packing Factor of all the Cubic structures and Hexagonal Close Packed structure. Diffusion: Vacancy Diffusion and Interstitial Diffusion, Fick's laws of diffusion, Factors affecting diffusion. Problems on diffusion.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **9 Hours**

Phase diagram: Solid solutions, Hume Rothary rules, substitution, and interstitial solid solutions, construction of equilibrium diagrams, Interpretation of equilibrium diagram. Numericals on phase diagrams.

Iron Carbon system: Iron carbon equilibrium diagram description of phases, Solidification of steels and cast irons and invariant reactions.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **9 Hours**

Solidification: Mechanism of solidification, Homogenous and Heterogeneous Nucleation, crystal growth. Cast metal structures. **TTT Diagrams:** TTT curves, continuous cooling curves, Effect of cooling rate on TTT diagram, effect of carbon and alloying elements on TTT diagram.

Heat treatment of Metals: Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Hardenability, surface hardening methods like Carburizing cyaniding, nitriding flame hardening and induction hardening.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **9 Hours**

Fracture: Types of fracture, Griffith theory of Brittle fracture, Theoretical Cohesive strength. Creep: Phenomenon with examples, three stages of creep, creep properties, Creep test, stress relaxation.

Fatigue: Types of fatigue loading with example, Mechanism of fatigue, fatigue properties, fatigue testing and SN diagram.
Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **9 Hours**

Engineering Materials and Their Properties: Classification, Ferrous materials: Properties, Compositions and uses of Grey cast iron, Malleable Iron, S.G Iron and steel. Non-Ferrous materials: Properties, Compositions and uses of Copper, Brass, Bronze.
The Design Process and Materials Data: Types of design, design tools and materials data, processes of obtaining materials data, materials databases. Material Selection Charts: Selection criteria for materials. ***Material property Charts, deriving property limits and material indices -For CIE Only***
Teaching Learning Process: Chalk and Talk / PPT / Field Visits

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)

Experiments (9-10 Lab slots)

PART-A

1. Tensile test for Aluminium and mild steel (0.2% Carbon steel) (L1, L2, L3)
2. Compression test for Aluminium and mild steel. (L1, L2, L3)
3. Torsion test for mild steel. (L1, L2, L3)
4. Bending test for rectangular section of wood. (L1, L2, L3)
5. Shear test for mild steel.
6. To conduct a wear test on Mild steel/ Cast Iron/Aluminium/ Copper to find the volumetric wear rate and coefficient of friction. (L1, L2, L3)

Part-B

7. Rockwell hardness test for mild steel, C.I. and Tool Steel. (L1, L2)- (Demo).
8. Brinell hardness test for mild steel & Aluminium. (L1, L2)- (Demo).
9. Vickers Hardness Test for Aluminium, Cu, Bronze, Mild Steel and Cast Iron (L1, L2)
10. Izod Impact test for mild steel. (L1, L2)
11. Charpy Impact test for mild steel (L1, L2)
12. Preparation of Specimen for Metallographic Examination and microstructural evaluation. (L1, L2, l3)
    i. For Aluminium, Mild Steel and Medium Carbon Steel Metal.
    ii. Microstructure observation of prepared specimen.
13. Hardening Heat treatment of Medium Carbon Steel and evaluation of Microstructure before and after treatment. (L1, L2, L3)
14. Die penetrant test – (Demo).
15. Magnetic particle inspection test – (Demo).

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the atomic arrangement in crystalline materials and describe the periodic arrangement of atoms in terms of unit cell parameters.
CO2	Understand the importance of phase diagrams and the phase transformations.
CO3	Explain various heat treatment methods for controlling the microstructure.
CO4	Understand types of failures of materials under different loading conditions like tensile, compression, bending, shear, impact and torsion.
CO5	Correlate between material properties and understand the concepts of material selection chart

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	**30**	**12**	**Marks of Tests and Assignments awarded for a maximum of 30.**
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	**20**	**8**	**Marks of Experiments, Record and Test awarded for a maximum of 20 marks.**
CIE: Theory + Practical (A + B + C)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks.**
SEE (D)	**50**	**18**	**SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE+SEE (A+B+C+D)	**100**	**40**	**Final marks shall be the sum of marks scored in Components A, B, C and D**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.

Suggested Learning Resources:

Text Books

1. Callister Jr, W.D., Rethwisch, D.G., (2019), Materials Science and Engineering: An Introduction, 10th Edition, Hoboken, NJ: Wiley.
2. Ashby, M.F. (2010), Materials Selection in Mechanical Design, 4th Edition, Butterworth-Heinemann.
3. Azaroff, L.V., (2001) Introduction to solids, 1st Edition, McGraw Hill Book Company.
4. Avner, S.H., (2017), Introduction to Physical Metallurgy, 2nd Edition, McGraw Hill Education.

Reference Books

1. Jones, D.R.H., and Ashby,M.F., (2011), Engineering Materials 1: An Introduction to Properties, Application and Design, 4th Edition, Butterworth-Heinemann.
2. Jones, D.R.H., and Ashby,M.F., (2012), Engineering Materials 2: An Introduction to Microstructure and Processing, 4th Edition, Butterworth-Heinemann.
3. Abbaschian, R., Abbaschian, L., Reed-Hill, R. E., (2009), Physical Metallurgy Principles, 4th Edition, Cengate Learning.
4. P. C. Angelo and R. Subramanian: Powder Metallurgy- Science, Technology and Applications, PHI, New Delhi,2009.

Web links and Video Lectures (e-Resources):

1. Bhattacharya,B., Materials Selection and Design, NPTEL Course Material, Department of Mechanical Engineering, Indian Institute of Technology Kanpur, http://nptel.ac.in/courses/112104122/
2. Prasad, R., Introduction to Materials Science and Engineering, NPTEL Course Material, Department of Materials

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Case studies
2. Quiz
3. Topic Seminar presentation
4. Assignments

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Principles of Energy & Thermodynamics**		
Course Code:	**25BMETH304**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:0:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Learn about the thermodynamic system and its equilibrium, basic law of zeroth law of thermodynamics.
- Understand various forms of energy - heat transfer and work, Study the first law of thermodynamics.
- Study the second law of thermodynamics.
- Understand the concept of entropy and interpret the behaviour of pure substances and its application in practical problems.
- Study of Ideal and real gases and evaluation of thermodynamic properties.

MODULE – 1 **9 Hours**

INTRODUCTION AND REVIEW OF FUNDAMENTAL CONCEPTS: Thermodynamic definition and scope, Microscopic and Macroscopic approaches. Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive, extensive properties, specific properties, pressure, specific volume, Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium Zeroth law of thermodynamics, Temperature; concepts, scales, (Numerical only for CIE).

WORK AND HEAT: Mechanics, definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Numericals.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **9 Hours**

FIRST LAW OF THERMODYNAMICS: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Numerical.

Extension of the First law to control volume; steady flow energy equation (SFEE), Numerical.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **9 Hours**

SECOND LAW OF THERMODYNAMICS: Limitations of first law of thermodynamics, Thermal reservoir, heat engine and heat pump: Schematic representation, efficiency and COP. Reversed heat engine. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II,

Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles, Numerical.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4	**9 Hours**
ENTROPY: Clausius inequality, Statement- proof, Entropy- definition, a property, change of entropy, entropy as a quantitative test for irreversibility, principle of increase in entropy, entropy as a coordinate. Numerical. **PURE SUBSTANCES:** P-T and P-V diagrams, triple point and critical points. Sub-cooled liquid, saturated liquid, mixture of saturated liquid and vapor, saturated vapor and superheated vapor states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, representation of various processes on these diagrams. Steam tables and its use. Throttling calorimeter, separating and throttling calorimeter. Numerical. **AI-Based Visualization (Only for CIE):** Interactive AI simulations of reversible and irreversible processes. Machine learning visualization of entropy generation in engineering systems. ***Teaching Learning Process: Chalk and Talk / PPT***	
MODULE – 5	**9 Hours**
IDEAL GASES: Ideal gas mixtures, Dalton's law of partial pressures, Amagat's law of additive volumes, evaluation of properties of perfect and ideal gases. **REAL GASES:** Introduction, Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart. Difference between Ideal and real gases Numerical. **AI-Assisted Concept Learning (Only for CIE):** Use AI chatbots to explain gas mixture behaviour with real-world examples, AI-generated visualizations of molecular motion in ideal gases, Interactive AI tutors for understanding Dalton's and Amagat's laws. ***Teaching Learning Process: Chalk and Talk / PPT***	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Explain fundamentals of thermodynamics and evaluate energy interactions across the boundary of thermodynamic systems
CO2	Apply 1st law of thermodynamics to closed and open systems and determine quantity of energy transfers.
CO3	Evaluate the feasibility of cyclic and non-cyclic processes using 2nd law of thermodynamics.
CO4	Apply the knowledge of entropy, reversibility and irreversibility to solve numerical problems and Interpret the behaviour of pure substances and its application in practical problems.
CO5	Recognize differences between ideal and real gases and evaluate thermodynamic properties of ideal and real gas mixtures using various relations.

Assessment Details (Both CIE and SEE)

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall

			be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2018.
2. Basic Thermodynamics, B.K. Venkanna, Swati B. Wadavadagi PHI, New Delhi 2016. Thermodynamics- An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications 20016.
3. Thermal Engineering, R K Rajput, Lakshmi Publications.

Reference Books

1. Thermodynamics for engineers Kenneth A. Kroos and Merle C. Potter, Cengage Learning 2016.
2. Principles of Engineering Thermodynamics, Michael J, Moran, Howard N. Shapiro, Wiley 9th Edition.

Data Book:

Thermodynamics data hand book by Nijaguna and Samaga, Sapna Publication

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=AwbhbN20xl9&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOzl1dn
2. https://ciechanow.ski/internal-combustion-engine/
3. https://www.youtube.com/watch?v=1Vn1PDuPHsY&list=PL4K9r9dYCOoozyQU9kmQFJkTz

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Case studies
2. Quiz
3. Topic Seminar presentation
4. Assignments

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Mechanics of Materials**		
Course Code:	**25BMETH305**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:0:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the concepts of stress and strain in simple and compound bars.
- Explain the importance of principal stresses and principal planes & analyse cylindrical pressure vessels under various loadings
- Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Evaluate stresses induced in different cross-sectional members subjected to shear loads.
- Apply basic equation of simple torsion in designing of circular shafts & Columns

MODULE – 1 **9 Hours**

SIMPLE STRESS AND STRAIN: Simple stress and strain: Definition of normal stress, shear stress, and normal strain and shear strain. Stress strain diagram for brittle and ductile materials (Numerical on elongation of length and reduction in cross-sectional area).

ELASTIC CONSTANTS: Elastic constants-relationship between elastic constants and Poisson's ratio, volumetric strain, Generalized Hook's law. Deformation of simple and compound bars, thermal stresses (only theory).

Teaching Learning Process: Chalk and Talk

MODULE – 2 **9 Hours**

BI-AXIAL STRESS SYSTEM: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, graphical method-Mohr's circle for plane stress.

THICK AND THIN CYLINDERS: Stresses in thin cylinders, Lami's equation for thick cylinders subjected to internal and external pressures, Changes in dimensions of cylinder (diameter, length and volume), simple numerical.

Teaching Learning Process: Chalk and Talk

MODULE – 3 **9 Hours**

BENDING MOMENT AND SHEAR FORCES IN BEAMS: Definition of beam, Types of beams, Concept of shear force and bending moment-S. F. and B. M. diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads, uniformly varying loads and combination of these loads and point of contra flexure.

Teaching Learning Process: Chalk and Talk

MODULE – 4 **9 Hours**

THEORY OF SIMPLE BENDING: Assumptions-Derivation of bending equation, Neutral axis, Determination of bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I and T sections, Design of simple beam sections.

SHEAR STRESSES: Derivation of formula-Shear stress distribution across various beams sections like rectangular, circular, triangular, I, and T sections. ***Teaching Learning Process: Chalk and Talk***
MODULE – 5 **9 Hours**
TORSION OF CIRCULAR SHAFTS: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts. **THEORY OF COLUMNS:** Long column and short column-Euler's formula and Rankine's formula. ***Teaching Learning Process: Chalk and Talk***

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the concepts of stress and strain in simple and compound bars.
CO2	Explain the importance of principal stresses and principal planes & Analyze cylindrical pressure vessels under various loadings
CO3	Apply the knowledge to understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
CO4	Evaluate stresses induced in different cross-sectional members subjected to shear loads.
CO5	Apply basic equation of simple torsion in designing of circular shafts & Columns

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- Use of Data hand book is permitted.

Suggested Learning Resources:

Text Books:

1. Mechanics of Materials, S.I. Units, Ferdinand Beer & Russell Johnstan, 7th Ed, TATA McGrawHill-2014
2. Mechanics of Materials, K.V.Rao, G.C.Raju, Subhash Stores, First Edition, 2007
3. Strength of Materials by R.K. Bansal, Laxmi Publications 2010.

Web Links and Video Lectures (E-Sources):

1. Statics and Strength of Materials, Shehata, 2nd edition, 1994. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGES/JTE12637J.htm
2. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/TESTEVAL/PAGE/JTE12637J.htm
3. http://www.freeengineeringbooks.com/Civil/Strength-of-MaterialBooks.php

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Use Mdsolids (https://web.mst.edu/mdsolids/) ANSYS or any open source software for active teaching and learning

ESTD : 2001
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B.E. (Mechanical Engineering)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – III

Course Title:	**Digital Design and Machine Drawing**		
Course Code:	**25BMELB306**	**CIE MARKS**	**50**
L : T : P + (SL)	**(0:0:2)**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Develop a comprehensive understanding of mechanical assemblies and design for manufacturing principles.
- Learn and apply best practices to create design that are robust, adoptable and cost effective.
- Master the art of maintaining control over designs throughout the entire life cycle, from initial sketch to final production
- Gain hands on experience in practical exercises and projects to reinforce theoretical concepts
- Acquire effective communication and collaboration skills for multidisciplinary team work in design and production process.

MODULE – 1 **9 Hours**

Introduction to computer aided sketching review of graphic interface of the software. Review of 2D Sketching, Parametric solid modeling, assembly creation and product rendering. limits, fits and tolerances: introduction, fundamental tolerances, deviations, methods of placing limit dimensions. types of fits with symbols and applications. Geometrical tolerances on drawings, standards followed in industry. (above topics to be studied as review)

Geometrical dimensions and tolerances (GD&T): Introduction, fundamentals tolerances, deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerance on drawings. standard followed in industry (only for CIE)

The basics of sketching and modeling: Explore fusion 360 user interface. navigation and display settings, create new projects and designs, creating basic 2D sketches, creating and modifying a solid 3D body with sections. (for SEE).

MODULE – 2 **9 Hours**

Create draft during a feature, create a draft as a feature. Add ribs and plastic supports, create holes and threads . thread forms: terminologies, ISO metric, BSW, Square and ACME. seller thread. American standard thread. Use a coil feature, mirror and patterns. Fasteners: 3D and section views - Hexagonal headed bolt and nut with washer, square headed bolt and nut with washer. keys: parallel key, taper key and feather key.

MODULE – 3 **9 Hours**

The different ways to create components use scripts to create gears, component color swatch and color cycling. use Mcmaster –Carr parts in a design. Assembly of joints and coupling using 3D environment. **Joints**: like cotter joint (Socket and spigot); couplings- universal coupling. **Mechanisms**: Modeling and animation of mechanisms like Slider crank, scotch yoke ,quick return ,Geneva mechanisms.(Part drawings shall be given)

MODULE – 4 **9 Hours**

Assembly drawings (part drawings shall be given) Drawing basics –Detailing drawing: Explode a D model for a drawing, create a drawing sheet and views, add geometry and dimensions to a drawing. ADD GD& T text, BOM, tables and symbols, place an exploded view, edit a title block, export to different file formats.

1. Lifting device (Screw jack)
2. Bearings (Plumber block)
3. Machine tool component (Machine vice)

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Create and modify a form based design
CO2	Use design tools for moulded parts.
CO3	Demonstrate proficiency in the setup and creation of a design and Build mechanism and animate
CO4	Simulate the assembly of machine components in 3D environment

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. K L Narayana,P Kannaiah,K venkata reddy,Machine drawing ",New age international.3rd edition 13;978-81-224-2518-5,2006.
2. N D Bhat, Machine drawing, charotar publishing house pvt ltd.50th edition ,ISBN-13:978-9385039232,2014.
3. Machine drawing by K R Gopalkrishna, subhas publication

Web links and video lectures (e-resources):

- Learn fusion 360 in 90 minutes http://www.autodesk.com/cerification/learn/course/learn-fusion-360-in-90-miutes

Ability Enhancement Course for III Semester	
25BMEAE307A	Spreadsheet for Engineers
25BMEAE307B	Basics of Python Programming
25BMEAE307C	Experiential Learning and Makers Lab
25BMEAE307D	Fundamentals of Drone Technology

ESTD : 2001
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B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title:	**Spread Sheet for Engineers**		
Course Code:	**25BMEAE307A**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- To create different plots and charts
- To compute different functions, conditional functions and make regression analysis
- To carryout iterative solutions for roots, multiple roots, optimization and non-linear regression analysis
- To carryout matrix operations
- To Understand VBA and UDF
- To understand VBA subroutines and Macros
- To carryout numerical integration and solving differential equations using different methods

Slno	Experiments
1.	Charting: Create an XY scatter graph, XY chart with two Y-Axes, add error bars to your plot, create a combination chart
2.	Functions: Computing Sum, Average, Count, Max and Min, Computing Weighted Average, Trigonometric Functions, Exponential Functions, Using The CONVERT Function to Convert Units
3.	Conditional Functions: Logical Expressions, Boolean Functions, IF Function, Creating a Quadratic Equation Solver, Table VLOOKUP Function, AND, OR and XOR functions.
4.	Regression Analysis: Trendline, Slope and Intercept, Interpolation and Forecast, The LINEST Function, Multilinear Regression, Polynomial Fit Functions, Residuals Plot, Slope and Tangent, Analysis ToolPack.
5.	Iterative Solutions Using Excel: Using Goal Seek in Excel, Using The Solver To Find Roots, Finding Multiple Roots, Optimization Using the Solver, Minimization Analysis, NonLinear Regression Analysis.
6.	Matrix Operations Using Excel: Adding Two Matrices, Multiplying a Matrix by a Scalar, Multiplying Two Matrices, transposing a Matrix, inverting a Matrix and Solving System of Linear Equations.
7.	VBA User-Defined Functions (UDF): The Visual Basic Editor (VBE), The IF Structure, The Select Case Structure, The For Next Structure, The Do Loop Structure, Declaring Variables and a. Data Types, An Array Function The Excel Object Model, For Each Next Structure.
8.	VBA Subroutines or Macros: Recording a Macro, Coding a Macro Finding Roots by Bisection, Using Arrays, Adding a Control and Creating User Forms.
	Demonstration Experiments (For CIE)
9.	Numerical Integration Using Excel: The Rectangle Rule, The Trapezoid Rule, The Simpson's Rule, Creating a User-Defined Function Using the Simpson's Rule.
10.	Differential Equations: Euler's Method, Modified Euler's Method, The Runge Kutta Method, Solving a Second Order Differential Equation

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Select different plots and charts and apply different functions, conditional functions, regression analysis, and matrix operations.
CO2	Develop iterative solutions for roots, multiple roots, optimization, and non-linear regression analysis.
CO3	Construct Visual Basic Analysis (VBA), User Defined Functions (UDF), VBA subroutines, and Macros.
CO4	Explain numerical integration and solving differential equations using different methods.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1. McFedries PaulMicrosoft Excel 2019 Formulas and Functions Microsoft Press, U.S, 2019 Edition
2. https://www.youtube.com/watch?v=uytIMO50vtE&list=PLG0RsQNPM9Vni5EYnZ7zl-VUGbDwlK6PT

B.E. (Mechanical Engineering)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title:	**Basics of Python Programming**		
Course Code:	**25BMEAE307B**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Learn the syntax and semantics of the Python programming language.
- Illustrate the process of structuring the data using lists, tuples, sets and Dictionary
- Illustrate the working of strings and automating tasks using Regular expressions
- Demonstrate the use of built-in functions to navigate the file system and work with various documents like PDF, word and others
- Enable debugging and implement exception handling in python

Slno	Experiments
1.	**Basics -lists and tuples** (Introduction to Python data types, lists, tuples, input/output, and arithmetic operations. Variables, conditional statements, comparison operators, and decision-making in Python) a. Develop a program to read the student details like Name, USN, and Marks in three subjects. Display the student details, total marks and percentage with suitable messages. b. Develop a program to read the name and year of birth of a person. Display whether the person is a senior citizen or not.
2.	**Variables** (Looping constructs and sequence generation using iterative programming User-defined functions, parameter passing, recursion/iteration, and factorial computation.) a. Develop a program to generate Fibonacci sequence of length (N). Read N from the console. b. Write a function to calculate factorial of a number. Develop a program to compute binomial coefficient (Given N and R).
3.	**Statistics** (Statistical computations using lists and the math module. String manipulation and frequency counting using dictionaries.) a. Read N numbers from the console and create a list. Develop a program to print mean, variance and standard deviation with suitable messages. b. Read a multi-digit number (as chars) from the console. Develop a program to print the frequency of each digit with suitable message.
4.	**Text handling** (File handling, dictionaries, and word frequency analysis. Text file processing, string methods, and sorting techniques.) a. Develop a program to print 10 most frequently appearing words in a text file. [Hint: Use dictionary with distinct words and their frequency of occurrences. Sort the dictionary in the reverse order of frequency and display dictionary slice of first 10 items] b. Develop a program to sort the contents of a text file and write the sorted contents into a separate text file. [Hint: Use string methods strip(), len(), list methods sort(), append(), and file methods open(), readlines(), and write()].
5.	**File handling** (File compression and backup using the zipfile module. Directory traversal and path handling using the os module.) a. Develop a program to backing Up a given Folder (Folder in a current working directory) into a ZIP File by using relevant modules and suitable methods.

	b. Develop a program to demonstrate the path handling cpapbility of python using os.walk() function.
6.	**Pattern recognition** (Pattern recognition using string operations and regular expressions. Searching and extracting phone numbers and email addresses using regular expressions.) a. Write a function called isphonenumber () to recognize a pattern 415-555-4242 without using regular expression and also write the code to recognize the same pattern using regular expression. b. Develop a python program that could search the text in a file for phone numbers (+919900889977) and email addresses (sample@gmail.com)
7.	**Error handling** (Assertions, exceptions, and error handling in Python functions. Function invocation, exception handling, and robust program development using try-except.) a. Write a function named DivExp which takes TWO parameters a, b and returns a value c (c=a/b). Write suitable assertion for a>O in function Div Exp and raise an exception for when b=O. b. Develop a suitable program which reads two values from the console and calls a function Div Exp

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Demonstrate knowledge of python variables and environment
CO2	Develop skill for coding in python, handling loops and creation of functions
CO3	Solve automation problems using regular expressions and relevant functions in python
CO4	Analyse various file handling techniques and their applications
CO5	Use various IDEs for programming to develop expertise in them

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

1. Al Sweigart,"Automate the Boring Stuff with Python",1 st Edition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)

2. Paul Barry, "Head First Python - A brain friendly guide", O'Reilly - 2nd Edition.

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – III

Course Title:	**Experiential Learning and Makers Lab**		
Course Code:	**25BMEAE307C**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- To visualize the engineering science concepts.
- To provide strong fundamentals through learning centric approach.
- To feel and understand fundamental concepts.
- To enhance the theoretical and practical knowledge of engineering science.
- To impart practical skills.

Slno	Experiments
1.	An experiment to understand and prove that **Atmospheric pressure** exists
2.	An experiment to understand **Pascal's Law**
3.	An experiment to understand **Hydrostatic Law**
4.	An experiment to understand and verify **Bernoulli's Principle.**
5.	An experiment to demonstrate **Gyroscopic Couple.**
6.	An experiment to understand the **Moment of inertia** and its effect on rotation of an object.
7.	An experiment to understand the **surface Tension of Liquids.**
8.	An experiment to demonstrate and understand **Vertical circular motion**.
9.	An experiment to demonstrate **Buoyancy force.**
10.	An experiment to verify **Centripetal and Centrifugal force**, **Angular velocity** in a circular motion
11.	An experiment to understand the **Centre of gravity** and its effects
12.	An experiment to demonstrate the **Newton's Laws of motion, I, II and III Law**.
13.	An experiment to understand M**omentum-Conservation of momentum-Newton's Cradle.**
14.	An experiment to demonstrate **Normal Reaction force.**
15.	An experiment to demonstrate **Types of Levers and Mechanical advantage**
16.	An experiment to understand **Mechanical advantage of Pulley system**
17.	An Experiment to understand and measure the **Reaction force** on a **simply supported beam**
18.	An experiment to understand the effect of providing **Inclined plane** while lifting a weight.
19.	An experiment to Demonstrate **First law of Thermodynamics**
20.	An experiment to understand **Free convection.**
21.	Demonstration of effect of A**rea on drag force**
22.	Study of Effect of **Point load** on simply supported beam at centre and near the supports – To visualize Deflection
	Mechanisms-Maker's Lab
1.	Four bar mechanisms and inversions.(Locomotive wheels ,Beam engine)
2.	Slider crank mechanism.
3.	Whitworth Quick return mechanism.
4.	Scotch Yoke Mechanism.
5.	Wiper Mechanism
6.	Geneva mechanism.

7.	Cams and Followers.
8.	Types of Gears-Spur gears, Helical gear ,Bevel gear ,Rack and Pinion, Worm and Worm wheel

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the Basic Law like Pascal's Law, Hydrostatic Law, and Newton's Law of motion and Bernoulli's Principle
CO2	Understand Basic concepts of physics like Moment of inertia, Centre of gravity, Types of levers and Mechanical advantage of Pulleys and inclined plane.
CO3	Understand and apply Four bar mechanism, and its inversions, Slider Crank, Scotch yoke mechanism, Geneva mechanism, Whitworth Quick return mechanism, Beam engine
CO4	Understand the first Law of Thermodynamics ,Variation of Boiling Point with Pressure, effect of Area on Drag Force
CO5	Identify and understand the working of different Components of machine, Specifications of Material and its shapes.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill, 6th Edition 2019
2. Thermodynamics, Yunus A, Cengel, Michael A Boles, Tata McGraw Hill 7th Edition

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title:	**Fundamentals of Drone Technology**		
Course Code:	**25BMEAE307D**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Remember the basics principles and rules of flying a drone
- Understand the functioning of all components of drone
- Make and Fly the drone

Slno	Experiments
1.	Identification of Drone Components and Types
2.	Assembly of Drone Components
3.	Drone Simulation and Control Software
4.	Drone Optics, Sensors, and Flight Control
5.	Drone Calibration and Maintenance
6.	Pre-flight inspection
7.	Drone Flying and Operations
8.	Controlled landing and post-flight maintenance

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Identify different drone types and their components.
CO2	Assemble and troubleshoot basic drone systems.
CO3	Use drone simulation software for virtual flight practice.
CO4	Perform calibration and maintenance procedures.
CO5	Conduct safe drone flights following standard operating procedures.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be**

			for 3 hours.
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Books

1. Introduction to UAV Systems by Paul G. Fahlstrom and Thomas J. Gleason.
2. Small Unmanned Aircraft: Theory and Practice by Randy Beard and Timothy McLain.
3. Quad Rotorcraft Control by Randal W. Beard.
4. Civil Aviation requirements and drone operation guidelines issued by the national aviation regulator (as applicable).

Web links and Video Lectures (e-Resources):

1. https://dgt.gov.in/sites/default/files/CTSRPA-DronePilot_CTS_NSQF-4.pdf
2. https://www.faa.gov/training_testing/testing/acs/media/uas_acs.pdf
3. https://irp.fas.org/doddir/army/34-212.pdf.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

5. Experimentation – gathering knowledge through experience through lab.
6. Exploration – gathering knowledge and attaining skills through active investigation.
7. Expression – encouraging students to express their views through visual presentations.

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title:	**Community Project (Project Based Learning)/ Societal Project**		
Course Code:	**25BCBPR308**	**CIE MARKS**	**50**
L : T : P: SL	**0:0:0:30**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**30**	**TOTAL MARKS**	**100**

COURSE LEARNING OBJECTIVES:

This course aims to integrate technical knowledge, field exposure and societal engagement so that students identify real community issues, frame problem statements and attempt appropriate, feasible and sustainable engineering responses within the scope of a one-semester project.

SET OF PROJECT ACTIVITIES (TW/SL = 30 HOURS)

Methods for project identification:

Students may identify the project topic using one or more of the following methods:

- Interaction with local rural or urban stakeholders such as local leaders, corporation/ municipality personnel, NGOs, panchayat representatives, etc.
- Review of issues highlighted in print and electronic media, and social networks (WhatsApp, Facebook, X, Instagram, etc.).
- After selecting a broad topic, students shall collect data, conduct a feasibility survey, estimate timelines and resources, approximate expenditure, and then define the problem statement and objectives clearly.

List of Projects

SL.NO	Project Title	Measurable Engineering Outcome
1.	Rural and urban water conservation and management systems	Prepare a site-specific water-saving plan, estimate water demand–supply gap, and propose a feasible conservation intervention with quantified savings.
2.	Waste management and recycling	Conduct waste audit, classify waste streams, and design a segregation/recycling workflow with measurable reduction in mixed waste.
3.	Afforestation	Identify a degraded area, prepare plantation layout, and demonstrate survival-rate tracking and maintenance schedule for saplings.
4.	Biogas generation and power generation	Estimate organic waste availability, size a small biogas system, and document expected gas output or energy yield.
5.	DPR for solar power rural plant	Prepare a DPR with load assessment, panel sizing, cost estimate, and projected energy generation and payback.

6.	DPR for electrification of village/tribal community	Map unserved/underserved households, propose electrification layout, and estimate coverage, losses, and implementation cost.
7.	DPR for rural drainage system	Survey drainage bottlenecks, develop a drainage layout, and estimate runoff handling capacity and flood-risk reduction.
8.	Sustainability and environmental health projects	Assess local environmental health issues and propose interventions with measurable improvement in hygiene, safety, or resource use.
9.	Plastic free campaigns	Measure plastic usage before and after awareness intervention and report percentage reduction or behavioural change.
10.	Health and nutrition awareness	Conduct baseline and post-program awareness survey and document improvement in awareness score or adoption of healthier practices.
11.	Societal projects involving health wellness	Identify a community health need and develop an awareness/service module with measurable participation and feedback outcomes.
12.	Air quality monitoring system	Collect air-quality data, compare with reference limits, and present trends along with possible mitigation suggestions.
13.	Plastic waste reduction campaign	Track collection, segregation, and replacement actions, and quantify reduction in plastic waste generation or littering.
14.	Urban greening projects	Prepare greening plan, identify planting locations, and assess environmental benefits such as shade, aesthetics, or heat mitigation.
15.	Smart agriculture solution	Design a low-cost monitoring or irrigation support solution and estimate improvement in water use efficiency or crop support.
16.	Smart irrigation system	Estimate crop water requirement, propose control logic, and quantify water savings compared with conventional irrigation.
17.	Youth mentoring programmes	Deliver a structured mentoring activity and measure participation, engagement, and skill/awareness improvement.
18.	Adult education	Conduct learner-needs assessment, prepare instructional content, and measure improvement in basic literacy or numeracy indicators.

19.	Food security initiatives / cold storage system	Estimate storage need, design a simple cold-chain concept, and document reduction in spoilage or wastage.
20.	Human rights awareness with legal systems	Prepare and deliver an awareness module and assess increase in legal awareness and access-to-rights understanding.
21.	House tax collection through digital media	Develop a simple digital workflow or awareness support and measure improvement in compliance, convenience, or response time.
22.	Use of application / application program	Build or demonstrate a useful community app and measure usability, adoption, or efficiency improvement.
23.	Creation of Panchayat library	Plan the library model, catalogue resources, and measure usage, accessibility, or participation outcomes.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Identify and analyse societal problems through field interaction and technical assessment
CO2	Develop skills in project planning, field survey, data collection, implementation, documentation and reporting
CO3	Formulate feasible engineering problem statements and solutions considering practical constraints and sustainability aspects
CO4	Apply principles of environmental responsibility, ethics and societal welfare in engineering practice through community-oriented interventions
CO5	Demonstrate teamwork and communication skills while interacting with technical and non-technical stakeholders and reflect on project impact on society.

Suggested Learning Resources:

Textbooks:

1. Phadke, N. D. Community Engagement and Social Innovation. 1st ed., Oxford University Press, New Delhi.
2. Garg, N. R. Project-Based Learning in Engineering Education. 1st ed., Pearson India Education Services, Noida.
3. Gupta, A. and P. Singh. Service Learning and Community Projects. 1st ed., McGraw-Hill Education (India), New Delhi.
4. Wilson, G. Practical Guide to Community Development Projects. 2nd ed., Routledge, London.

Reference books/ Web links/Video Lectures (e-Resources):

1. NPTEL courses on Project-Based Learning and Social Innovation.
2. SWAYAM courses on community engagement and sustainability.
3. UN Sustainable Development Goals portal: https://sdgs.un.org

4. MyGov India and local civic body portals for community initiatives.
5. YouTube resources on design thinking, social innovation, and community service learning.
6. NGO and government field-action case studies related to sanitation, water, health, education, and environment.

Teaching Learning Process

The suggested TLP for Community / Societal Project is as follows;

Week / Phase	Teaching–Learning Activity	Faculty Role	Student Activity	Output / Evidence
1.	Course introduction, objectives, ethics, conduct, and assessment briefing	Explain course scope, rules, rubrics, and expected deliverables	Understand course requirements and form teams	Team list, course plan
2.	Community problem identification and topic selection	Guide topic framing and feasibility	Identify local issues through discussion and observation	Shortlisted project topic
3.	Stakeholder interaction and preliminary survey	Demonstrate survey methods and stakeholder engagement	Collect initial data from community/users	Survey notes, interview record
4.	Problem statement and objective formulation	Review and refine problem statement	Prepare problem statement, scope, and objectives	Approved problem statement
5.	Literature/case study review and baseline analysis	Suggest relevant references and examples	Study existing solutions and compare approaches	Baseline analysis summary
6.	Project planning and role assignment	Help teams organize tasks, timeline, and responsibilities	Plan activities, divide roles, and prepare schedule	Work plan / Gantt chart
7.	Feasibility analysis and solution brainstorming	Check technical feasibility and practicality	Generate possible engineering solutions	Solution alternatives sheet
8.	Selection of final solution and design approach	Review final concept and design logic	Finalize concept, methods, and expected outcome	Concept note / design outline
9.	Data processing / calculations / sizing / mapping	Support computations and technical review	Analyze data, perform calculations, prepare maps/charts	Technical analysis sheet
10.	Prototype / model / audit / DPR / app development	Monitor progress and correct technical issues	Develop the selected output	Working model / draft DPR / map / app
11.	Testing, refinement, and implementation planning	Evaluate technical correctness and improvements	Test prototype or validate proposal with users	Test results / revised output
12.	Field implementation / demonstration / awareness activity	Facilitate community interaction and documentation	Conduct implementation or demonstration	Photos, attendance, implementation record
13.	Documentation of outcomes, feedback, and impact	Review report structure and completeness	Compile findings, stakeholder feedback, and observations	Draft report
14.	Presentation preparation and viva practice	Conduct mock presentation and feedback	Prepare slides/poster and rehearse	Presentation deck

15.	Final presentation, submission, and reflection	Evaluate performance using rubrics	Present project, submit report, reflect on learning	Final report, presentation, viva

Assessment structure:

A. Continuous Internal Evaluation (CIE) – 50 marks

- Students, in batches of 3–4, shall undertake at least one project (or a combination of two related activities) aiming, as far as possible, at a logical implemented or implementable outcome.
- CIE will be conducted by a departmental committee (HoD/nominee, guide and one senior faculty) using the following rubrics totalling 50 marks:

CIE pass requirement:

- A student shall secure a minimum of 20 marks out of 50 in CIE to become eligible to appear for SEE.
- Students who fail to earn the required CIE marks may be given additional opportunities before closure of the semester; no re-doing of CIE is permitted after the end of the semester.

B. Semester End Examination (SEE) – 100 marks (scaled to 50)

- Examination duration: 3 hours.
- Maximum examination marks: 100 (entered as 100 in the ERP portal; the ITI-SMU module automatically scales 100 → 50 for result processing).
- The SEE shall be conducted batch-wise by a committee of three faculty: project guide, one faculty from the same department and one from a different department.

SEE pass requirement and overall passing rule:

- For a pass in SEE, a student shall secure minimum 35 marks out of 100.
- For declaration of a pass grade, the sum of CIE marks (out of 50) and scaled SEE marks (out of 50) shall be
  ≥ 40; otherwise, the student is awarded grade F (Fail).

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**National Service Scheme (NSS)**		
Course Code:	**25BNSSP309**	**CIE MARKS**	**100**
L : T : P + (SL)	**0:0:0 + (30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Identify the needs and problems of the community and involve the problem–solving.
- Develop among them a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
- Develop competence required for group-living and sharing of responsibilities & gain skills in mobilising community participation to acquire leadership qualities and democratic attitudes.

MODULE – 1
Introduction to NSS, Life Competencies, Youth Leadership and NSS
MODULE – 2
Social connect and responsibilities.
MODULE – 3
Activities -1 (Choose from Activity list)
MODULE – 4
Activities -2 (Choose from Activity list)
MODULE – 5
Activities -3 (Choose from Activity list)

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Communicate effectively with the community and with the officials.

ACTIVITY LIST	
Plantation Drive: Adopt a Tree	Developing & managing an efficient garbage disposal system
Food Preservation/ Packaging awareness	Tourism Promotion: Innovative Approaches
Facilitating 100% digitized money transactions	Contribution to any national-level initiative of the Government of India. E.g. Digital India/ Skill India/ Swachh Bharat Internship etc.,

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
Evaluation based on Reports (A)	100	-	5 modules Reports, 5 modules X 10 M each = 50 M
Total CIE Theory (A)	**100**	**40**	
SEE (B)	**-**	**-**	**-**
CIE+SEE (A+B)	**100**	**40**	**Final marks shall be the sum of marks scored in Components A, B**

- The minimum marks to be secured in CIE is 40 out of allotted 50 marks with minimum 40 % scored in every component of CIE.
- No SEE for this subject

Suggested Learning Resources:

Reference Books

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual.

Weblinks

1. https://nss.gov.in/
2. https://pledge.mygov.in/

ESTD:2001 An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Physical Education (PE) (Sports and Athletics)**		
Course Code:	**25BPEDU309**	**CIE MARKS**	**100**
L : T : P + (SL)	**0:0:0 + (30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness
- Familiarization of health-related Exercises, Sports for overall growth and development
- Participate in the competition at regional/state / national / international levels.
- Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle

MODULE – 1

Orientation

A. Meaning and Importance of Physical Education
B. Lifestyle
C. Health & Wellness

MODULE – 2

General Fitness & Components of Fitness

A. Meaning and Importance of Fitness
B. Warming up (Free Hand exercises)
C. Strength – Push-up / Pull-ups

MODULE – 3

Specific games (Anyone to be selected by the student)

A. Kabaddi

a) Fundamental skills: Hand touch, Toe Touch, Thigh Hold, Ankle hold and Bonus.
b) Offensive Skills: Raiding, Hand Touch, Toe Touch, Dubki, Squat Thrust
c) Defensive Skills: Tackling, Ankle Hold, Thigh Hold, Waist Hold, Blocking, Chain Tackle
d) Other Important Skills: Agility, Speed, Breath Control, Breath Holding
e) Rules and their interpretation and duties of the officials

B. Kho-Kho

a) Fundamental skills: Giving Kho, Single Chain, Pole dive, Pole turning, 3-6 Up.
b) Skills in Chasing: Sit on the box (Parallel & Bullet toe method), Get up from the box (Proximal & Distal foot method), Give Kho (Simple, Early, Late & Judgment), Pole Turn, Pole Dive, Tapping, Rectification of foul.
c) Skills in running: Chain Play, Ring play and Chain & Ring mixed play.
d) Game practice with application of Rules and Regulations.
e) Rules and their interpretations and duties of the officials.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness
CO2	Familiarization of health-related Exercises, Sports for overall growth and development
CO3	Participate in the competition at regional / state / national / international levels.
CO4	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Quiz for a maximum of 40 marks
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.

Reference Books

1. Saraswati Health and Physical Education Textbook
2. V.K. Sharma's Health and Physical Education

An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Yoga**		
Course Code:	**25BYOGA309**	**CIE MARKS**	**100**
L : T : P + (SL)	**0:0:0 + (30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Physical, Mental & spiritual Objectives of Yoga
- Explain the meaning of Yoga.
- Discuss the importance of the Yoga and its scope.
- Describe the aims and objectives of Yoga.
- Clarify the misconceptions on Yoga

MODULE – 1

Orientation

A. Introduction of Yoga
B. Aim, and Objectives of Yoga,
C. Yoga, its origin, history and development.

MODULE – 2

General Fitness & Components of Fitness

A. Yoga, its meaning, definitions.
B. Brief introduction of yogic practices for the common man c) Rules and regulations
C. Misconceptions of Yoga e) Suryanamaskara

MODULE – 3

Asanas

Types of Asanas:

A. Sitting- 1. Padmasana, 2. Vajrasana
B. Standing- 1. Vrikshana, 2. Trikonasana
C. Prone line- 1. Bhujangasana 2. Shalabh asana
D. Supine line- 1. Utthita dvipadasana 2. Ardha halasana

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the fundamental concepts of Yoga
CO2	Improves of health and related aspects, overall growth and development
CO3	Participate in the competition at regional/state/national/international levels.
CO4	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Quiz for a maximum of 40 marks
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. The Yoga Sutras of Patanjali – Sri Swami Satchidananda.
2. Light on Yoga — B.K.S Iyengar.

Reference Books

1. The Heart of Yoga — T.K.V Desikachar.
2. "Asana Pranayama Mudra Bandha" bySwami Satyananda Saraswati

ESTD : 2001
An Institute with a Difference

B.E. (Common to All the Branches) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Music**		
Course Code:	**25BMUSK309**	**CIE MARKS**	**100**
L : T : P + (SL)	**0:0:0 + (30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the origin, evolution, and fundamental concepts of Indian classical music.
- Familiarize themselves with the basic forms of Carnatic and Hindustani music compositions and appreciate their musical structure and significance.
- Identify and classify the major musical instruments used in Carnatic and Hindustani music and understand their construction and performance characteristics.
- Recognize the contributions of eminent Indian composers and musicians to the development and preservation of Indian classical music.
- Develop an appreciation for India's rich musical heritage, fostering creativity, cultural awareness, and lifelong interest in music.

MODULE – 1
Origin of the Indian Music: Evolution of the Indian music system, Understanding of Shruthi, Nada, Swara, Laya, Raga Tala, Mela.
MODULE – 2
Compositions: Introduction to the few types of composition in Carnatic Music- Geethe, Swarajathi, Varna, Madhyama Kala Krithi,
MODULE – 3
Compositions: Introduction to the few types of composition in Hindustani Music : Khayal, Drupad, Tarana
MODULE – 4
Music Instruments: Classification and construction of string instruments, wind instrurnents, percussion instruments in both Carnatic and Hindustani Music.
MODULE – 5
Composers: Biography and contributions of of the following eminent personalities Purandaradasa, Thyagaraja, Mysore Vasudevacharya. Pt. Mallikarjun Mansur, Vidhushi Gangubhai Hangal.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution, and fundamental concepts of Indian classical music. (Bloom's Level: Understand – L2)
CO2	Compare and distinguish the characteristics of selected Carnatic and Hindustani music compositions. (Bloom's Level: Analyze – L4)
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music. (Bloom's Level: Analyze – L4)
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music. (Bloom's Level: Evaluate – L5)

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. Vidushi Vasantha Madhavi, “Theory of Music”, Prism Publication, 2007.
2. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana- Vol. 1 (English), Shreenivaas Prakaashana, 2018.
3. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Government of India, New Delhi.

Reference Books

1. Lakshminarayana Subramaniam, Viji Subramanaim, "Classical Music of India: A Practical Guige, Tranqueber 2018.
2. R. Rangaramanuja Ayyangar, "History of South Indian (Carnatic) Music", Vipanci Charitable Trust; Third edition, 2019,
3. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai.

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – III

Additional Mathematics – I

(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech. Programmes)

Course Title:	**Additional Mathematics – I**		
Course Code:	**25BMADP310**	**CIE MARKS**	**100**
L : T : P + (SL)	**1:0:0 + (14 Hours/Sem)**	**SEE MARKS**	**00**
Credits:	**PP**	**EXAM HOURS**	**00**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Apply the fundamental concepts of complex trigonometry, vector algebra, and differential and integral calculus to analyze mathematical and engineering problems.
- Apply the principles of vector differentiation and solve first-order ordinary differential equations in relevant scientific and engineering contexts.

MODULE – 1

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).
Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

MODULE – 2

Differential Calculus: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

MODULE – 3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.

MODULE – 4

Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof) and evaluation of these with standard limits-Examples.

MODULE – 5

Ordinary differential equations (ODE's): Introduction-solutions of first order and first-degree differential equations: exact, linear differential equations. Equations are reducible to exact and Bernoulli's equation.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Apply concepts of complex numbers and vector algebra to analyze the problems arising in related areas.
CO2	Apply derivatives and partial derivatives to calculate rate of change of multivariate functions
CO3	Solve problems involving position, velocity, and acceleration in two and three dimensions using vector-valued functions.

CO4	Apply the fundamental techniques of elementary integration to solve standard integrals.
CO5	Identify and solve first order ordinary differential equations.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	60	-	Two tests of each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 60 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods of each of 20 marks as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 40 marks.
Total CIE (A+B)	**100**	**40**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**-**	**-**	No SEE for this subject
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

Suggested Learning Resources:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N. P .Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	1st Edition, 2015

Additional Mathematics I and II:

1. These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semesters to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.
2. Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.
3. Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.

B.E. (Mechanical Engineering)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
Skill lab Course

Course Title:	**Additive Manufacturing & 3d Printing Skill Lab**		
Course Code:	**25BMESL001**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Introduce students to the principles, classifications and applications of Additive Manufacturing.
- Develop practical skills in CAD modelling and preparation of digital models for 3D printing.
- Familiarize students with slicing software and selection of suitable process parameters.
- Provide hands-on experience in FDM/FFF and DLP-based additive manufacturing using available 3D printers.
- Develop skills in post-processing, dimensional inspection, defect identification and application of Design for Additive Manufacturing (DfAM).

Sl no	Experiments / Hands-on learning
1.	**Study of Additive Manufacturing Equipment:** Identification and study of major components and working principles of Ender 3, Bambu Lab P1S and DLP 3D printers.
2.	**CAD Modelling for Additive Manufacturing:** Develop a mechanical component using CAD software and prepare STL/3MF files.
3.	**Design for Additive Manufacturing:** Redesign a conventional component considering wall thickness, overhang, fillets, clearances and support requirements.
4.	**Slicing and Build Orientation:** Generate slicing parameters and study the effect of layer height, build orientation and support structures on printing time and material consumption.
5.	**Infill Parameter Study:** Investigate the influence of different infill densities and patterns on material consumption, printing time and estimated component strength
6.	**Ender 3 – FDM Printing:** Perform printer setup, bed levelling, filament loading and fabrication of a PLA component.
7.	**Bambu Lab P1S – Advanced FDM Printing:** Prepare slicing parameters and fabricate an engineering component using Bambu Studio and Bambu Lab P1S.
8.	**DLP 3D Printing:** Prepare, orient and fabricate a detailed component using suitable photopolymer resin.
9.	**Defect Identification and Troubleshooting:** Identify common defects such as warping, stringing, under-extrusion, layer shifting and poor bed adhesion and determine suitable corrective measures.
10.	**Dimensional Accuracy Evaluation:** Measure critical dimensions of printed components and compare them with CAD dimensions to determine dimensional deviation.
11.	**Comparative Evaluation and Mini Project:** Compare FDM and Ender 3D components based on dimensional accuracy, surface quality, printing time and material consumption, followed by fabrication of a functional prototype.
	Demonstration Experiments (For CIE)
1.	**Study of Additive Manufacturing Equipment:** Identification and study of major components and working principles of DLP 3D printers.
2.	**Post-Processing of Printed Components:** Perform support removal, cleaning, washing, curing and surface finishing of DLP printed components.

3.	**Comparative Evaluation and Mini Project:** Compare FDM and DLP components based on dimensional accuracy, surface quality, printing time and material consumption, followed by fabrication of a functional prototype.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	**Explain** the principles, process chain, classification and applications of major Additive Manufacturing technologies.
CO2	**Develop** CAD models and prepare STL/3MF files considering Design for Additive Manufacturing (DfAM) principles.
CO3	**Select and optimize** suitable slicing parameters, build orientation, infill and support structures for a given component.
CO4	**Operate** FDM and DLP 3D printers to fabricate and post-process functional engineering components.
CO5	**Evaluate** dimensional accuracy, print quality and defects, and **develop** a functional prototype using appropriate Additive Manufacturing techniques.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Textbooks:

3. Ian Gibson, David Rosen, Brent Stucker and Mahyar Khorasani, *Additive Manufacturing Technologies*, 3rd Ed., Springer, 2021.
4. Eujin Pei et al. (Eds.), *Springer Handbook of Additive Manufacturing*, 1st Ed., Springer, 2023

5. Kun Zhou (Ed.), *Additive Manufacturing Technology: Design, Optimization, and Modeling*, 1st Ed., Wiley-VCH, 2023

Reference books/ Web links/Video Lectures (e-Resources):

1. Andreas Gebhardt and Jan-Steffen Hötter, *Additive Manufacturing: 3D Printing for Prototyping and Manufacturing*, Hanser, 2016.
2. *Sunpreet Singh, Chander Prakash and Seeram Ramakrishna (Eds.), Innovative Processes and Materials in Additive Manufacturing, 1st Ed., Elsevier, 2022.*
3. Panagiotis Stavropoulos, *Additive Manufacturing: Design, Processes and Applications*, 1st Ed., Springer, 2023.

STANDARDS

1. **ISO/ASTM 52900:2021**, *Additive Manufacturing — General Principles — Fundamentals and Vocabulary*.
2. **ISO/ASTM 52901:2017**, *Additive Manufacturing — General Principles — Requirements for Purchased AM Parts*.
3. **ISO 17295:2023**, *Additive Manufacturing — General Principles — Part Positioning, Coordinates and Orientation*.

Web Links and Video Lectures (e-Resources):

1. NPTEL, *Fundamentals of Additive Manufacturing Technologies*, IIT Guwahati, Prof. Sajan Kapil. Link
2. NPTEL, *Metal Additive Manufacturing*, IIT Kanpur. Link
3. NPTEL, *Navigating the Latest Trends in Additive Manufacturing Landscape*, IIT Bombay–Wipro 3D. Link
4. NPTEL+, *Additive Manufacturing Technologies for Practising Engineers*, IIT Madras. Link
5. MIT Open CourseWare, *3D Printing*. Link
6. Bambu Lab Academy, *Bambu Studio and P1S Learning Resources*. Link
7. Creality, *Ender-3 User Manuals and Support Resources*. Link
8. ASTM International, *Additive Manufacturing Standards and Learning Resources*. Link

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Problem Identification → CAD Design → DfAM → Slicing → Parameter Selection → 3D Printing → Post-Processing → Inspection → Evaluation → Prototype Improvement

CORE COURSES
IV SEMESTER

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Mathematical Methods for Mechanical Engineering**		
Course Code:	**25BMETH401**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:2:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- **Develop** the ability to formulate, analyze, and solve mathematical models of real-world engineering systems using appropriate mathematical techniques for Mechanical Engineering applications.
- **Apply** regression analysis techniques to model and analyze relationships between variables.
- **Understand** the principles of statistical hypothesis testing, including Type-I and Type-II errors, levels of significance, and decision-making under uncertainty.
- **Analyze** engineering problems using partial differential equations and apply finite difference methods to approximate derivatives and solve numerical problems.

MODULE – 1	**9 Hours**
Mathematical Modelling: Modelling principles, Population models, Mechanical vibration models, Heat transfer models. Fluid flow models, Case studies in Mechanical Engineering.	
MODULE – 2	**9 Hours**
Statistical Method: Principles of least squares, Curve fitting by the method of least squares in the form $y = a + bx$, $y = a + bx + cx^2$, and $y=ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, standard error of estimate, rank correlation.	
MODULE – 3	**9 Hours**
Statistical inference: Statistical Measures, Population and Sampling distributions: Mean, Proportions, Differences and sums, Statistical Estimation, Statistical Decisions-Type-I, Type-II errors, Levels of Significance, Tests- 't'-distribution, z-test and Chi-square Test.	
MODULE – 4	**9 Hours**
Partial Differential Equations (PDEs): Formation of PDE's by elimination of arbitrary constants and function, solution of non- homogeneous PDE by direct integration, homogeneous PDE involving derivatives with respect to one independent variable only, application of PDE: Derivation of one-dimensional heat equation and wave equation.	
MODULE – 5	**9 Hours**
Numerical Solution of PDE: Classification of second-order partial differential equations, finite difference approximation of derivatives. Solution of one-dimensional heat equation by Schmidt explicit formula and Crank- Nicholson method. Solution of one-dimensional wave equation using explicit three level formula and implicit scheme.	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Solve problems involving mathematical models of engineering systems related to mechanical vibrations, heat transfer, fluid flow, and other Mechanical Engineering applications.

CO2	Apply correlation and regression analysis techniques to model and interpret relationships between variables in engineering and scientific data.
CO3	Apply statistical inference methods, including estimation and hypothesis testing, to analyze sample data and support decision-making under uncertainty.
CO4	Apply partial differential equations and their solutions for physical interpretations
CO5	Apply finite difference methods to approximate derivatives and obtain numerical solutions of engineering and mathematical problems.

Assessment Details (Both CIE and SEE)

Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44thEdition, 2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2018.
3. J. N. Kapur, *Mathematical Modelling*, 2nd Edition, New Age International Publishers, 2019.

Reference Books

1. B. V. Ramana: "Higher Engineering Mathematics" McGraw-Hill Education, 11thEdition, 2017
2. N.P Bali and Manish Goyal: "A Textbook of Engineering Mathematics" Laxmi Publications, 10th Edition, 2022.
3. C. Ray Wylie, Louis C. Barrett: "Advanced Engineering Mathematics" McGraw–Hill Book Co., New York, 6thEd., 2017.
4. H.K. Dass and Er. Rajnish Verma: "Higher Engineering Mathematics" S.Chand Publication,3rd Edition, 2014.

Web links and Video Lectures (e-Resources):

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU e-Shikshana Program

5. VTU EDUSAT Program.
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Programming Assignment 2. Tool/Software Exploration 3. Problem-Based Learning (PBL) 4. Assignments

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Machining Science and Metrology**		
Course Code:	**25BMEIC402**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:0:2)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
- To introduce students to different machine tools to produce components having different shapes and sizes.
- To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
- Understand the importance of surface finishing.
- To understand the basic principles of measurements
- To enrich the knowledge pertaining to gauge, comparator and angular measurement

MODULE – 1 **9 Hours**

Introduction to Metal cutting: Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems.

Cutting tools and Operations: Cutting tool materials and applications. Introduction to basic metal cutting machine tools: Lathe Operations: Thread cutting, Taper turning.

Teaching Learning Process: Chalk and Talk / PPT / Field Visits /videos

MODULE – 2 **9 Hours**

Milling Machines: up milling & down milling, classification of milling machines, constructional features (Column and Knee and vertical milling machine), milling cutter nomenclature, Milling operations: Gear cutting, Straddle milling, Gang milling. Indexing: Need of indexing Simple, compound. Simple numerical on indexing.

Shaping, Slotting and Planning Machines Tools: Driving mechanisms of Shaper, Slotter and Planer. Operations done on Shaper, Planer & Slotter Difference between shaping and planning operations. Drilling Machines: Constructional features (Radial & Bench drilling Machines), operations, types of drill & drill bit nomenclature. Grinding: Grinding operation, classification of grinding processes: cylindrical, surface & centerless grinding.

Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos

MODULE – 3 **9 Hours**

Tool life and tool Wear: progressive tool wear; forms of wear in metal cutting: crater wear, flank wear, tool-life criteria, cutting tool materials: basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; the work material and its machinability Cutting fluids: Action of coolants and application of cutting fluids.

Broaching process: Principle of broaching. Details of a broach. Types of broaching machines-constructional details. Applications. Advantages and Limitations. Finishing and other Processes Lapping and Honing operations – Principles, arrangement of set up and application. Super finishing process, polishing, buffing operation and application.

Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos

MODULE – 4	**9 Hours**
Introduction to Metrology: Introduction to metrology & measurements, definition, objectives and classification of metrology, standards of length- wave length standard, sub division of standards, numerical problems on length calibration. Line & End Standards: Line and end standard, slip gauges, wringing phenomena, numerical problems on slip gauges. **Systems of Limits, Fits & Tolerance:** Definition of tolerance, tolerance specification in assembly, principle of interchangeability and selective assembly, limits of size, Indian standards, concepts of limits of size and tolerances, cost v/s tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation. ***Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos***	
MODULE – 5	**9 Hours**
Gauges: Classification of gauges, Taylor's principle, design of GO, NO GO gauges, wear allowance on gauges, types of gauges- plain plug gauges, ring gauges, snap gauge, limit gauge, simple problems. **Comparators:** Introduction to comparators, classification, characteristics, systems of displacement amplification in mechanical comparators, Reed type, Sigma comparator, Zeiss ultra-optimeter, Solex air gauge, ultrasonic gauges, LVDT. Angular Measurements: Bevel protractor, sine bar, sine center, angular gauges, numerical on building of angles. ***Teaching Learning Process: Chalk and Talk / PPT / Field Visits/videos***	

PRACTICAL COMPONENT OF IPCC (May cover all / major modules)	
Sl. No	**Experiments**
	Measurement
1.	Calibration of Pressure Gauge
2.	Calibration of Thermocouple
3.	Calibration of LVDT
4.	Calibration of Load cell
5.	Determination of modulus of elasticity of a mild steel specimen using strain gauges.
	Metrology
6.	Measurements using Optical Projector / Toolmaker Microscope.
7.	Measurement of angle using Sine Centre / Sine bar / bevel protractor
8.	Measurement of alignment using Autocollimator / Roller set
	Demo experiments for CIE
9.	Measurement of cutting tool forces using
10.	a)Lathe tool Dynamometer OR b) Drill tool Dynamometer
11.	Measurements of Screw Thread Parameters using two wire or Three-wire methods.
12.	Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Analyse various cutting parameters in metal cutting.
CO2	Understand the construction of machines & machine tools and compute the machining time of various operations.
CO3	Understand the concept of Temperature in Metal Cutting, forms of wear in metal cutting and Cutting fluids

CO4	Understand the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters. Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
CO5	Understand the working principle of different types of comparators, gauges, angular Measurements

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE- IA Tests (A)	20	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 20 marks.
Continuous and Comprehensive Evaluation (B)	10	-	Any one Assessment methods as per 24RNBE4.2 scaled to 10 marks.
Total CIE Theory (A+B)	**30**	**12**	**Marks of Tests and Assignments awarded for a maximum of 30.**
CIE Practical	12	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 12 marks.
CIE Practical Test	8	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 8.
Total CIE Practical (C)	**20**	**8**	**Marks of Experiments, Record and Test awarded for a maximum of 20 marks.**
CIE: Theory + Practical (A + B + C)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks.**
SEE (D)	**50**	**18**	**SEE is a theory exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE+SEE (A+B+C+D)	**100**	**40**	**Final marks shall be the sum of marks scored in Components A, B, C and D**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.
- The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included in their respective modules only.

Suggested Learning Resources:

Books

1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2. McGeough, J A, (1999), Advanced Methods of Machining, Springer.

3. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.
4. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.
5. Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications.
6. Rao P. N., Manufacturing Technology II, Tata McGraw Hill.
7. Mechanical Measurements Beckwith Marangoni and Lienhard Pearson Education 6thEd.,
8. Instrumentation, Measurement and Analysis B C Nakra, K K Chaudhry McGraw–Hill 4th Edition
9. Engineering Metrology R.K. Jain Khanna Publishers 2009

Web links and Video Lectures (e-Resources):

1. V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: http://nptel.ac.in/courses/112104029/.
2. U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: http://nptel.ac.in/courses/112103249/.
3. A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Practical Based learning Visit any one machining center or machining industry and/or Case study on process parameter influence on anyone advanced machining process

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Applications of Energy Conversion & Thermodynamics**		
Course Code:	**25BMETH403**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:2:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Explain the air standard cycle and combustion in I. C. Engines.
- Describe the gas power cycle and vapour power cycles.
- Explain the performance of compressor.
- Explain the concepts of Refrigeration and Air conditioning.

MODULE – 1 **9 Hours**

Air standard cycles: Carnot cycle. Otto, Diesel, Dual and cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. (No derivation on Mean Effective Pressure) Comparison of Otto and Diesel cycles (Numericals only on Otto and diesel cycle).

I.C. Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation Performance analysis of I.C Engines, Heat balance, Morse test, Numericals.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **9 Hours**

Gas power Cycles: Gas turbine (Brayton) cycle; description and analysis. Regenerative, Intercooling and reheating in gas turbine cycles, Numericals.

Jet Propulsion cycles: Turbojet, Turboprop, Turbofan, Ram Jet, Rocket, Pulse Jet, Ram Rocket.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **9 Hours**

Vapour Power Cycles: Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-S diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance, Numericals.

Actual vapour power cycles: Actual vapour power cycles, regenerative vapour power cycle with open and closed feed water heaters. Reheat Rankine cycle, Numericals..

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **9 Hours**

Refrigeration Cycles: Vapour compression refrigeration system; description, analysis, refrigerating effect. Capacity, power required, units of refrigeration, COP, Refrigerants and their desirable properties, alternate Refrigerants. Vapour absorption refrigeration system. (Numericals on Vapour compression refrigeration only for CIE only)

Psychometrics and Air-conditioning Systems: Psychometric properties of Air (Only definitions), Psychometric Chart, Analysing Air-conditioning Processes; Heating, Cooling, Dehumidification and Humidification, Evaporative Cooling. Adiabatic mixing of two moist air streams, Numericals

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **9 Hours**

Reciprocating Compressors: Operation of a single stage reciprocating compressors. Work input through

p-v diagram and steady state steady flow analysis. Effect of Clearance and Volumetric efficiency. Adiabatic, Isothermal and Mechanical efficiencies. Multi-stage compressor, saving in work, Optimum intermediate pressure, Inter-cooling, Minimum work for compression. (simple Numericals) Steam nozzles: Flow of steam through nozzles, Shape of nozzles, effect of friction, Critical pressure ratio, Super saturated flow, design parameters of nozzle: Velocity of steam through a nozzle, mass flow rate through a nozzle, effect of back pressure ratio, effect o Mach number. Numericals

Teaching Learning Process: Chalk and Talk / PPT

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Analyse air standard cycle to evaluate the performance of I C engines.
CO2	Analyse the gas power cycles to evaluate the overall efficiency of gas turbine plant.
CO3	Apply thermodynamic concepts to analyse the performance of vapour power cycles.
CO4	Analyse the vapour compression and vapour absorption systems to improve refrigeration.
CO5	Determination of various parameters of air compressors and steam nozzles.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. Engineering Thermodynamics, P.K. Nag, Tata McGraw Hill, 6th Edition 2019
2. Thermodynamics, Yunus A, Cengel, Michael A Boles, Tata McGraw Hill 7th Edition
3. Applied thermodynamics by Omkar singh, New age pblishers,3rd edition.

Reference Books

1. Thermodynamics for engineers Kenneth A. Kroosand Merle C. Potter, Cengage Learning 2016
2. Principles of Engineering Thermodynamics, Michael J, Moran,Howard N. Shapiro, Wiley 9th Edition
3. I.C.Engines, M.L.Mathur&Sharma. Dhanpat Rai& sons-India

Data Book: Thermodynamics data hand book by Nijaguna and Samaga, Sapna Publication

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=AwbhbN20xl9&list=PLwdnzlV3ogoVJnW1S9GgOKYj5heOzl1dn
2. https://ciechanow.ski/internal-combustion-engine/
3. https://www.youtube.com/watch?v=1Vn1PDuPHsY&list=PL4K9r9dYCOoozyQU9kmQFJkTz

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Organise Industrial visits to Thermal power plants and submission of report.
2. Visit to a building under construction to explore the design consideration of duct to understand the concept of centralized Air Conditioning.

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Kinematics of Machines**		
Course Code:	**25BMETH404**	**CIE MARKS**	**50**
L : T : P + (SL)	**(3:2:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**4**	**EXAM HOURS**	**03**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the fundamentals of kinematic chains, mechanisms, and their inversions used in mechanical systems.
- Develop the ability to analyze the velocity and acceleration characteristics of planar mechanisms using graphical and analytical methods.
- Apply kinematic principles to synthesize and evaluate mechanisms for specified motion and function generation.
- Acquire knowledge of gear geometry, gear trains, and power transmission mechanisms for engineering applications.
- Develop the capability to analyse cam-follower systems for desired motion characteristics in mechanical devices.

MODULE – 1 **9 Hours**

Introduction: Definitions-Link, joint, types of links, types of joints, kinematic pairs, constrained motion, kinematic chain, mechanism, degrees of freedom of planar mechanisms. Equivalent mechanisms, Grashoff's criteria and types of four bar mechanisms, inversions of four bar mechanism, slider crank mechanism, double slider crank mechanism and its inversions.

Mechanisms: Quick return motion mechanism, drag link mechanism, Whitworth quick return motion mechanism and crank and slotted lever mechanism. Straight line motion mechanisms, Peaucellier mechanism and Robert's mechanism. Intermittent motion mechanisms-Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, pantograph, steering gear mechanism, condition for correct steering.

Teaching Learning Process: Chalk and Talk

MODULE – 2 **9 Hours**

Velocity and Acceleration Analysis of Mechanisms (Graphical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism, angular velocity and angular acceleration of links (using Relative Velocity and Acceleration method).

Velocity and Acceleration Analysis of Mechanisms: Definition, Kennedy's theorem, determination of linear and angular velocity using instantaneous center method. Determination of linear and angular velocity and acceleration using Klein's construction.

Teaching Learning Process: Chalk and Talk

MODULE – 3 **9 Hours**

Velocity and Acceleration Analysis of Mechanisms (Analytical Method): Velocity and acceleration analysis of four bar mechanism, slider crank mechanism using complex algebra method.

Freudenstein's equation for four bar mechanism and slider crank mechanism. Function generation for four bar mechanisms.

Teaching Learning Process: Chalk and Talk
MODULE – 4 **9 Hours**
Spur Gears: Gear terminology, law of gearing, path of contact, arc of contact, contact ratio of spur gear, interference in involute gears, methods of avoiding interference, condition and expressions for minimum number of teeth to avoid interference. **Gear Train:** Simple gear train, compound gear train and reverted gear train. Epicyclic gear train- Methods for finding velocity ratio of epicyclic gear train and torque calculation in epicyclic gear train. ***Teaching Learning Process: Chalk and Talk***
MODULE – 5 **9 Hours**
Cams: Classification of cams, types of followers, cam nomenclature, follower motions and motion analysis of Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), uniform velocity, cycloidal motion, cam profile with and without offset knife edge follower, roller follower and flat faced follower. ***Teaching Learning Process: Chalk and Talk***

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand planar mechanisms, their inversions, mobility, and motion characteristics for engineering applications.
CO2	Determine the velocity and acceleration of planar mechanisms using graphical methods and instantaneous center techniques.
CO3	Analyze the kinematic performance of mechanisms using analytical methods and synthesize four-bar mechanisms for function generation.
CO4	Evaluate the performance of spur gears and gear trains by determining velocity ratios, interference conditions, and torque transmission.
CO5	Analyze cam profiles for different follower motions to satisfy specified motion requirements.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Two tests each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**SEE is a theory exam conducted for 100 marks**

			and scaled down to 50 marks. Exam duration shall be for 3 hours.
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. Rattan S.S, Theory of Machines, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 4th Edition, 2014.
2. Ambekar A. G., Mechanism and Machine Theory, PHI, 2009.

Reference Books

1. Theory of Machines and Mechanism, by JosphEdwarShigley and J. J. Uicker.
2. Michael M Stanisic, Mechanisms and Machines-Kinematics, Dynamics and Synthesis, Cengage Learning, 2016.
3. Sadhu Singh, Theory of Machines, Pearson Education (Singapore)Pvt. Ltd, Indian Branch New Delhi, 2nd Edi. 2006.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/112104121/1
2. https://nptel.ac.in/courses/112104121/4
3. https://www.youtube.com/watch?v=lLHMoRemmMg
4. https://www.youtube.com/watch?v=3ogbAudtngs

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Students shall undertake a team-based mini project on the design, analysis, or simulation of mechanisms using appropriate engineering tools.

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B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**Machine Shop lab**		
Course Code:	**25BMELB405**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Understand the construction, working principles, operating procedures, and safety precautions of conventional machine tools such as lathe, shaper, milling, drilling, and grinding machines.
- Develop practical skills in performing basic and advanced machining operations including turning, taper turning, thread cutting, drilling, boring, shaping, milling, grinding, and gear cutting.
- Produce engineering components with the required dimensions, and surface finish by selecting appropriate machining processes.
- Analyze machining performance by studying chip formation, chip reduction coefficient, and the influence of cutting speed, feed, and depth of cut on machining outcomes.

Slno	Experiments
1.	Preparation of model on lathe involving-Step turning,Taper turning
2.	Preparation of model on lathe involving - Thread cutting(External & Internal).
3.	Preparation of model on lathe involving - Drilling, Boring
4.	Cutting of V Groove/ dovetail / Rectangular slots using a shaper.
5.	Cutting of Gear Teeth using Milling Machine.(Using simple indexing method)
6.	Preparation of model on lathe involving taper turning using attachment.
7.	Simple operations on Radial drilling machine
8.	Simple operations on Grinding machine.
Demonstration Experiments (For CIE)	
9.	Preparation of model on lathe involving Eccentric turning
10.	Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool With different depth of cut, speed, and feed rate

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Demonstrate the operation of machine tools such as lathe, shaper, milling, drilling, and grinding machine.
CO2	Demonstrate the operation of conventional machine tools such as lathe, shaper, milling, drilling, and grinding machines by following standard safety practices
CO3	Produce components using shaping and milling operations, including V-grooves, dovetails, rectangular grooves, and gear cutting with indexing methods.
CO4	Apply suitable machining processes to produce components with the required dimensions and finish.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing**	**Evaluation Details**

		Marks	
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

Text Books

1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press.
2. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press.
3. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India.

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Ability Enhancement Course for IV Semester	
25BMEAE406A	Advanced Python Programming
25BMEAE406B	IoT Lab
25BMEAE406C	Industry Supported Lab
25BMEAE406D	Introduction to Data Analytics

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**Advanced Python Programming**		
Course Code:	**25BMEAE406A**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- To understand the problem-solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures – lists, tuples, dictionaries.
- To do input/output with files in Python

Slno	Experiments
1.	Demonstrate following functions/methods which operates on strings in Python with suitable examples: i) len( ) ii) strip( ) iii) rstrip( ) iv) lstrip( ) v) find( ) vi) rfind( ) vii) index( ) viii) rindex(),ix) count( ) x) replace( ) xi) split( ) xii) join( ) xiii) upper( ) xiv) lower( ) xv) swapcase() xvi) title( ) xvii) capitalize( ) xviii) startswith( ) xix) endswith( )
2.	Implementing programs using Functions. (Factorial, largest number in a list, area of shape).
3.	NESTED LISTS: Write a program to read a 3 X 3 matrix and find the transpose, addition, subtraction, multiplication of two 3 X 3 matrices, check whether two given 3 X 3 matrices are identical or not.
4.	Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters). Real time applications using sets and Dictionaries
5.	Scientific problems using Conditionals and Iterative loops. (Number series and different Patterns).
6.	Numpy Library: Linear Algebra a. Write a python program to find rank, determinant, and trace of an array. b. Write a python program to find eigen values of matrices Write a python program to solve a linear matrix equation, or system of linear scalar equations.
7.	Graphics: a. Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object oriented approach. b. Design a Python program using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.
8.	Create a colour images using NumPy in Python.
	Demonstration Experiments (For CIE)
9.	Write a python program to implement Pandas Series with labels.
10.	Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word).
11.	Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation).
12.	Developing a game activity using Pygame like bouncing ball, car race etc.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Develop algorithmic solutions to simple computational problems.
CO2	Develop and execute simple Python programs.
CO3	Use functions to decompose a Python program.
CO4	Process compound data using Python data structures.
CO5	Utilize Python packages in developing software applications.

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Books

1. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
2. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data'', Third Edition, MIT Press, 2021
3. Paul Deitel and Harvey Deitel, "Python for Programmers", Pearson Education, 1st Edition, 2021. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
4. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2018.Nem Chand Bros, Roorkee.

Web links and Video Lectures (e-Resources):

1. Intro to Python Livestream - Python Basics with Sam (youtube.com)
2. https://www.youtube.com/watch?v=1DGe0oVsHeA&list=PLiEts138s9P0aG6soKBoMsmJrwIOPXoXR

3. https://www.youtube.com/watch?v=cVSb6-yaYMc&list=PLiEts138s9P0w-WX4Rmml-_zhnBkXLWtc
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning 1. Adopt collaborative (Group Learning) learning in the class

ESTD : 2001
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B.E. (Mechanical Engineering)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title:	**IoT Lab**		
Course Code:	**25BMEAE406B**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Understand the design, characteristics and technologies of Internet of Things
- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network.
- Appraise the role of IoT protocols for efficient network communication
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry

Slno	Experiments
1.	Interfacing Light Emitting Diode(LED)- Blinking LED and Controlling the Light Emitting Diode (LED) with a push button
2.	Controlling the LED blink rate with the potentiometer interfacing with Arduino.
3.	Interfacing Light Dependent Resistor (LDR) and LED, displaying automatic night lamp
4.	Interfacing Temperature Sensor (LM35) and/or humidity sensor (e.g.DHT11).
5.	Interfacing Liquid Crystal Display (LCD) – display data generated by sensor on LCD.
6.	Interfacing Air Quality Sensor-pollution (e.g. MQ135) – display data on LCD switch on LED when data sensed is higher than specified value.
7.	Interfacing Relay module to demonstrate Bluetooth based home automation application. (using Bluetooth and relay).
8.	Interfacing Bluetooth module (e.g. HC05)- receiving data from mobile phone on Arduino and display on LCD
9.	Potentiometer and IR Sensor Interfacing With Arduino
10.	Controlling Two Actuators Using Arduino
11.	Iot Based Air Pollution Control System
12.	TDs Sensor Interfacing With Arduino
13.	Actuator Controlling by Mobile Using Arduino
14.	Detection of the light using photo resistor
15.	Interfacing of the Active Buzzer with Arduino
16.	Interfacing Servo Motor with the Arduino
17.	Interfacing of the Relay with Arduino
18.	Building Intrusion Detection System with Arduino and Ultrasonic sensor
19.	Directional Control of the DC motor using Arduino

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Choose the sensors and actuators for an IoT application
CO2	Select protocols for a specific IoT application
CO3	Utilize the cloud platform and APIs for IoT application

CO4	Experiment with embedded boards for creating IoT prototypes
CO5	Design a solution for a given IoT application

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

Text book

1. Internet of Things (IoT) — *Surya Durbha & Jyoti Joglekar*
2. Programming the Internet of Things: An Introduction to Building Integrated, Device-to- Cloud IoT Solutions — Andy King (O'Reilly)
3. Enabling the Internet of Things: Fundamentals, Design and Applications — Muhammad Azhar Iqbal et al.
4. 4. Internet of Things from Scratch — Renaldi Gondosubroto

Web links and video lectures (e-resources):

1. MOOC Practical IoT with Raspberry Pi – a full YouTube playlist on hands-on IoT using Raspberry Pi: https://www.youtube.com/playlist?list=PL8bSwVy8_IcO1kFUjq-9rU12u2JYU0u3H
2. IoT / Arduino / Raspberry Pi Projects – IoT project playlist with sensor and cloud demos: https://www.youtube.com/playlist?list=PLClI9hVc2IAZZ8ncN8E0HtnvFwgbOiolP
3. IoT Lab – Raspberry Pi & NodeMCU Experiments – a practical lab demo video: https://www.youtube.com/watch?v=UhH0NbPTY-M

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**Industry Supported Lab**		
Course Code:	**25BMEAE406C**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- Understand the construction and working principles of the Toyota 2GD diesel engine.
- Develop practical skills in engine assembly and disassembly.
- Perform inspection and fault diagnosis of engine components.
- Assemble the engine according to manufacturer specifications.
- Follow workshop safety, maintenance, and quality control procedures.

Slno	Experiments
1.	Identification of Toyota 2GD Diesel Engine Components
2.	External Engine Disassembly
3.	Cylinder Head Disassembly and Inspection
4.	Timing System Disassembly
5.	Crankshaft, Pistons, and Connecting Rod Disassembly
6.	Measurement and Inspection of Engine Components
7.	Engine Component Wear and Failure Analysis
8.	Complete Engine Assembly
9.	Torque Tightening and Engine Timing Adjustment
10.	Final Engine Inspection and Functional Verification

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Identify all major components of the Toyota 2GD diesel engine and explain their functions.
CO2	Safely disassemble and reassemble the engine using the correct sequence and tools.
CO3	Measure engine components and compare values with manufacturer specifications
CO4	Diagnose wear, defects and common engine failures

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for 100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**

SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1. Toyota Motor Corporation. Toyota 2GD-FTV / 1GD-FTV Engine Repair Manual.
2. Toyota Motor Corporation. Toyota Hilux Workshop Manual.
3. V. Ganesan. Internal Combustion Engines. McGraw Hill Education.
4. John B. Heywood. Internal Combustion Engine Fundamentals. McGraw-Hill.
5. Kirpal Singh. Automobile Engineering, Volumes I & II. Standard Publishers.

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV

Course Title:	**Introduction to Data Analytics**		
Course Code:	**25BMEAE406D**	**CIE MARKS**	**50**
L : T : P + (SL)	**0:0:2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**

COURSE LEARNING OBJECTIVES: *The purpose of the course is to facilitate the learner to:*

- To understand Numpy, Pandas and Matplot library
- To understand basics of statistics
- To learn the basic of decision tree algorithm.
- To understand random forest algorithm and Anova
- To use Python data structures.
- To use excel in data analytics

Slno	Experiments
1.	Use Numpy to create single and multi-dimensional array and perform various operations using Python.
2.	Use Pandas to access dataset, cleaning, manipulate data and analyze using Python
3.	Use matplot library to plot graph for data visualization using Python
4.	Determine probability, sampling and sampling distribution using Python
5.	Determine frequency distributions, variability, average, and standard deviation using Python
6.	Draw normal curves, correlation, correlation coefficient and scatter plots using Python
7.	Implement and analyze Linear regression in Python (Single variable & Multivariable)
8.	Implement and analyze Logistic regression in Python
9.	Implement and analyze Decision tree algorithm in Python
10.	Implement and analyze Random Forest algorithm in Python
	Demonstration Experiments (For CIE)
11.	Implementation of two samples T-test and paired two-sample T-test in excel.
12.	Implementation of one-way and two-way ANOVA in excel.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Analyze data using tools and represent for visualization
CO2	Implement various statistical methods.
CO3	Understand and use decision tree and random forest algorithm
CO4	Understand and Implement T test and Anova

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE Practical (A)	30	-	Marks awarded for Weekly Conduction of Experiments and Submission of Laboratory records, scaled to 30 marks.
CIE Practical Test (B)	20	-	Average of marks of Two tests, each conducted for

			100 marks covering all experiments, scaled to 20.
Total CIE Practical (A+B)	**50**	**20**	**Sum of Marks of Experiments, Record and Test shall be CIE marks awarded for a maximum of 50.**
SEE (C)	**50**	**20**	**SEE is a lab exam, conducted for 100 marks and scaled down to 50 marks. Exam duration shall be for 3 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**
• The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.			

Suggested Learning Resources:

1. McKinney, W. (2012). Python for data analysis: Data wrangling with Pandas, NumPy, and IPython. " O'Reilly Media, Inc.".
2. Swaroop, C. H. (2003). A Byte of Python. Python Tutorial.
3. Ken Black, sixth Editing. Business Statistics for Contemporary Decision Making. "John Wiley & Sons, Inc"
4. https://www.simplilearn.com/tutorials/data-analytics-tutorial/data-analytics-with-python
5. https://www.youtube.com/watch?v=GPVsHOlRBBI&ab_channel=freeCodeCamp.org

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Biology for Engineers**		
Course Code:	**25BFETH407**	**CIE MARKS**	**50**
L : T : P + (SL)	**(2:0:0)+(45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**2**	**EXAM HOURS**	**02**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Familiarize the students with the basic biological concepts and their engineering applications.
- Enable the students with an understanding of bio-design principles to create novel devices and structures.
- Provide the students with an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- Motivate the students to develop interdisciplinary vision of biological engineering.

MODULE – 1	**6 Hours**
Introduction to fundamentals of life: Structure and functions of a cell. Biomolecules: Properties and functions of Carbohydrates, Nucleic acids, Proteins, Enzymes and Lipids.	
MODULE – 2	**6 Hours**
Introduction to applications of biomolecules: Carbohydrates in cellulose-based water filters production, PHA and PLA in bioplastics, Nucleic acids in vaccines and diagnosis, Proteins in food production, Enzymes in biosensors fabrication, Genome & protein data types.	
MODULE – 3	**6 Hours**
Introduction to adaptations of anatomical principles for bioengineering design - Brain as a CPU system. Eye as a Camera system. Heart as a pump system. Lungs as purification system. Kidney as a filtration system.	
MODULE – 4	**6 Hours**
Introduction to nature inspired biomaterials and mechanisms - Echolocation, Photosynthesis, Bird flying, Lotus leaf effect, Shark skin, Kingfisher beak. Artificial blood - haemoglobin-based oxygen carriers (HBOCs).	
MODULE – 5	**6 Hours**
Introduction to trends in bioengineering, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bio-concrete.	

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Corroborate the concepts of biomimetics for specific requirements.
CO2	Understand the basic biological concepts for relevant industrial applications & adaptations.
CO3	Evaluate the principles of design and development for exploring engineering knowledge in biological stream.
CO4	Explore innovative biobased solutions for socially relevant problems

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Continuous and Comprehensive Evaluation (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 20 marks.
Total CIE (A+B)	**50**	**20**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**50**	**18**	**Question papers having 50 MCQs with each question carrying 01 mark, and Exam duration shall be for 2 hours.**
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

- The minimum marks to be secured in CIE is 20 (40%) out of allotted 50 marks to appear for SEE.

Suggested Learning Resources:

Text Books

1. Basuchandra's Biology for Engineers, Chandra shekara. B.M, Basavaraju B.C, 2025.
2. Biology for Engineers, Rajendra Singh C and Rathnakar Rao N, Rajendra Singh C and Rathnakar Rao N Publishing, Bengaluru, 2023.

Reference Books

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edit ion, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W.
3. Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
4. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
5. Biomedical Instrumentation, Leslie Cromwell, Prent ice Hall 2011.
6. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
7. Biomimet ics: Nature-Based Innovat ion, Yoseph Bar-Cohen, 1st edit ion, 2012, CRC Press.
8. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
9. Bioremediat ion of heavy metals: bacterial part icipation, by C R Sunil kumar, N Geetha, A C Udaya shankar, Lambert Academic Publishing, 2019.

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**National Service Scheme (NSS)**		
Course Code:	**25BNSSP409**	**CIE MARKS**	**100**
L : T : P + (SL)	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Identify the needs and problems of the community and involve the problem–solving.
- Develop among them a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
- Develop competence required for group-living and sharing of responsibilities & gain skills in mobilising community participation to acquire leadership qualities and democratic attitudes.

MODULE – 1
Environment Issues and Role of NSS
MODULE – 2
Disaster Management and Role of NSS
MODULE – 3
Activities -1 (Choose from Activity list).
MODULE – 4
Activities -2 (Choose from Activity list)
MODULE – 4
Activities -3 (Choose from Activity list)

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the motto and concepts of NSS
CO2	Develop overall personality of volunteers and make them as leaders and responsible citizens of our nation
CO3	Analyze the environmental and societal problems/issues and will be able to design solutions for the same.
CO4	Communicate effectively with the community and with the officials.

ACTIVITY LIST	
Helping local schools achieve good results and enhance their enrolment in Higher/technical/Vocational Education.	Preparing an actionable business proposal for enhancing the village income.
Reduction in energy consumption	Preparing an actionable business proposal for enhancing the village's income
Creating awareness about rainwater harvesting in urban and rural areas.	Developing Sustainable Water Management system

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
Evaluation based on Reports (A)	100	-	5 modules Reports, 5 modules X 10 M each = 50 M
Total CIE Theory (A)	**100**	**40**	
SEE (B)	**-**	**-**	**-**
CIE+SEE (A+B)	**100**	**40**	**Final marks shall be the sum of marks scored in Components A, B**

- The minimum marks to be secured in CIE is 40 out of allotted 50 marks with minimum 40 % scored in every component of CIE.
- No SEE for this subject

Suggested Learning Resources:

Reference Books

1. NSS Course Manual, Published by NSS Cell, VTU Belagavi.
2. Government of Karnataka, NSS cell, activities reports and its manual.
3. Government of India, NSS cell, Activities reports and its manual

Weblinks

1. https://nss.gov.in/
2. https://pledge.mygov.in/

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Physical Education (PE) (Sports and Athletics)**		
Course Code:	**25BPEDU409**	**CIE MARKS**	**100**
L : T : P + (SL)	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness
- Familiarization of health-related Exercises, Sports for overall growth and development
- Participate in the competition at regional/state / national / international levels.
- Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

MODULE – 1

Athletics

A. Track - Sprints
B. Throws - Shotput
C. Jumps - Long jump

A. Track Events

i) Starting Techniques: Standing start and Crouch start (its variations) use of Starting Block.
ii) Acceleration with proper running techniques.
iii) Finishing technique: Run Through, Forward Lunging and Shoulder Shrug, Torso Finish.

B. Long Jump: Approach Run, Take-off, Flight in the air (Hang Style/Hitch Kick) and Landing

C. Shot put: Holding the Shot, Placement, Initial Stance, Glide, Delivery Stance and Recovery (Perry O'Brien Technique)

MODULE – 2

Volleyball

A. Fundamental skills

1. Service: Underarm Service, Side arm Service, Tennis Service, Floating Service
2. Pass: Under arm Pass, Overhead Pass
3. Spiking & Blocking
4. Game Practice with application of Rules & Regulations

B. Rules and their interpretation and duties of the officials

MODULE – 3

Throwball

A. Fundamental skills: Overhand service, Side arm service, two hand catching, one hand overhead return, side arm return

B. Rules and their interpretation and duties of the officials

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the fundamental concepts of Physical Education, games and sports skills, Health, Nutrition and Fitness

CO2	Familiarization of health-related Exercises, Sports for overall growth and development
CO3	Participate in the competition at regional/state/national/international levels.
CO4	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Quiz for a maximum of 40 marks
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. Saha, A. K. Sarir Siksher Ritiniti, Rana Publishing House, Kalyani.
2. Bandopadhyay, K. Sarir Siksha Parichay, Classic Publishers, Kolkata.

Reference Books

1. Saraswati Health and Physical Education Textbook
2. V.K. Sharma's Health and Physical Education
3. Oswaal Books: Educart Chapterwise Question Bank: Offers detailed coverage of concepts and questions by chapter

ESTD : 2001
An Institute with a Difference

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Yoga**		
Course Code:	**25BYOGA409**	**CIE MARKS**	**100**
L : T : P + (SL)	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Physical, Mental & spiritual Objectives of Yoga
- Explain the meaning of Yoga.
- Discuss the importance of the Yoga and its scope.
- Describe the aims and objectives of Yoga.
- Clarify the misconceptions on Yoga

MODULE – 1

Patanjali Ashtanga Yoga

A. Yama: Ahimsa, satya, asteya, brahmacarya, aparigraha

B. Niyama: shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan

C. Suryanamaskara: 12 Counts, 4 Rounds

MODULE – 2

Asana

a) Meaning, Need & Importance of Asana b) Different Types of Asanas:

i. Sitting - 1. Sukhasana, 2. Paschimottanasana

ii. Standing - 1. ArdhakatiChakrasana 2. Parshva Chakrasana

iii. Prone line - Dhanurasana

iv. Supine line- Halasana

c) Asana Technique

d) Precautionary measures and benefits of each Asana

MODULE – 3

Pranayama

A. Meaning, Need & importance of Pranayama.

Different types of pranayama, technique, precautionary measures and benefits of each Pranayama.

1. Suryanuloma -Viloma
2. Chandranu loma-Viloma

B. Kapalabhati: Meaning, importance and benefits of Kapalabhati.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Understand the fundamental concepts of Yoga
CO2	Improves of health and related aspects, overall growth and development
CO3	Participate in the competition at regional/state/national/international levels.
CO4	Create consciousness among the students on Health, Fitness and Wellness in developing and maintaining a healthy lifestyle.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**
CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Quiz for a maximum of 40 marks
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. The Yoga Sutras of Patanjali – Sri Swami Satchidananda.
2. Light on Yoga — B.K.S Iyengar.

Reference Books

1. The Heart of Yoga — T.K.V Desikachar.
2. "Asana Pranayama Mudra Bandha" bySwami Satyananda Saraswati

ESTD : 2001
An Institute with a Difference

B.E. (Common to All the Branches) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Music**		
Course Code:	**25BMUSK409**	**CIE MARKS**	**100**
L : T : P + (SL)	**(0:0:0)+(30 Hours/Sem)**	**SEE MARKS**	**--**
Credits:	**PP**	**EXAM HOURS**	**--**

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Understand the significance of music in daily life and gain an overview of Indian folk, contemporary, and Western music traditions.
- Acquire basic knowledge of introductory Carnatic music exercises and compositions.
- Compare the fundamental features of Carnatic and Hindustani music.
- Recognize the classification of wind instruments and appreciate the contributions of eminent composers to Indian classical music.

MODULE – 1
Importance of music in daily life ,Indian folk, and contemporary music. Introduction to Western music.
MODULE – 2
Compositions: Introduction to the few types of composition in Carnatic Music- Nottu Swara, Sarale and janti varase, Alakara.
MODULE – 3
Comparative Study of Carnatic and Hindustani Music based on Geographical origin and development , Musical structure and style ,Raga and Tala systems.
MODULE – 4
Music Instruments: Classification and construction of wind instrurnents in both Car-natic and Hindustani Music.
MODULE – 5
Composers: Biography and contributions of of the following eminent personalities Mut-tuswami Dikshitaru , Shyama Shastri, Mysore Vasudevacharya, Pt. Bheemasen Joshi

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Explain the origin, evolution and fundamental concepts of Indian classical music.
CO2	DCompare and distinguish the characteristics of selected Carnatic and Hindustani music compositions.
CO3	Classify the major categories of Indian musical instruments and describe their construction and applications in Carnatic and Hindustani music.
CO4	Examine the contributions of eminent Composers/Musicians and appreciate their role in preserving and promoting Indian classical music.

Assessment Details (Both CIE and SEE)			
Assessment Type	**Maximum Marks**	**Minimum Passing Marks**	**Evaluation Details**

CIE – IA Tests (A)	60	--	Sum of Two Internal Assessment Tests (MCQs) each conducted for 30 marks.
Quiz(B)	40	--	Submission of report on a topic related to music.
Total CIE (A+B)	100	40	CIE Evaluation is done for a maximum of 100 marks
• The minimum marks to be secured in CIE is 40 (40%) out of 100 marks allotted to Pass • No SEE for this subject			

Suggested Learning Resources:

Text Books

1. T Sachidevi and T Sharadha (Thirumalai Sisters), Karnataka Sangeetha Dharpana-Vol. 1 (English), Shreenivaas Prakaashana, 2018.
2. B. Chaitanya Deva, An Introduction to Indian Music, Publications Division, Government of India, New Delhi.

Reference Books

1. Lakshminarayana Subramaniam, Viji Subramanaim, Classical Music of India: A Practical Guige, Tranqueber 2018.
2. Vamanrao H. Deshpande, Indian Musical Traditions: An Aesthetic Study of the Gharanas in Hindustani Music, Popular Prakashan, Mumbai.

ESTD : 2001
An Institute with a Difference

Course Title:	Additional Mathematics – II		
Course Code:	25BMADP410	CIE MARKS	100
L : T : P + (SL)	1:0:0 + (14 Hours/Sem)	SEE MARKS	00
Credits:	PP	EXAM HOURS	00

COURSE LEARNING OBJECTIVES:

The purpose of the course is to facilitate the learner to:

- Apply the essential concepts of linear algebra to solve systems of linear equations and analyze mathematical models.
- Solve second- and higher-order ordinary differential equations using appropriate analytical methods in engineering contexts.
- Develop the knowledge and problem-solving skills required to evaluate multiple integrals, apply change of order of integration.
- Apply numerical methods to obtain approximate solutions to mathematical problems arising in science and engineering.

MODULE – 1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and Eigen vectors of a square matrix. Problems.

MODULE – 2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule (without proof) Problems.

MODULE – 3

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators. *[Particular Integral restricted to* $R(x) = eax$ *,* $sin\ ax$ */*$cos\ ax$ *for* $f\ (D)y\ =\ R(x)$*.]*

MODULE – 4

Double integrals: Definition, evaluation of rectangular and general regions, Change of order of integration

MODULE – 5

Triple integrals: Definition and evaluation over simple regions, Applications of triple integrals to the evaluation of volumes.

COURSE OUTCOMES:

After successfully completing the course, the student will be able to:

CO1	Solve systems of linear equations using matrix algebra
CO2	Apply the knowledge of numerical methods in modelling and solving engineering problems
CO3	Apply analytical methods to solve higher order differential equations
CO4	Solve double integrals, including change of order of integration
CO5	Solve triple integrals, volumes of geometrical regions

Assessment Details (Both CIE and SEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details

CIE – IA Tests (A)	60	-	Two tests of each of 50 marks shall be conducted. Average of Two Internal Assessment Tests shall be scaled down to 60 marks.
Continuous and Comprehensive Evaluation (B)	40	-	Any two Assessment methods of each of 20 marks as per 24RNBE4.2 (*if it is project based, one assignment shall be given), scaled to 40 marks.
Total CIE (A+B)	**100**	**40**	**CIE Evaluation is done for a maximum of 50 marks**
SEE (C)	**-**	**-**	No SEE for this subject
CIE + SEE (A+B+C)	**100**	**40**	Final marks shall be the sum of marks scored in Components **A, B and C.**

Suggested Learning Resources:

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N. P .Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	1st Edition, 2015

Additional Mathematics I and II:

1. These courses are prescribed for III and IV semesters respectively to lateral entry Diploma holders admitted to III semester of B.E./B.Tech., programs. They shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the Continuous Internal Evaluation (CIE). In case any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the course requirements during subsequent semesters to earn the qualifying CIE marks. These courses are slated for CIE only and have no SEE.
2. Additional Mathematics I and II shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses shall be mandatory for the award of degree.
3. Successful completion of the courses Additional Mathematics I and II shall be indicated as satisfactory in the grade card. Non-completion of the courses Additional Mathematics I and II shall be indicated as Unsatisfactory.



VISION

Building RNSIT into a World Class Institution.

MISSION

To impart high quality education in Engineering, Technology and Management with a difference, enabling students to excel in their career by

- Attracting quality students and preparing them with a strong foundation in fundamentals so as to achieve distinctions in various walks of life leading to outstanding contributions.
- Imparting value based, need based, choice based and skill based professional education to the aspiring youth and carving them into disciplined, World class professionals with social responsibility.
- Promoting excellence in Teaching, Research and Consultancy that galvanizes academic consciousness among Faculty and Students.
- Exposing Students to emerging frontiers of knowledge in various domains and make them suitable for Industry, Entrepreneurship, Higher studies, and Research & Development.
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