RNS TRUST ®

RNS INSTITUTE OF TECHNOLOGY

Autonomous Institution affiliated to Visvesvaraya Technological University, Belagavi
Approved By AICTE, New Delhi. Accredited by NAAC 'A+' Grade
Channasandra, Dr. Vishnuvardhan Road, Bengaluru - 560 098
Ph:(080)28611880,28611881 URL: www.rnsit.ac.in

ESTD.: 2001
An Institute with a Difference

Dr. R N Shetty
Founder

DEPARTMENT OF MECHANICAL ENGINEERING

BACHELOR OF ENGINEERING

Scheme and Syllabus of III & IV Semesters

2024 SCHEME

INSTITUTION'S INNOVATION COUNCIL (Ministry of HRD Initiative)

www.rnsit.ac.in

Scheme and Syllabus
Batch 2024 - 2028

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

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.

<table>
<tr><th colspan="14">3rd Semester (Mechanical Engineering)</th></tr>
<tr><th rowspan="2">SL NO</th><th rowspan="2">COURSE</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th rowspan="2">TD/ PSB</th><th colspan="3">TEACHING HOURS PER WEEK</th><th rowspan="2">Term work (TW) + Self learning (SL) per semester</th><th colspan="4">EXAMINATION</th><th rowspan="2">CREDITS</th></tr>
<tr><th>THEORY LECTURE (L)</th><th>TUTORIAL (T)</th><th>PRACTICAL (P)</th><th>DURATION IN HOURS</th><th>CIE MARKS</th><th>SEE MARKS</th><th>TOTAL MARKS</th></tr>
<tr><td>1</td><td>PCC</td><td>BME301</td><td>PRICIPLES OF ENERGY & THERMODYNAMICS</td><td>ME</td><td>3</td><td>2</td><td>0</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td>2</td><td>IPCC</td><td>BME302</td><td>MAMUFACURING TECHNOLOGY</td><td>ME</td><td>3</td><td>0</td><td>2</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>3</td><td>IPCC</td><td>BME303</td><td>MECHANICS OF MATERILS</td><td>ME</td><td>3</td><td>0</td><td>2</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>4</td><td>PCC</td><td>BME304</td><td>FUNDAMENTALS OF MATERIAL ENGINEERING</td><td>ME</td><td>3</td><td>0</td><td>0</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td>5</td><td>PCCL</td><td>BMEL305</td><td>DIGITAL DESIGN AND MACHINE DRAWING</td><td>ME</td><td>0</td><td>0</td><td>2</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td><td>1</td></tr>
<tr><td>6</td><td>ESC</td><td>BME306x</td><td>ESC/ETC/PLC (BUCKET LIST – A PROVIDED)</td><td>Respective Dept.</td><td>3</td><td>0</td><td>0</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td>7</td><td>UHV</td><td>BSCK307</td><td>SOCIAL CONNECT AND RESPONSIBILITY</td><td>Any Department</td><td>0</td><td>0</td><td>2</td><td>0</td><td>2</td><td>100</td><td>0</td><td>100</td><td>1</td></tr>
<tr><td rowspan="4">8</td><td rowspan="4">AEC/ SEC</td><td rowspan="4">BME358x</td><td rowspan="4">BUCKET LIST – B PROVIDED</td><td rowspan="4">Concerned department</td><td colspan="4">IF COURSE IS THEORY</td><td rowspan="2">2</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="4">100</td><td rowspan="4">1</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>15</td></tr>
<tr><td colspan="4">IF COURSE IS PRACTICAL</td><td rowspan="2">3</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">MC</td><td>BNSK359</td><td>NATIONAL SERVICE SCHEME (NSS)</td><td>NSS coordinator</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">2</td><td rowspan="3">0</td><td rowspan="3"></td><td rowspan="3">100</td><td rowspan="3">0</td><td rowspan="3">100</td><td rowspan="3">0</td></tr>
<tr><td>BPEK359</td><td>PHYSICAL EDUCATION (PE) (SPORTS AND ATHLETICS)</td><td>Physical Education Director</td></tr>
<tr><td>BYOK359</td><td>YOGA</td><td>Yoga Teacher</td></tr>
<tr><td></td><td colspan="9">TOTAL</td><td>550</td><td>350</td><td>900</td><td>20</td></tr>
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EMERGING SCIENCE COURSES / EMERGING TECHNOLOGY COURSES BUCKET LIST - A	
BME306A	ELECTRIC AND HYBRID VEHICLE TECHNOLOGY
BME306B	INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP
BME306C	IOT FOR MECHANICAL ENGINEERING
BME306D	SURFACE TREATMENT AND FINISHING

ABILITY ENHANCEMENT COURSES / SKILL DEVELOPMENT COURSES BUCKET LIST - B	
BFLC358A	FOREIGN LANGUAGE COURSE– 1-GERMAN
BFLC358B	FOREIGN LANGUAGE COURSE– 1-SPANISH
BMEL358C	SPREADSHEET FOR ENGINEERS
BMEL358D	SHEET METAL AND SURFACE MODELLING
BMEL358E	EXPERIENTIAL LEARNING AND MAKERS LAB

<table>
<tr><th colspan="14">4th Semester (Mechanical Engineering)</th></tr>
<tr><th rowspan="2">SL NO</th><th rowspan="2">COURSE</th><th rowspan="2">COURSE CODE</th><th rowspan="2">COURSE TITLE</th><th rowspan="2">TD/ PSB</th><th colspan="3">TEACHING HOURS PER WEEK</th><th rowspan="2">Term work(TW)+ Self learning (SL) per semester</th><th colspan="4">EXAMINATION</th><th rowspan="2">CREDITS</th></tr>
<tr><th>THEORY LECTURE (L)</th><th>TUTORIAL (T)</th><th>PRACTICAL (P)</th><th>DURATION IN HOURS</th><th>CIE MARKS</th><th>SEE MARKS</th><th>TOTAL MARKS</th></tr>
<tr><td>1</td><td>PCC</td><td>BME401</td><td>APPLICATIONS OF ENERGY CONVERSION & THERMODYNAMICS</td><td>ME</td><td>3</td><td>2</td><td>0</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>2</td><td>IPCC</td><td>BME402</td><td>MACHINING SCIENCE & PRECISION ENGINEERING</td><td>ME</td><td>3</td><td>0</td><td>2</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>3</td><td>IPCC</td><td>BME403</td><td>THEORY OF MACHINES</td><td>ME</td><td>3</td><td>0</td><td>2</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>4</td></tr>
<tr><td>4</td><td>PCCL</td><td>BMEL404</td><td>INDUSTRY SUPPORTED AND MACHINING LAB</td><td>ME</td><td>0</td><td>0</td><td>2</td><td>0</td><td>3</td><td>50</td><td>50</td><td>100</td><td>1</td></tr>
<tr><td>5</td><td>ESC</td><td>BME405x</td><td>ESC/ETC/PLC (BUCKET LIST – C PROVIDED)</td><td>: Respective Dept.</td><td>3</td><td>0</td><td>0</td><td>45</td><td>3</td><td>50</td><td>50</td><td>100</td><td>3</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">AEC/ SEC</td><td rowspan="4">BME456x</td><td rowspan="4">BUCKET LIST – D PROVIDED</td><td rowspan="4">: Concerned department</td><td colspan="4">IF COURSE IS THEORY</td><td rowspan="2">2</td><td rowspan="4">50</td><td rowspan="4">50</td><td rowspan="4">100</td><td rowspan="4">1</td></tr>
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<tr><td colspan="4">IF COURSE IS PRACTICAL</td><td rowspan="2">3</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>0</td></tr>
<tr><td>7</td><td>BSC</td><td>BENS407/ BBOE407</td><td>ENVIRONMENTAL STUDIES/BIOLOGY FOR ENGINEERS</td><td>ME</td><td>2</td><td>0</td><td>0</td><td>30</td><td>2</td><td>50</td><td>50</td><td>100</td><td>2</td></tr>
<tr><td>8</td><td>UHV</td><td>BUHV408</td><td>UNIVERSAL HUMAN VALUES</td><td>Any Department</td><td>1</td><td>0</td><td>0</td><td>15</td><td>2</td><td>50</td><td>50</td><td>100</td><td>1</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">MC</td><td>BNSK459</td><td>NATIONAL SERVICE SCHEME(NSS)</td><td>NSS coordinator</td><td rowspan="3">0</td><td rowspan="3">0</td><td rowspan="3">2</td><td rowspan="3">0</td><td rowspan="3"></td><td rowspan="3">100</td><td rowspan="3">0</td><td rowspan="3">100</td><td rowspan="3">0</td></tr>
<tr><td>BPEK459</td><td>PHYSICAL EDUCATION(PE) (SPORTS AND ATHLETICS)</td><td>Physical Education Director</td></tr>
<tr><td>BYOK459</td><td>YOGA</td><td>Yoga Teacher</td></tr>
<tr><td></td><td colspan="9">TOTAL</td><td>500</td><td>400</td><td>900</td><td>20</td></tr>
</table>

NOTE: (i) 1st semester Chemistry cycle sections will study "ENVIRONMENTAL STUDIES" in 4th semester & "BIOLOGY FOR ENGINEERS" in 5th semester

(ii) 1st semester Physics cycle sections will study "BIOLOGY FOR ENGINEERS" in 4th semester & "ENVIRONMENTAL STUDIES" in 5th semester

EMERGING SCIENCE COURSES / EMERGING TECHNOLOGY COURSES BUCKET LIST - C	
BME405A	**DRONE TECHNOLOGY**
BME405B	**SUPPLY CHAIN MANAGEMENT**
BME405C	**MECHATRONICS**
BME405D	**AUTOMATION AND ROBOTICS**

ABILITY ENHANCEMENT COURSES / SKILL DEVELOPMENT COURSES BUCKET LIST - D	
BFAT456A	**FINANCE AND ACCOUNTING**
BMEL456B	**ADVANCED PYTHON PROGRAMMING**
BMET456C	**SUSTAINABILITY FOR MECHANICAL ENGINEERS**
BMEL456D	**INTRODUCTION TO DATA ANALYTICS**

CORE COURSES
III SEMESTER

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

Course Title:	**PRICIPLES OF ENERGY & THERMODYNAMICS**		
Course Code:	**BME301**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 2 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**03**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory**	**Total Marks**	**100**

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

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. Numericals. ***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 Numericals. ***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.

2, 3 and 4-Credit Theory Courses			
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. • **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**			

Suggested Learning Resources:

Books

1) Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill 2nd Ed., 2002.
2) Basic Thermodynamics, B.K. Venkanna, Swati B. Wadavadagi PHI, New Delhi 2010.
   Thermodynamics- An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications 2002
3) Thermal Engineering, R K Rajput, Lakshmi Publications.
4) Thermodynamics for engineers Kenneth A. Kroos and Merle C. Potter, Cengage Learning 2016.
5) Principles of Engineering Thermodynamics, Michael J, Moran, Howard N. Shapiro, Wiley 9th Edition.

Data Book:

1) 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=PLwdnzlV3ogoVJnW1S9GgOKYj5 heOzl1dn
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:	**MANUFACURING TECHNOLOGY [IPCC]**		
Course Code:	**BME302**	**CIE MARKS**	**50**
L : T : P + (SL)	**3:0:2 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**04**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory+ 10 to 12 Lab slots**	**Total Marks**	**100**

COURSE LEARNING OBJECTIVES:

- 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. Method of making cores, 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, centrifugal casting, squeeze casting, slush casting, thixo casting, and continuous casting processes. Casting defects, their causes and remedies. Solidification. Numericals on 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, Numericals 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. Hermit 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:** Soldering, Brazing and adhesive bonding Advance welding processes: Resistance welding processes, friction stir welding (FSW). **Teaching Learning Process: Chalk and Talk / PPT / Field Visits*/videos***	

PRACTICAL COMPONENT OF IPCC

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	Use of Arc welding tools and welding equipment Preparation of welded joints using Arc Welding equipment L Joint, T-Joint, Butt joint, V-Joint, Lap joints on M.S. flats
6	To study the effect of heat affected zone on the microstructure of steel weldment using MMAW.
7	Preparing minimum three forged models involving upsetting, drawing and bending operations
8	Sheet metal punch/die design and layout optimization
	Demo experiments for CIE
9	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
10	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. Importance & applications of Powder metallurgy in industries
CO4	Demonstrate skills in preparation of forging models involving upsetting, drawing and bending operations.
CO5	Demonstrate skills in preparation of Welding models

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, 2006.

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/112105127/) 2. http://www.astm.org/DIGITAL_LIBRARY/MNL/SOURCE_PAGES/MNL11.htm 3. http://www.astm.org/DIGITAL_LIBRARY/JOURNALS/COMPTECH/PAGES/CTR10654J.htm 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.

<table>
<tr><td colspan="4">B.E. (Mechanical Engineering)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – III</td></tr>
<tr><td>Course Title:</td><td colspan="3">MECHANICS OF MATERIALS (IPCC)</td></tr>
<tr><td>Course Code:</td><td>BME303</td><td>CIE MARKS</td><td>50</td></tr>
<tr><td>L : T : P + (SL)</td><td>3 : 0 : 2 (45 Hours/Sem)</td><td>SEE MARKS</td><td>50</td></tr>
<tr><td>Credits:</td><td>04</td><td>EXAM HOURS</td><td>03</td></tr>
<tr><td>Total Hours of Pedagogy</td><td>45 hours Theory+ 10 to 12 Lab slots</td><td>Total Marks</td><td>100</td></tr>
</table>

COURSE LEARNING OBJECTIVES:

- 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 **9Hours**

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, Generalised Hook's law – Deformation of simple and compound bars, thermal stresses (only theory).

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

MODULE – 2 **9Hours**

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, Lame'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 / PPT / Field Visits/*videos*

MODULE – 3 **9Hours**

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 – Point of contra flexure.

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

MODULE – 4 **9Hours**

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, 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.

MODULE – 5 **9Hours**

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 – Rankine's formula. **Teaching Learning Process: Chalk and Talk / PPT / Field Visits*/videos***
PRACTICAL COMPONENT OF IPCC (May cover all / major modules)
Experiments (9-10 Lab slots) **PART-A** 1. Specimen preparation for macro and micro structural examinations and study the macrostructure and microstructure of a sample metal/ alloys. ((L1, L2) 2. Study the heat treatment processes (Hardening and tempering) of steel/Aluminium specimens (L1, L2, L3) 3. To determine the hardness values of Mild Steel/ Aluminium by Rockwell hardness/Vickers Hardness. (L1, L2) 4. To determine the hardness values of Copper/ Brass by Brinell's Hardness testing machine. (L1, L2) 5. To determine the tensile strength, modulus of elasticity, yield stress, % of elongation and % of reduction in area of Cast Iron, Mild Steel/ Aluminium and to observe the necking. (L1, L2, L3) 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) 7. To determine the Impact strength of the mild steel using Izod test and Charpy test (L1, L2) **Part-B (Demonstration)** 8. Torsion Test on steel bar. 9. Fatigue Test (demonstration only). 10. Study the chemical corrosion and its protection 11. Heat treatment: Annealing and normalizing of steel.

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 & Analyse 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 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:

Test 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-RESOURCES):

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 S/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

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	FUNDAMENTALS OF MATERIAL ENGINEERING		
Course Code:	BME304	**CIE MARKS**	50
L : T : P + (SL)	3 : 0 : 0 + (45 Hours/Sem)	**SEE MARKS**	50
Credits:	03	**EXAM HOURS**	03
Total Hours of Pedagogy	45 hours	**Total Marks**	100

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**

Physical Metallurgy

Constitution of alloy systems and Phase diagram: Classification of alloys, pure metals & intermediate alloy phase. Solid solutions, types of solid solutions, Solubility limit, Hume- Rothery Rules for forming substitutional solid solution. Phase Diagram: Equilibrium phase diagram, types, Construction of phase diagram, Cooling curves, isomorphous phase diagram, Binary phase diagram, Gibbs phase rule, Invariant reactions, Eutectic, eutectoid, peritectic and peritectoid reaction. Level rule and simple numerical.

Iron Carbon equilibrium Diagram: Detailed study of Fe-C diagram, temperatures involved, different carbon composition, and definition of structures, steel and cast iron, classification of steel and related microstructure.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **9 Hours**

Nucleation, growth & Heat treatment: Introduction to homogeneous and heterogeneous nucleation, critical radius for nucleation. Recovery-Recrystallization-Grain Growth. Strengthening mechanisms: Strain hardening, Precipitation hardening (Solid-Solution Strengthening), Grain refinement. **Heat treatment**: Purpose of doing heat treatment, Annealing, Normalizing, hardening, salient feature of

Martensitic structure. **Time temperature transformation diagram (TTT):** Construction of TTT diagram, detailed analysis of TTT diagram for eutectoid steel, Hardenability: Jominy End Quench test, Tempering, Austempering & Martempering. Nitriding, Cyaniding, Induction Hardening and Flame Hardening, Recent advances in heat treat technology. ***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***	

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

2, 3 and 4-Credit Theory Courses

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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

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

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:	**BMEL305**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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

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

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

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

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
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

1-Credit Lab Course			
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.			

EMERGING SCIENCE / TECHNOLOGY COURSES III SEMESTER

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER –III			
Course Title:	**ELECTRIC AND HYBRID VEHICLE TECHNOLOGIES**		
Course Code:	**BME306A**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**03**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory**	**Total Marks**	**100**

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

- Understand the architecture and vehicle dynamics of electric and hybrid vehicles
- Analyze the power management systems for electric and hybrid vehicles
- Understand different motor control strategies for electric and hybrid vehicles
- Analyze various Hydrogen Fuel production
- Understand the domain related grid interconnections of electric and hybrid vehicles.

MODULE – 1 **(9 hours)**

Introduction: Basic architecture of EV and hybrid drive train, vehicle motion and the dynamic equations for the vehicle. Types of HV and EV Advantages over conventional vehicles

Disposal of Battery: limitations of EV and HV Impact on environment of EV and HV technology Disposal of battery, cell and hazardous material Their impact on environment

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

Battery: Power and Energy management strategies General architecture of EV and HV Various battery sources, Working principles of Li-Ion, NiCad, Leadacid, Aluminium-air, Zink-air batteries

Power storage and Management systems: Battery Management Systems (BMS) Fuel cells, their characteristics Super capacitor-based energy storage, flywheel Hybridization of various energy storage devices Selection of the energy storage technology

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(9 hours)**

AC Motors: Various types of motors Selection and size of motors Induction motor drives and control characteristics Permanent magnet motor drives and characteristics

DC Motors: Brushed & Brush less DC motor drive and characteristics Switched reluctance motors and characteristics IPM motor drives and characteristics. Mechanical and electrical connections of motors.

MODULE – 4 **(9 hours)**

Resistances: Rolling Resistance, Grading, Aero Dynamic and Acceleration Resistance and their effects on Vehicle speed.

Hydrogen as a Fuel – Its Production and Storage:

Hydrogen as a Fuel, Fuel Reforming, Steam Reforming, Partial Oxidation and Auto Thermal Reforming Further Fuel Processing – Carbon Monoxide Removal and Hydrogen Storage

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5	(9 hours)
Introduction to smart charging: Grid to vehicle and vehicle to grid, Smart metering, and ancillary services Preliminary discussion on vehicle to vehicle and vehicle to personal communication systems, **Introduction to battery charging stations:** Charging Stations and its installation and commissioning Preliminary discussion on estimation on station capacity Associated technical issues Different connectors ***Teaching Learning Process: Chalk and Talk / PPT***	

COURSE OUTCOMES:

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

CO1	Understand the architecture and vehicle dynamics of electric and hybrid vehicles
CO2	Analyse the power management systems for electric and hybrid vehicles
CO3	Understand different motor control strategies for electric and hybrid vehicles
CO4	Analyse various Hydrogen Fuel production and Storage concerns.
CO5	Understand the domain related grid interconnections of electric and hybrid vehicles.

2, 3 and 4-Credit Theory Courses			
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. • **If any courses of 3 credits are of Integrated Course type, for such courses the method**			

suggested for 4 credits IPCC shall be followed.

TEXT BOOKS:

1	Chris Mi, M. Abul Masrur, David Wenzhong Gao	, "Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives", Wiley publication ,2011.
2	Iqbal Hussain	"Electric and Hybrid Vehicles Design Fundamentals", 1st Edition, CRC Press, 2003.

REFERENCE BOOKS:

1	James Larminie, John Lowry	"Electric Vehicle Technology Explained", 1st Edition, John Wiley and Sons, 2003
2	Allen Fuhs	"Hybrid Vehicles and the future of personal transportation", CRC Press, 2009.

ONLINE RESOURCES:

1. Web course on "Introduction to Hybrid and Electric Vehicles" by Dr. Praveenkumar and Prof. S Majhi, IIT Guwahati available on NPTEL at https://nptel.ac.in/courses/109/103/109103009/
2. Video Course on "Electric Vehicles" by Prof. Amitkumar Jain, IIT Delhi available on NPTEL at https://nptel.ac.in/courses/109/102/109102121/

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

Course Title:	**INDUSTRIAL MANAGEMENT & ENTREPRENEURSHIP**		
Course Code:	**BME306B**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**03**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory**	**Total Marks**	**100**

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

- Understand the basic concepts of management, planning, organizing, staffing, directing and controlling.
- Identify various types of supporting agencies and financing available for an entrepreneur
- Prepare project report and decide selection of industrial ownership.

MODULE – 1 **(9 hours)**

Management: Introduction - Meaning - nature and characteristics of Management, Functions of Management. Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches –Modern management approaches. 14 principles of management. Introduction to Industrial Safety-Mechanical safety and Fire Safety, Safety in Material Handling.
Planning: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Importance of planning - steps in planning & planning premises - Hierarchy of plans.
Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

Organizing and Staffing: Nature and purpose of organization. Principles of organization - Types of organizations - Departmental Committees Centralization Vs Decentralization of authority and responsibility, Nature and importance of staffing Process of Selection & Recruitment (in brief).
Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. steps in controlling, Essentials of a sound control system - Methods of establishing control (in brief).***Teaching Learning Process: Chalk and Talk / PPT***

MODULE – 3 **(9 hours)**

Entrepreneur: Meaning of Entrepreneur; Evolution of the Concept; Functions of an Entrepreneur, Types of Entrepreneurs, Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship;
Stages in entrepreneurial process: Concept of Entrepreneur, entrepreneur and manager. Role of entrepreneurs in Economic Development; Entrepreneurship – its Barriers.
Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(9 hours)**

Small Scale Industries: Definition; Characteristics; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI, steps to start SSI
Different Policies of government towards SSI;, woman entrepreneurship- roles and challenges, government schemes for woman entrepreneurs. Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry
Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **(9 hours)**

Institutional Support: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single

Window Agency; SISI; NSIC; SIDBI; KSFC. **Preparation of Project**: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study ***Teaching Learning Process: Chalk and Talk / PPT***

COURSE OUTCOMES:

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

CO1	Explain about the management and planning.
CO2	Apply the knowledge on planning, organizing, staffing, directing and controlling.
CO3	Describe the requirements towards the small-scale industries and project preparation.
CO4	Evaluate the role of economic development to country development
CO5	Apply the knowledge to prepare the project report preparation

2, 3 and 4-Credit Theory Courses

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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

Suggested Learning Resources:

Text Books

1. Principles of Management, P. C.Tripathi,P.N. Reddy, Tata McGraw Hill,

2. Dynamics of Entrepreneurial Development & Management, Vasant Desai, Publishing House.
3. Entrepreneurship Development, Poornima. M.Charantimath, Small Business Enterprises – Pearson, 2006 (2 & 4).
4. Management Fundamentals-Concepts, Application , Skill , RobersLusier –Thomson
5. Entrepreneurship Development, S.S.Khanka, S.Chand& Co
6. Management, Stephen Robbins, Pearson Education/PHI, 17th Edition, 2003

Web links and Video Lectures (e-Resources):

1. www.nptel.ac.in
2. https://onlinecourses.nptel.ac.in/noc23_mg74/preview
   https://onlinecourses.nptel.ac.in/noc23_mg70/preview https://cleartax.in/s/small-
3. scaleindustriesssi#:~:text=Small%20Scale%20Industries%20(SSI)%20are,50%20crore
4. https://www.startupindia.gov.in/content/sih/en/startup-scheme.html

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:	**IOT FOR MECHANICAL ENGINEERING**		
Course Code:	**BME306C**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**03**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory**	**Total Marks**	**100**

COURSE LEARNING OBJECTIVES:

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It's becoming the Internet of Things (IoT). The course enables student to

- Understand the basics of Internet of things and protocols.
- Understand some of the application areas where Internet of Things can be applied.
- Learn about the middleware for Internet of Things.
- Understand the concepts of Web of Things

MODULE – 1 **(9 hours)**

IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE902.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(9 hours)**

IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles-

IoT Devices and deployment models- IoTivity: An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(9 hours)**

WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **(9 hours)**

IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Teaching Learning Process: Chalk and Talk / PPT

COURSE OUTCOMES:

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

CO1	Explain the definition and usage of the term "Internet of Things" in different contexts
CO2	Understand the key components that make up an IoT system
CO3	Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
CO4	Apply the knowledge and skills acquired during the course to build and test a complete, working IoT system involving prototyping, programming and data analysis
CO5	Understand where the IoT concept fits within the broader ICT industry and possible future trends and Appreciate the role of big data, cloud computing and data analytics in a typical IoT system

2, 3 and 4-Credit Theory Courses			
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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

Suggested Learning Resources:

Text Books

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the

Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a Highly Connected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

References Books:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O‟Reilly Media, 2011, ISBN: 979-1-4493-9357-1

Web links and Video Lectures (e-Resources):

1. Introduction to IoT - https://www.youtube.com/watch?v=WUYAjxnwjU4&list=PLE7VH9RC_N3bpVn- e9QzOAHziEgmjQ2qE
2. https://www.coursera.org/learn/beginning-custom-projects-with-raspberry-pi
3. https://www.edx.org/course/introduction-to-the-internet-of-things-3

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

1. Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to turn ON LED for 1 sec after every 2 seconds.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
4. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.
5. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
6. To interface OLED with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
7. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smartphone using Bluetooth.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when '1'/'0' is received from smartphone using Bluetooth.
9. Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to thing speak cloud.
10. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity data from thing speak cloud.
11. To install MySQL database on Raspberry Pi and perform basic SQL queries.
12. Write a program on Arduino/Raspberry Pi to publish temperature data to MQTT broker.

<table>
<tr><td colspan="4">B.E. (Mechanical Engineering)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – III</td></tr>
<tr><td>Course Title:</td><td colspan="3">SURFACE TREATMENT & FINISHING</td></tr>
<tr><td>Course Code:</td><td>BME306D</td><td>CIE MARKS</td><td>50</td></tr>
<tr><td>L : T : P + (SL)</td><td>3 : 0 : 0 + (45 Hours/Sem)</td><td>SEE MARKS</td><td>50</td></tr>
<tr><td>Credits:</td><td>03</td><td>EXAM HOURS</td><td>03</td></tr>
<tr><td>Total Hours of Pedagogy</td><td>45 hours Theory</td><td>Total Marks</td><td>100</td></tr>
<tr><td colspan="4">COURSE LEARNING OBJECTIVES:
This course covers the principles and practices of surface treatment and finishing techniques used in various industries. Students will learn about different methods, materials, and applications of surface treatment and finishing.
1. Understand the importance of surface treatment and finishing in various industries.
2. Identify and explain different surface treatment and finishing techniques (e.g., coating, plating, polishing, etc.).
3. Analyze the properties and applications of various surface treatment and finishing methods.
4. Select and apply suitable surface treatment and finishing techniques for specific engineering applications.
5. Evaluate the performance and durability of surface-treated and finished components.
6. Apply safety protocols and regulations related to surface treatment and finishing processes.</td></tr>
<tr><td colspan="4">MODULE – 1 (9Hours)</td></tr>
<tr><td colspan="4">Fundamentals of Electro plating, galvanizing, Hot dip metal coating, thin coating, chromium plating, Nickel plating.
Teaching Learning Process: Chalk and Talk / PPT</td></tr>
<tr><td colspan="4">MODULE – 2 (9Hours)</td></tr>
<tr><td colspan="4">Vacuum coating, FVD & CVD metal spraying - Methods, surface preparation, mechanical Properties of sprayed metals, plasma coating.
Teaching Learning Process: Chalk and Talk / PPT</td></tr>
<tr><td colspan="4">MODULE – 3 (9Hours)</td></tr>
<tr><td colspan="4">Plastic coating of metal - PVC coating Spherodising process details, phosphate coating - mechanism of formation. Testing of surface coating-methods.
Teaching Learning Process: Chalk and Talk / PPT</td></tr>
<tr><td colspan="4">MODULE – 4 (9Hours)</td></tr>
<tr><td colspan="4">Heat treatment methods, Annealing, Normalizing, Tempering, Case hardening methods, flame hardening sub zero treatment Heat treatment methods for gears, spindles, cutting tools.
Teaching Learning Process: Chalk and Talk / PPT</td></tr>
<tr><td colspan="4">MODULE- 5 (9Hours)</td></tr>
<tr><td colspan="4">Fundamentals of Advanced coating technologies:
Hard facing, electro deposition technique, Nano coatings, coating characterization
Teaching Learning Process: Chalk and Talk / PPT / Field Visits</td></tr>
</table>

COURSE OUTCOMES:

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

CO1	Understand the basic concept of coating, plating
CO2	Understand the mechanism of coating formation and their properties and metal spray methods in electroplates

CO3	Understand the mechanism of Plastic coating of metal
CO4	Test coated and spray metal surfaces using suitable heat treatment methods
CO5	Understand electro deposition and Nano coating technique.

2, 3 and 4-Credit Theory Courses

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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

Suggested Learning Resources:

Text Books

1. Surface preparations & finishes for Metals - James A Murphy - McGraw Hill.
2. Principles of metal surface treatment and protection - Pergamon Press Gabe, David Russell - Description, Oxford ; New York

Reference Books:

1. Handbook of metal treatment and testing - John wiley& sons
2. Heat Treatment of Metals – Zakrov - MIR Publications.
3. Metals Hand Book – ASM.

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

Case studies, Quiz, Topic Seminar presentation, Assignments, Industry Visits

B.E. (Common to All Branches) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**Social Connect and Responsibility**		
Course Code:	**BSCK307**	**CIE MARKS**	**100**
L :T : P	**0:0:2**	**SEE MARKS**	**-**
Credits:	**1**	**EXAM HOURS**	**-**

COURSE LEARNING OBJECTIVES:

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

1. Provideaformalplatformforstudentstocommunicateandconnecttothesurrounding.
2. Createaresponsibleconnectionwiththesociety.
3. Understandthecommunityin generalinwhichthey work.
4. Identifytheneedsandproblemsofthecommunityandinvolvetheminproblem–solving.
5. Developamongthemselvesasenseofsocial&civic responsibility&utilizetheirknowledge in finding practical solutions to individual and community problems.
6. Developcompetencerequiredforgroup-livingandsharingofresponsibilities&gainskills inmobilizingcommunityparticipationtoacquireleadershipqualitiesanddemocraticattitudes.

General Instructions - Pedagogy:

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the activities will develop students' theoretical and applied social and cultural skills.
2. State the need for activities and its present relevance in the society and provide real-life examples.
3. Support and guide the students for self-planned activities.
4. You will also be responsible for assigning homework, grading assignments and quizzes, and documenting students' progress in real activities in the field.
5. Encourage the students for group work to improve their creative and analytical skills.

Module-1 **3 Hours**

Plantationand adoptionof atree: Plantationofa tree that willbe adopted for four yearsbyagroup ofBEstudents. (ONESTUDENT-ONE TREE).

Students can prepare either a Reportor a Poster describing the plant's origin, its usage in daily life, its appearance in folklore andliterature.

Module-2 **3 Hours**

Heritage walk and crafts corner Heritage walk- Heritage tour, knowing the history and culture of the city, connecting to people around through their history. crafts corner- Knowing the city and its craftsman, photo blog and documentary on evolution and practice of various craft forms.	
Module-3	**3 Hours**
Organicfarmingand waste management **OrganicFarming:**History of organicfarming, objective of organic farming, types of organic farming, Usefulnessoforganicfarming. **Waste Management:** Study of wetwastemanagementincollege, Hostel and neighboring villages, and implementation in the campus.	
Module-4	**3 Hours**
Water conservation Knowing the present practices in the surrounding villages and implementation in the campus, documentary or photo blog presenting the current practices.	
Module-5	**3 Hours**
Food walk City's culinary practices, food lore, and indigenous materials of the region used in cooking.	

Course outcomes

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

CO1	Communicate and connect to the surrounding.
CO2	Create a responsible connection with the society.
CO3	Involve in the community in general in which they work.
CO4	Notice the needs and problems of the community and involve them in problem – solving.
CO5	Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
CO6	Develop competence required for group-living and sharing of responsibilities & gain skills in mobilizing community participation to acquire leadership qualities and democratic attitudes.

AssessmentDetailsforCIE(bothCIEandSEE)

Weightage	**CIE – 100%**	• Implementationstrategiesoftheproj

<table>
<tr><td>FieldVisit,Plan,Discussion</td><td>10 Marks</td><td rowspan="6">ect.
• The last report should be signed by SCR Coordinator,theHODandPrincipal.
• Atlastreportshouldbeevaluatedbyt heSCR Coordinator.
• Finally,theconsolidated markssheetshould besenttotheCoE/ universityandtobemade available at LIC visit.</td></tr>
<tr><td>Commencementofactivitiesanditsprog ress</td><td>20 Marks</td></tr>
<tr><td>Casestudy-basedAssessment Individualperformancewithreport</td><td>20 Marks</td></tr>
<tr><td>Sectorwisestudy&itsconsolidation5*5 =25</td><td>25 Marks</td></tr>
<tr><td>Videobasedseminarfor10minutesbyeach student at the end of semester with Report.
Activities1to5,5*5=25</td><td>25 Marks</td></tr>
<tr><td>Totalmarksforthecourseineach semester</td><td>100 Marks</td></tr>
<tr><td colspan="3">Foreachactivity,20marksCIEwillbeevaluatedforIAmarksattheendofsemester,Reportandassessmentcopyshouldbemadeavailableinthedepartment.</td></tr>
<tr><td colspan="3">Studentsshouldpresenttheprogressoftheactivitiesasperthescheduleintheprescribedpracticalsessioninthefield.
Thereshouldbepositiveprogressintheverticalorderforthebenefitofsocietyingeneralthroughactivities.</td></tr>
</table>

GuidelineforAssessmentProcess:
ContinuousInternalEvaluation(CIE)

After completion of the course, the student shall prepare, with daily diary as reference, a comprehensive report in consultation with the mentor/s to indicate what he has observed and learnedinthesocialconnectperiod.Thereportshouldbesignedbythementor.Thereportshall be evaluated on the basis of the following criteria and/or other relevant criteria pertaining to the activitycompleted.Marksallottedforthediaryareoutof50.Planningandschedulingthesocial connect Information/Data collected during the social connect Analysis of the information/data and report writing Considering all above points allotting the marks as mentioned below:

Excellent **:80 to100**
Good **:60 to79**
Satisfactory **:40to59**
Unsatisfactory and fail **: <39**

SPECIALNOTE:NOSEMESTERENDEXAM (SEE)–
COMPLETELYPRACTICALANDACTIVITIES-BASEDEVALUATION

ACTIVITIES

Jammingsession,openmic,andpoetry:Platformtoconnecttoothers.Sharethestorieswith others. Share the experience of Social Connect. Exhibit the talent like playing instruments, singing, one-act play, art-painting, and fine art.

PEDAGOGY

The pedagogy will include interactive lectures, inspiring guest talks, field visits, social immersion, and a course project. Applying and synthesizing information from these sources to define the social problem to address and take up the solution as the course project, with your group.Socialimmersion withNGOs/socialsectionswillbeakeypartofthecourse.Willalllead to the course project that will address the needs of the social sector?

COURSETOPICS

The course will introduce social context and various players in the social space, and present approaches to discovering and understanding social needs. Social immersion and inspiring conversionwillculminateindevelopinganactual,ideaforproblem-basedintervention,based on an in-depth understanding of a key social problem.

DURATION

Atotal of30 - 35 hours engagement per semesteris required forthe3rd semesterof the B.E./B.Tech. program. The students will be divided into groups. Each group will be handled by faculty mentors. Faculty mentors will design the activities (particularly Jamming sessions open mic, andpoetry)FacultymentorshavetodesigntheevaluationsystemasperVTUguidelinesof scheme & syllabus.

PEDAGOGY–GUIDELINES

Itmaydifferdependingonlocalresourcesavailableforthestudyaswellasenvironmentand climatic differences, location and time of execution.

Sl. No	Topic	Group size	Location	Activity Execution	Reporting	Evaluation oftheTopic
1.	**Plantationand adoption of a tree:**	May be individual or team of 5	Farmers land/ parks / Villages /roadside/ community area / Collegecampusetc…..	Siteselection /proper consultation/Contin uous monitoring/ Information board	Report shouldbesubmittedby individualto theconcernedevaluation authority	Evaluation as per the rubrics Ofschemeand syllabus by Faculty
2.	**Heritagewalk and crafts corner:**	May be individual or team of 5	Temples/monumental places / Villages/ City Areas / Grama panchayat/public associations/Government Schemes officers/ campus etc…..	Siteselection /proper consultation/Continuous monitoring/ Information board	Report shouldbesubmittedby individualtothe concerned evaluationauthority	Evaluation as per the rubrics Ofschemeand syllabus by Faculty
3.	**Organicfarming and waste management:**	May be individual or team of 5	Farmersland/parks/ Villages visits /roadside/community area / College campus etc…..	Groupselection / properconsultation / Continuous monitoring / Informationboard	Report shouldbesubmittedby individualtothe concerned evaluationauthority	Evaluation as per the rubrics Ofschemeand syllabus by Faculty

4.	**Water conservation:** & conservation techniques	May be individual or team of 5	Villages/CityAreas/ Grama panchayat/public associations/Government Schemes officers / campus etc…..	siteselection / proper consultation/Continuous monitoring/ Information board	Report shouldbesubmittedby individualtothe concerned evaluationauthority	Evaluation as per the rubrics Ofschemeand syllabus by Faculty
5.	**Foodwalk: Practicesin society**	May be individual or team of 5	Villages/CityAreas/ Grama panchayat/public associations/Government Schemes officers/ campus etc…..	Groupselection / properconsultation / Continuous monitoring / Informationboard	Report shouldbesubmittedby individualtothe concerned evaluationauthority	Evaluation as per the rubrics Ofschemeand syllabus by Faculty

PlanofAction(ExecutionofActivities)

Sl. NO	PracticeSessionDescription
1	Lecturesessioninfieldtostartactivities
2	StudentsPresentationonIdeas
3	Execution of Activity - Plantation and adoption of a tree
4	Execution of Activity - Heritage walk and crafts corner
5	Execution of Activity - Organic farming and waste management
6	Execution of Activity - Water conservation
7	Execution of Activity - Foodwalk
8	CasestudybasedAssessment,Individualperformance
9	Sector/Teamwisestudyanditsconsolidation
10	Videobasedseminarfor10minutesbyeachstudentAttheendofsemesterwith Report.

- Eachstudentshoulddoactivitiesaccordingtothe schemeandsyllabus.
- Attheendofsemesterstudentperformancehasto beevaluatedbythe facultyfortheassigned activity progress and its completion.
- Atlastconsolidatedreportofallactivitiesfrom1stto5th,compiledreportshouldbesubmittedas per the instructions and scheme.

ABILITY ENHANCEMENT COURSES / SKILL DEVELOPMENT COURSES III SEMESTER

<table>
<tr><td colspan="4" align="center">B.E. (Common to all Branches)
Outcome Based Education(OBE) and Choice Based Credit System(CBCS)
SEMESTER – III</td></tr>
<tr><td>Course Title:</td><td colspan="3">FOREIGN LANGUAGE COURSE 1- GERMAN</td></tr>
<tr><td>Course Code:</td><td>BFLC358A</td><td>CIE MARKS</td><td>50</td></tr>
<tr><td>(L :T : P) + SL</td><td>(1:0:0) + (15 Hours/ Sem)</td><td>SEE MARKS</td><td>50</td></tr>
<tr><td>Credits:</td><td>1</td><td>EXAM HOURS</td><td>02</td></tr>
<tr><td colspan="4">COURSE LEARNING OBJECTIVES:
The purpose of the course is to facilitate the learner to:
1. To develop basic communication skills in German.
2. To introduce German grammar and sentence structure.
3. To enhance vocabulary in everyday and academic contexts.
4. To enable students to comprehend and respond in spoken and written German.
5. To build intercultural awareness through authentic material like short films and dialogues.</td></tr>
<tr><td colspan="3" align="center">Module 1</td><td>3 Hours</td></tr>
<tr><td colspan="4">Vocabulary for day to day activities, Time – official/inofficial, Possessive articles, Speaking about family, Time prepositions, Worksheets, Short Film

Textbook 1: Chapter 5, 6</td></tr>
<tr><td colspan="3" align="center">Module 2</td><td>3 Hours</td></tr>
<tr><td colspan="4">Talk about hobbies, Talking about plans, Trennbareverben/seperable verbs, Going to a restaurant, Worksheets, Short Film

Textbook: Chapter 5, 6</td></tr>
<tr><td colspan="3" align="center">Module 3</td><td>3 Hours</td></tr>
<tr><td colspan="4">Talking about jobs, Talking about the workplace, Helping verbs in Past tense , Attending events in your town, Worksheets, Short Film

Textbook: Chapter 7,8</td></tr>
<tr><td colspan="3" align="center">Module 4</td><td>3 Hours</td></tr>
<tr><td colspan="4">Daily routine, Body parts, Common illnesses, Visiting the doctor, Healthy living, Worksheets, Short Film

Textbook: Chapter 7,8</td></tr>
<tr><td colspan="3" align="center">Module 5</td><td>3 Hours</td></tr>
<tr><td colspan="4">Dativ Imperative, Small Talk…Worksheets, Short Film

Textbook: Chapter 7,8</td></tr>
</table>

Courseoutcomes

Atthe end ofthe coursethestudent will be able to:

CO1: Understand and apply basic German grammar and sentence structure.

CO2: Communicate using appropriate vocabulary and expressions in daily situations.

CO3: Fill out simple forms and conduct structured conversations.

CO4: Comprehend basic written and audio-visual content in German.

CO5: Recognize basic cultural and linguistic distinctions in German-speaking countries.

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 25 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 25 marks.
Total CIE (A+B)	50	20	The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks.
SEE (C)	50	18	Question papers having 50 MCQs with each question carrying 01 mark, and Examination duration is 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 are 20 out of allotted 50 marks to appear for SEE.			

Textbooks

1.Netzwerk A1 Neu Kursbuch

2.Netzwerk A1 Neu Ubungsbuch

WeblinksandVideoLectures(e-Resources)

- https://www.youtube.com/playlist?list=PLquImyRfMt6esqE6C4RdOeg0h0IBeYWri
- https://www.youtube.com/playlist?list=PLWO81tQUNYnX7laegkYvzQiMrSghMXYCZ
- https://www.youtube.com/watch?v=4-eDoThe6qo
- https://learngerman.dw.com/en/wer-spricht/l-56577891/e-57119877

ActivityBasedLearning(SuggestedActivitiesinClass)/PracticalBasedlearning

- RolePlay
- Flippedclassroom
- Debate
- Films
- Quiz

- Games
- Handouts

B.E. (Common to all Branches) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – III			
Course Title:	**FOREIGN LANGUAGE COURSE 1- SPANISH**		
Course Code:	**BFLC358B**	**CIE MARKS**	**50**
(L :T : P) + SL	**(1:0:0) + (15 Hours/ Sem)**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**02**

COURSE LEARNING OBJECTIVES:

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

1. To introduce learners to the basics of Spanish phonetics and vocabulary.
2. To familiarize learners with basic sentence elements such as articles, pronouns, and regular verbs.
3. To promote simple self-expression and comprehension in everyday scenarios.
4. To prepare the learners to introduce and describe a person.

Module 1 — **3 Hours**

Introduction and Phonetics:

- Spanish alphabet and sounds.
- Numbers (0–50), days and months.
- Greetings and introducing yourself.

Textbook: Chapter 0 and Chapter 1 – Lesson 2

Module 2 — **3 Hours**

Nouns and Articles

- Gender and number of nouns.
- Definite and indefinite articles.
- Simple sentence structure with nouns.

Textbook: Chapter 2 – Lesson 3

Module 3 — **3 Hours**

Subject Pronouns and Regular Verbs

- Subject pronouns (yo, tú, él, etc.).
- Present tense of regular AR/ER/IR verbs.
- Making positive and negative sentences.

Textbook: Chapter 2 – Lesson 4

Module 4 — **3 Hours**

Ser vs Estar and Adjectives

• Usage of 'ser' and 'estar'. • Descriptive adjectives and agreement. • Describing people and places. Textbook: Chapter 6 – Lesson 11	
Module 5	**3 Hours**
Demonstratives, Possessives, and Family • Demonstrative adjectives (este, esa, etc.). • Possessive adjectives (mí, tu, su, etc.). • Talking about family and relationships. Textbook: Chapter 4 – Lesson 7 & Lesson 8; Chapter 6 – Lesson 12	

Courseoutcomes

Atthe end ofthe coursethestudent will be able to:

CO1: Recognize and pronounce basic Spanish phonemes and vocabulary.
CO2: Use articles, nouns, subject pronouns and regular verbs in simple sentences.
CO3: Construct and understand basic descriptive sentences using 'ser' and 'estar'.
CO4: Identify and describe relationships using demonstratives and possessives.

AssessmentDetails(bothCIEandSEE)

Assessment Type	Maximum Marks	Minimum Passing Marks	Evaluation Details
CIE – IA Tests (A)	30	-	Average of Two Internal Assessment Tests (MCQs) each conducted for 25 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 25 marks.
Total CIE (A+B)	50	20	The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks.
SEE (C)	50	18	Question papers having 50 MCQs with each question carrying 01 mark, and Examination duration is 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 are 20 out of allotted 50 marks to appear for SEE.

Textbook:

1. Chicos Chicas 1
2. Resources and Exercises from Aventura Hispana

Weblinks:

- **YouTube channels:** Butterfly Spanish, Dreaming Spanish

ActivityBasedLearning(SuggestedActivitiesinClass)/PracticalBasedlearning

- RolePlay
- Debate
- Short videos
- Games
- Handouts

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – III			
Course Title:	**SPREAD SHEET FOR ENGINEERS**		
Course Code:	**BMEL358C**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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 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.

1-Credit Lab Course

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:	**SHEET METAL AND SURFACE MODELLING**		
Course Code:	**BMEL358D**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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

- Understand and apply the principles of surface development for various geometries like trays, funnels, and transition pieces.
- Model complex 3D surfaces such as detergent bottles, fan blades, and dodecahedrons using CAD tools.
- Translate 3D solid models into sheet metal components, demonstrating real-world applications in manufacturing.
- Use standard data exchange formats (IGES, STEP) to import/export models between CAD and analysis software.
- Demonstrate proficiency in creating surface models and developments applicable in industries such as automotive, aerospace, and product design.

Sl. No	Experiments
1.	Development of lateral surfaces for Tray.
2.	Development of lateral surface for funnel.
3.	Development of lateral surfaces of transition pieces connecting circular duct and rectangular duct.
4.	Surface modelling of a simple Detergent bottle.
5.	Surface modelling of a Shoe horn.
6.	Surface modelling of a Dodecahedron.
7.	Surface modelling of a Fan blade.
8.	Surface modelling of a Shovel.
	Demonstration Experiments (For CIE)
9.	Demonstrate the use of graphics standards (IGES, STEP etc.,) to import the model from modeler to solver.
10.	Draw the development of fuselage.
11.	Conversion of Solid Body To Sheet Metal

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

CO1	Create accurate lateral surface developments for simple and compound geometric objects using CAD tools.
CO2	Generate and validate surface models for consumer products and mechanical components.
CO3	Demonstrate competency in converting solid bodies into sheet metal parts with appropriate design considerations.

CO4	Efficiently utilize graphics standards such as IGES and STEP for inter-software model transfer.
CO5	Apply surface development and modeling techniques to conceptualize and design parts like fan blades, shovels, and fuselages for industrial applications.

1-Credit Lab Course			
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. K L Narayana, P Kannaiah, K Venkata Reddy, Machine drawing, New age international.3rd edition 13;979-91-224-2519-5,2006.
2. N D Bhat, Machine drawing, Charotar publishing house pvt ltd.50th edition, ISBN-13:979-9395039232, 2014.
3. Machine drawing by K R Gopalkrishna, Subhash publication Web links and video lectures (e-resources):
4. Learn fusion 360 in 90 minutes http://www.autodesk.com/cerification/learn/course/learn-fusion-360-in-90-miutes

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:	**BMEL358E**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**2**
Total Hours of Pedagogy	**15 Lab slots**	**Total Marks**	**100**

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.

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 **Momentum-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.

1-Credit Lab Course			
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.			

CORE COURSES
IV SEMESTER

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:	**BME401**	**CIE MARKS**	**50**
L : T : P + (SL)	**2 : 2 : 0+ (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**45 hours Theory**	**TOTAL MARKS**	**100**

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 / Field Visits /videos

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 / Field Visits /videos

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 / Field Visits /videos

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 / Field Visits /videos

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 / Field Visits /videos***

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.

2, 3 and 4-Credit Theory Courses			
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. • **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**			

SUGGESTED LEARNING RESOURCES:

TEST 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

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://www.youtube.com/watch?v=AwbhbN20xl9&list=PLwdnzlV3ogoVJnW1S9GgOKYj5
2. heOzl1dn
3. https://ciechanow.ski/internal-combustion-engine/
4. 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

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER –IV			
Course Title:	**MACHINING SCIENCE & PRECISION ENGINEERING (IPCC)**		
Course Code:	**BME402**	**CIE MARKS**	**50**
L : T : P + (SL)	**2 : 2 : 2 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**04**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory+ 15 Lab slots**	**Total Marks**	**100**

COURSE LEARNING OBJECTIVES:

- 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. calculation of machining time. 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

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 a)Lathe tool Dynamometer OR b) Drill tool Dynamometer
10	Measurements of Screw Thread Parameters using two wire or Three-wire methods.
11	Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
12	Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micro meter

	COURSE OUTCOMES
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 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 Visit any one machining center or machining industry and/or Case study on process parameter influence on anyone advanced machining process and hybrid machining process

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

Course Title:	**THEORY OF MACHINES (IPCC)**		
Course Code:	**BME403**	**CIE MARKS**	**50**
L : T : P + (SL)	**2 : 2 : 2 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**04**	**EXAM HOURS**	**03**
Total Hours of Pedagogy	**45 hours Theory**	**Total Marks**	**100**

Course objectives:

- To understand the concept of machines, mechanisms and to Analyse a mechanism for displacement, velocity and acceleration at any point in a moving link.
- To understand the force motion relationship in components subjected to external forces and analysis of standard mechanisms
- To understand the theory of gears and gear trains.
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the principles in mechanisms used for speed control and stability control.
- To compute the natural and damped frequencies of free 1DOF mechanical systems and to analyse the vibrational motion of 1DOF mechanical systems under harmonic excitation conditions.

MODULE – 1 **(9 hours)**

Introduction: Mechanisms and machines, Kinematic pairs types, degree of freedom, Kinematic chains and their classification, Kinematic inversions (Beam Engine, Whitworth quick return mechanism, Scotch yoke and Oldham's Coupling) -Simple Numericals on degree of freedom

Velocity and Acceleration analysis of planar mechanisms Graphical method: Velocity and Acceleration Analysis of Mechanisms- Four bar mechanism, slider crank mechanism.

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

MODULE – 2 **(9 hours)**

Static force analysis: Static equilibrium, analysis of four bar mechanism, slider crank mechanism. **Flywheel: Introduction to Flywheel and calculation of its size for simple machines like punching** machine, shearing machine.

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

MODULE – 3 **(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,

Gear Trains: Simple gear trains, compound gear trains. Epicyclic gear trains: Tabular methods of finding velocity ratio of epicyclic gear trains, torque calculation in epicyclic gear trains.

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

MODULE – 4 **(9 hours)**

Balancing of Rotating Masses: Static and Dynamic Balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes. Discussions on applications.

Governors: Types of Governors; Force Analysis of Porter and Hartnell Governors. Controlling Force, Controlling Force, Stability, Sensitiveness, Isochronism, Effort and Power. Discussion on applications.

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

MODULE – 5 **(9 hours)**

Free vibrations: Basic elements of vibrating system, Types of free vibrations, Longitudinal vibrations Equilibrium method, D'Alembert's principle, Determination of natural frequency of single degree freedom systems for undamped free vibations *(for CIE only*), and damped free vibrations: Under damped, over damped and critically damped systems, Logarithmic decrement, simple numericals.

Forced vibrations: Undamped forced vibration of spring mass system, damped forced vibrations, rotating unbalance, Reciprocating unbalance, Vibration isolation. Simple Numericals.

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

COURSE OUTCOMES:

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

1. Knowledge of mechanisms and their motion and the inversions of mechanisms
2. Analyse the velocity, acceleration of links and joints of mechanisms.
3. Analyse the mechanisms for static and dynamic equilibrium.
4. Carry out the balancing of rotating and reciprocating masses
5. Analyse different types of governors used in real life situation.

PRACTICAL COMPONENT OF IPCC

Sl. No.	**Experiments**
1	Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2	Balancing of rotating masses
3	Determination of critical speed of a rotating shaft
4	Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proell /Hartnell Governor.
5	Determination of Pressure distribution in Journal bearing
6	Study of different types of cams, types of followers and typical follower motions. Obtain cam profile for any two types of follower motions and types of followers
7	Determination of Fringe constant and stress concentration of Photoelastic material for Circular disc subjected to diametral compression.
Demo experiments for CIE	
8	Study the principle of working of a Gyroscope and demonstrate the Effect of gyroscopic Couple on plane disc
9	Demonstration and study of operation of different Mechanisms and their Inversions: Slider crank chain, Double slider crank chain and its inversions, Quick return motion mechanisms Peaucellier's mechanism. Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, pantograph, Ackerman steering gear mechanism
10	Determination of Fringe constant of Photoelastic material for pure bending specimen (four point bending).

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. Theory of Machines Kinematics and Dynamics Sadhu Singh Pearson Third edition 2019.
2. Mechanism and Machine Theory G. Ambekar PHI 2009.

Reference Books

3. Theory of Machines Rattan S.S Tata McGraw-Hill Publishing Company 2014.
4. Mechanisms and Machines Kinematics, Dynamics and Synthesis Michael M Stanisic Cengage Learning 2016
4. Machines and Mechanisms David H. Myszka, 2012, Prentice Hall,

Web links and Video Lectures (e Resources):

1. https://archive.nptel.ac.in/courses/112/106/112106270/
2. https://nptel.ac.in/courses/112105269

3. https://archive.nptel.ac.in/courses/112/104/112104121/

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

1. Course Seminar
2. Term project
3. Assignment

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**INDUSTRY SUPPORTED LAB AND MACHINING LAB**		
Course Code:	**BMEL404**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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.
- To develop skills of assembling and disassembling Innova Car engine and Gear box

Sl. No	Experiments
1.	TYOTA Engine disassembly and assembly.
2.	Preparation of one model on lathe involving - Plain turning, Facing, Knurling, Drilling, Boring, Internal Thread cuts and Eccentric turning.
3.	Preparation of One model on lathe involving - Plain turning, Facing, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning
4.	One Job, Cutting of V Groove/ dovetail / Rectangular groove using a shaper.
5.	Cutting of Gear Teeth using Milling Machine.
6.	Simple operations and One Job on the drilling and grinding machine.
7.	Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations.
8.	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
9.	Experiment on anyone advanced machining process-MTAB CNC Machine

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

CO1	Analyze 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 working of simple CNC machine
CO5	Understand the various engine components

1-Credit Lab Course			
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. 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

EMERGING SCIENCE / TECHNOLOGY COURSES IV SEMESTER

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

Course Title:	**DRONE TECHNOLOGY**		
Course Code:	**BME405A**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**45 hours**	**TOTAL MARKS**	**100**

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

- To introduce the basic concepts of unmanned aerial vehicles and its classification.
- To impart knowledge on the hardware components and their selection
- To impart knowledge on the component integration with airframe.
- To impart knowledge on transmitter receiver and telemetry selection.
- To impart knowledge on control and testing of drones.

MODULE – 1 **(9 hours)**

Introduction to Unmanned Aircraft Systems (UAS): Some Applications of UAS, what are UAS? Why Unmanned Aircraft? , The Systemic Basis of UAS, System Composition, Conceptual Phase, Preliminary Design, Detail Design, Selection of the System,
Aerodynamics and Airframe Configurations: Lift-induced Drag, Parasitic Drag, Rotary-wing Aerodynamics, Response to Air Turbulence, Airframe Configurations
Teaching Learning Process: Chalk and Talk / PPT / Field Visits/*videos*

MODULE – 2 **(9 hours)**

Characteristics of Aircraft Types: Long-endurance, Long-range Aircraft, Medium-range, Tactical Aircraft, Close-range/Battlefield Aircraft, MUAV Types, MAV and NAV Types, UCAV, Novel Hybrid Aircraft Configurations, Research UAV
Design Standards and Regulatory Aspects: Introduction, United Kingdom, Europe, United States of America, India.
Teaching Learning Process: Chalk and Talk / PPT / Field Visits/*videos*

MODULE – 3 **(9 hours)**

Aspects of Airframe Design: Scale Effects, Packaging Density, Aerodynamics, Structures and Mechanisms, Selection of power-plants, Modular Construction, Ancillary Equipment, Design for Stealth.
Acoustic Signature: Visual Signature, Thermal Signature Radio/Radar Signature, Examples in Practice
Teaching Learning Process: Chalk and Talk / PPT / Field Visits/*videos*

MODULE – 4 **(9 hours)**

Payload Types: Non-dispensable Payloads, Dispensable Payloads
Communications: Communication Media, Radio Communication, Mid-air Collision (MAC) Avoidance, Communications Data Rate and Bandwidth Usage, Antenna Types.
Teaching Learning Process: Chalk and Talk / PPT / Field Visits/*videos*

MODULE – 5 **(9 hours)**

Control and Stability: HTOL Aircraft, Helicopters, Convertible Rotor Aircraft, Payload Control, Sensors, Autonomy
Navigation: NAVSTAR Global Positioning System (GPS), TACAN, LORAN C, Inertial Navigation, Radio Tracking, Way-point Navigation
Teaching Learning Process: Chalk and Talk / PPT / Field Visits/*videos*

COURSE OUTCOMES:

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

CO1	Explain the importance of design and selection of system and frame of UAV
CO2	Identify the characteristics of UAV and know the regulations
CO3	Analyze the design aspect of frame and and acoustics of UAV
CO4	Analyze the payload and communication in UAV.
CO5	Identify the control, stability and navigation methods in UAV

2, 3 and 4-Credit Theory Courses			
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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

SUGGESTED LEARNING RESOURCES:

Test Books

1. Daniel Tal and John Altschuld, “Drone Technology in Architecture, Engineering and Construction: AStrategic Guide to Unmanned Aerial Vehicle Operation an Implementation”, 2021 John Wiley & Sons, Inc.
2. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016

References Books:

1. John Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, QuePublishing, 2016
2. Zavrsnik, “Drones and Unmanned Aerial Systems: Legal and Social Implications for Security andSurveillance”, Springer, 2019

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**SUPPLY CHAIN MANAGEMENT**		
Course Code:	**BME405B**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**45 hours**	**TOTAL MARKS**	**100**

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

- To acquaint with key drivers of supply chain performance and their inter-relationships with strategy.
- To impart analytical and problem-solving skills necessary to develop solutions for a variety of supply chain management & design problems.
- To study the complexity of inter-firm and intra-firm coordination in implementing programs such as e-collaboration, quick response, jointly managed inventories and strategic alliances.

MODULE – 1 **(9 hours)**

Introduction: Supply Chain – Fundamentals –Evolution- Role in Economy - Importance - Decision Phases.

Supplier Manufacturer-Customer chain. - Enablers/ Drivers of Supply Chain Performance. Supply chain strategy - Supply Chain Performance Measures.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

Strategic Sourcing Outsourcing – Make Vs buy - Identifying core processes - Market Vs Hierarchy - Make Vs buy continuum.

Sourcing strategy - Supplier Selection and Contract Negotiation. Creating a world class supply base- Supplier Development - World Wide Sourcing.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(9 hours)**

Warehouse Management: Stores management-stores systems and procedures-incoming materials control stores accounting and stock verification Obsolete, surplus and scrap-value analysis-material handling transportation and traffic management -operational efficiency-productivity-cost effectiveness-performance measurement.

SCM Network design: Supply Chain Network Distribution Network Design – Role - Factors Influencing Options, Value Addition – Distribution Strategies - Models for Facility Location and Capacity allocation. Distribution Center Location Models.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(9 hours)**

SCM Models: Supply Chain Network optimization models. Impact of uncertainty on Network Design - Network Design decisions using Decision trees.

SCM Planning: Planning Demand, -multiple item -multiple location inventory management. Pricing and Revenue Management.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **(9 hours)**

Current Trends: Supply Chain Integration - Building partnership and trust in Supply chain Value of Information: Bullwhip Effect - Effective forecasting - Coordinating the supply chain. Supply Chain restructuring,

SCM Mapping: Supply Chain Mapping - Supply Chain process restructuring, Postpone the point of

differentiation – IT in Supply Chain - Agile Supply Chains -Reverse Supply chain. Future of IT in supply chain- E Business in supply chain. ***Teaching Learning Process: Chalk and Talk / PPT***

COURSE OUTCOMES:

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

CO1	Understand the framework and scope of supply chain management
CO2	Build and manage a competitive supply chain using strategies, models, techniques and information technology.
CO3	Plan the demand, inventory and supply and optimize supply chain network.
CO4	Understand the emerging trends and impact of IT on Supply chain.
CO5	Analyze the current trend of SCM and perform mapping

2, 3 and 4-Credit Theory Courses

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.
- **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**

SUGGESTED LEARNING RESOURCES:

Test Books

1. Supply Chain Management– Text and Cases Janat Shah Pearson Education 2009
2. Supply Chain Management Strategy Planning and Operation Sunil Chopra and Peter Meindl PHI Learning / Pearson Education 2007

Reference Books

1 Business Logistics and Supply Chain Management Ballou Ronald H Pearson Education 5th Edition, 2007
2 Designing and Managing the Supply Chain: Concepts, Strategies, and Cases David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi Tata McGraw-Hill 2005
3 Supply Chain ManagementConcept and Cases Altekar Rahul V PHI 2005
4 Modeling the Supply Chain Shapiro Jeremy F Thomson Learning Second Reprint , 2002
5 Principles of Supply Chain Management- A Balanced Approach Joel D. Wisner, G. Keong Leong, KeahChoon Tan South-Western, Cengage Learning 2009

WEB LINKS AND VIDEO LECTURES (E-RESOURCES):

1. https://onlinecourses.nptel.ac.in/noc21_mg45/preview
2. https://nptel.ac.in/courses/110106045
3. https://www.udemy.com/course/sapmmtraining/
4. https://www.udemy.com/course/saps4hana

ACTIVITY BASED LEARNING (SUGGESTED ACTIVITIES IN CLASS)/ PRACTICAL BASED LEARNING

Case study of companies' example Amazon, Flipkart, Parle, DMart, Reliance etc can be discussed

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**MECHATRONICS**		
Course Code:	**BME405C**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0 + (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**3**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**45 hours**	**TOTAL MARKS**	**100**

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

- To acquire a strong foundation in science and focus in mechanical, electronics, control, software, and computer engineering, and a solid command of the newest technologies.
- To understand the evolution and development of Mechatronics as a discipline.
- To substantiate the need for interdisciplinary study in technology education
- To understand the applications of microprocessors in various systems and to know the functions of each element.
- To demonstrate the integration philosophy in view of Mechatronics technology
- To be able to work efficiently in multidisciplinary teams.

MODULE – 1 **(9 hours)**

Introduction: Scope and elements of Mechatronics, Mechatronics design process, measurement system, requirements and types of control systems, feedback principle, Basic elements of feedback control systems, Classification of control system. Examples of Mechatronics Systems such as Automatic Car Park system, Engine management system, Antilock braking system (ABS) control, Automatic washing machine.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, Potentiometers, LVDT, Capacitance sensors, force and pressure sensors, Strain gauges, temperature sensors, proximity switches and Hall Effect sensors.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

Signal Conditioning: Introduction – Hardware – Digital I/O, Analog to digital conversions, resolution, Filtering Noise using passive components – Registers, capacitors, amplifying signals using OP amps. Digital Signal Processing – Digital to Analog conversion, Low pass, high pass, notch filtering. Data acquisition systems DAQS), data loggers, Supervisory control and data acquisition (SCADA), Communication methods.

Electro Mechanical Drives: Relays and Solenoids – Stepper Motors – DC brushed motors – DC brushless motors – DC servo motors – 4-quadrant servo drives, PWM's – Pulse Width Modulation.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(9 hours)**

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data Registers, Program Counter, Flags, Fetch cycle, write cycle, state, bus interrupts. Intel's 9095A Microprocessor.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(9 hours)**

Programmable Logic Controller: Introduction to PLCs, Basic structure of PLC, Principle of

operation, input and output processing, PLC programming language, ladder diagram, ladder diagrams circuits, timer counters, internal relays, master control, jump control, shift registers, data handling, and manipulations, analogue input and output, selection of PLC for application. **Application of PLC control:** Extending and retracting a pneumatic piston using latches, control of two pneumatic pistons, control of process motor, control of vibrating machine, control of process tank, control of conveyer motor etc. ***Teaching Learning Process: Chalk and Talk / PPT***	
MODULE – 5	**(9 hours)**
Mechatronics in Computer Numerical Control (CNC) machines: Design of modern CNC machines – Machine Elements: Different types of guide ways, Linear Motion guide ways. Bearings: anti-friction bearings, hydrostatic bearing and hydrodynamic bearing. Re-circulating ball screws. Typical elements of open and closed loop control systems. Adaptive controllers for machine tools. **Mechatronics Design process:** Stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier. ***Teaching Learning Process: Chalk and Talk / PPT***	

COURSE OUTCOMES:

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

CO1	Illustrate various components of Mechatronics systems.
CO2	Assess various control systems used in automation.
CO3	Design and conduct experiments to evaluate the performance of a Mechatronics system or Component with respect to specifications, as well as to analyse and interpret data.
CO4	Apply the principles of Mechatronics design to product design.
CO5	Function effectively as members of multidisciplinary teams.

2, 3 and 4-Credit Theory Courses			
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. • **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**			

SUGGESTED LEARNING RESOURCES:
Test Books

1. Mechatronics System Design by Devdas Shetty and Richard A Kolk, Second edition, Thomson Learning Publishing
2. Company, Vikas publishing house, 2001.
3. W. Bolton, “Mechatronics” - Addison Wesley Longman Publication, 1999.
4. Shetty and Kolk “Mechatronics System Design”- Cengage Learning, 2010

ACTIVITY BASED LEARNING (SUGGESTED ACTIVITIES IN CLASS)/ PRACTICAL BASED LEARNING

1. Quiz
2. Presentations
3. Group Activity

B.E. (Mechanical Engineering) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER –IV			
Course Title:	**AUTOMATION AND ROBOTICS**		
Course Code:	**BME405D**	**CIE MARKS**	**50**
L : T : P + (SL)	**3 : 0 : 0+ (45 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**03**	**EXAM HOURS**	**03**
Total hours of Pedagogy	**45 Hours**	**TOTAL MARKS**	**100**

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

- Identify potential areas for automation and justify need for automation
- Select suitable major control components required to automate a process or an activity
- Study the various parts of robots and fields of robotics.
- Identify the various kinematics and inverse kinematics of robots.
- Evaluate and compare the use Robots in different applications.

MODULE – 1 **(9 hours)**

INTRODUCTION TO AUTOMATION

- Basic elements of an automated system
- Advanced automation functions
- Levels of automation
- Comparison: Process industries vs. Discrete manufacturing industries
- Continuous control vs. Discrete control systems
- Hardware components for automation and process control
- Overview of sensors and actuators in automation

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(9 hours)**

Automated production lines

- Fundamentals of automated production lines
- Applications of automated production lines
- Analysis of transfer lines and line balancing
- Fundamentals of automated assembly systems
- Configuration and types of automated assembly systems
- Automatic Identification and Data Capture (AIDC) technologies:
- Barcode technology
- Radio Frequency Identification (RFID)

Other AIDC methods (e.g., QR codes, biometrics, magnetic stripes)

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(9 hours)**

Industrial Robotics

- Robotic configurations (Cartesian, Cylindrical, SCARA, Articulated, etc.)
- Robot anatomy and key attributes
- Robot control systems (Open loop, Closed loop)
- End effectors: Grippers, tools, and their types
- Sensors in robotics and their roles

- Applications of industrial robots in manufacturing
- Robot accuracy, precision, and repeatability
- Types and generations of robots
- Degrees of freedom in robotic systems
- Asimov's Three Laws of Robotics

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(9 hours)**

Robot actuators and Feedback component

Actuators:

- Pneumatic actuators
- Hydraulic actuators
- Electric motors
- Stepper motors
- Comparison of actuator types (force, speed, precision, cost, control)

Sensors in Robotics:

- Position Sensors: Potentiometers, Resolvers, Encoders
- Velocity Sensors
- Tactile Sensors
- Proximity Sensors

Manipulator Kinematics:

- Homogeneous transformations for rotation and translation
- Denavit-Hartenberg (D-H) notation
- Forward kinematics
- Inverse kinematics

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **(9 hours)**

Processing Operations, Assembly & Inspection

Processing Operations Using Robots:

- Spot welding
- Continuous arc welding
- Spray painting and coating
- Other robotic manufacturing operations

Robotic Assembly Automation:

- Part presentation methods
- Assembly operations and techniques
- Compliance and Remote Center Compliance (RCC) devices
- Assembly system configurations
- Design considerations for robotic assembly

Inspection Automation:

- Need for automated inspection
- Types of sensors and systems used in inspection
- Applications of robotics in inspection tasks

Teaching Learning Process: Chalk and Talk / PPT

COURSE OUTCOMES:

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

CO1	Translate and simulate a real time activity using modern tools and discuss the Benefits of automation.

CO2	Identify suitable automation hardware for the given application.
CO3	Recommend appropriate modelling and simulation tool for the given manufacturing Application.
CO4	Explain the basic principles of Robotic technology, configurations, control and Programming of Robots.
CO5	Explain the basic principles of programming and apply it for typical Pick & place, Loading & unloading and palletizing applications

2, 3 and 4-Credit Theory Courses			
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. • **If any courses of 3 credits are of Integrated Course type, for such courses the method suggested for 4 credits IPCC shall be followed.**			

Suggested Learning Resources:

Books

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. SrinivasMedida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007. (http://www.pacontrol.com/download/Industri al Automation-Pocket-Guide.pdf)

3. Roland Siegwart, Illah R. Nourbakhsh, and DavideScaramuzza, “Introduction to Autonomous Mobile Robots”, 2ndEdition, PHI, 2011.

Data Book:

1. Thermodynamics data hand book by Nijaguna and Samaga, Sapna Publication.

Reference Books

1. Robotics for Engineers Yoram Koren McGraw Hill International 1st edition, 1995.
2. Industrial Robotics Weiss, Nagel McGraw Hill International 2nd edition, 2012
3. Robotic Engineering – An Integrated approach Klafter, Chmielewski and Negin PHI 1st edition, 2009
4. Computer Based Industrial Control Krishna Kant EEE-PHI 2nd edition,2010

E- Learning

1. Nptel.ac.in
2. VTU, E- learning
3. MOOCS
4. Open courseware

ABILITY ENHANCEMENT COURSES / SKILL DEVELOPMENT COURSES IV SEMESTER

B.E. (Common to All branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**Finance and Accounting**		
Course Code:	**BFAT456A**	**CIE MARKS**	**50**
(L: T: P) + S	**(1:0:0) + (15 HOURS / SEM)**	**SEE MARKS**	**50**
Credits:	**01**	**EXAM HOURS**	**02**

COURSE LEARNING OBJECTIVES:

1. To enable the students to understand the conceptual framework of accounting, reporting and financial statements.
2. To enable the students in understanding of books of accounts and accounting records leading to final accounts and interpretation there-off.
3. To acquaint the students with the concepts of Time value of Money for decision making.

Module-1 — **3 Hours**

Introduction to Accounting: Meaning and objectives, Branches of Accounting, GAAP, IAS, IFRS, Concepts and Conventions, Users of accounting, accounting terminologies. (Only Theory)

Self-Learning Activity: Self-exploration exercise where students write about their understanding of Golden rules of Accounting, Classification of Assets and Liabilities.
Students can Compare GAAP, IAS, and IFRS side by side on Origin, purpose, scope, key differences.
Textbook 1: Section 1; Chapter 1, 2 and 3

Module-2 — **3 Hours**

Journal, Ledgers, Trial balance, accounting equation, subsidiary books and final accounts (Only theory)

Self-Learning Activity: Students willwrite the liquidity and Profitability status by reading the financial statements of a Company.
Textbook 1: Section 1; Chapter 4, 5, 6 and 8

Module-3 — **2 Hours**

Emerging accounting Practices: Window dressing, forensic accounting, Green Accounting, Human resource accounting and sustainability reporting.

Self-Learning Activity: Students will understand the significance of human resources accounting in the corporate environment.

Textbook 2: Chapter 6

Module-4 — **3 Hours**

Overview of Financial Management: Meaning and scope- objectives of Financial Management- Functions of Finance-Role and functions of finance managers. Indian Financial System: Structure-types-Financial markets- Financial Instruments -Financial institutions and financial services- Non-Banking Financial Companies (NBFCs). (Theory only) **Self-Learning Activity**: Students will have to understand the classification of Banking industry and write the functions of Banking and Non -banking Organisations. **Textbook 3**: Part 1; Chapter 1 and 2	
Module-5	**4 Hours**
Emerging areas in Financial Management: Risk Management- Behavioural Finance- Financial Engineering- Derivatives (Theory). **Time Value of Money:** Time value of money –Future value of single cash flow & annuity – Present value and discounting-present value of single cash flow, annuity & perpetuity. Simple interest & Compound interest & loan amortization schedule (Simple problems on FV, FV for Annuity, PV and PV for annuity & Amortization Schedule) **Self-Learning Activity**:Students will Write their own simple problems based on the concepts and solve them. Example: “Calculate the FV of $1,000 invested for 5 years at 6% compound interest.” Students are engaged in preparing the Loan amortisation table with detailed interpretation. Students can Create mind maps showing the relationships and key components of risk management, financial engineering, derivatives, and behavioural finance. **Textbook 3**: Part III; Chapter 6	

COURSE OUTCOMES:

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

CO1	Recall the basic accounting concepts and terminologies
CO2	Understanding of journal, ledger, trial balance subsidiary books and accounting Equation and final accounts.
CO3	Analyse emerging trends in accounting
CO4	Familiar with the Emerging areas of financial management and create a Loan Amortisation table.

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 25 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 25 marks.
Total CIE (A+B)	50	20	The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks.
SEE (C)	50	18	Question papers having 50 MCQs with each question carrying 01 mark, and Examination duration is 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 are 20 out of allotted 50 marks to appear for SEE.			

Textbooks

1. Accounting forManagement, Maheswari S. N,Maheswari Sharad K, Vikas PublishingHouse (P) Ltd., Ed 2024.
2. Accounting for Managers, H.H. Ramesha, Pralhad Rathod, Praveen Kumar B. H., R.G. Saha, Himalaya Publishing House Pvt Ltd.,
3. Financial Management, Prasanna Chandra, TMH, Ed 2024

References

1. Financial Management, Ravi M Kishor, Taxmann's. (Recent Edition)
2. Financial Management, I M Paney, Vikas Publishing House Pvt. Ltd. (Recent Edition)
3. Accounting forManagement, Dr Jawahar Lal, Himalaya Publishing House Pvt Ltd., (Recent Edition)

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**ADVANCED PYTHON PROGRAMMING**		
Course Code:	**BMEL456B**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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 d) Write a python program to solve a linear matrix equation, or system of linear scalar equations.
7.	Graphics: • Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Use object oriented approach. • 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.

1-Credit Lab Course

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. 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.
4. Eric Matthes, "Python Crash Course, A Hands – on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.
5. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc-Graw Hill, 2019.

B.E. (Mechanical Engineering) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**SUSTAINABILITY IN MECHANICAL ENGINEERING**		
Course Code:	**BMET456C**	**CIE MARKS**	**50**
L : T : P + (SL)	**2 : 0 : 0 + (15 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**30 hours**	**TOTAL MARKS**	**100**

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

- Introduce students to the principles of sustainability in mechanical engineering.
- Understand the environmental impact of engineering decisions.
- Develop skills for integrating sustainability into engineering design and processes.
- Promote awareness of life-cycle thinking, energy efficiency, and green manufacturing.

MODULE – 1 **(6hours)**

Introduction to Sustainability Definition, need, and importance of sustainability. UN Sustainable Development Goals (SDGs) relevant to engineering. Role of mechanical engineers in achieving sustainability.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 2 **(6 hours)**

Sustainable Design and Manufacturing Design for environment (DfE), eco-design, and green product design. Energy-efficient machines and processes. Sustainable materials and recycling in mechanical design.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 3 **(6 hours)**

Energy and Resource Efficiency Renewable energy in mechanical systems (solar, wind, bio-energy). Waste heat recovery, energy auditing. Efficient use of resources in mechanical processes.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 4 **(6 hours)**

Sustainable Industrialization and Urbanization – Sustainable urbanization, industrialization, material selection, pollution prevention, industrial ecology, industrial symbiosis, poverty reduction.

Teaching Learning Process: Chalk and Talk / PPT

MODULE – 5 **(6 hours)**

Green technology and Green Business: Sustainable business, green technology, green energy, green construction, green transportation, green chemistry, green computing

Activity/Project Work Group-based mini-project or case study. Example topics: redesigning a mechanical product for sustainability, energy audit of a system, or analysing the LCA of a product. Presentation and report submission - For assignments

Teaching Learning Process: Chalk and Talk / PPT

COURSE OUTCOMES:

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

CO1	Explain the key concepts of sustainability and its relevance to mechanical engineering.
CO2	Identify sustainable materials, processes, and energy systems.
CO3	Analyze the environmental impact of mechanical systems and products using life-cycle

	assessment (LCA) basics.
CO4	Propose sustainable alternatives in engineering design and manufacturing.
CO5	Work on a mini-project that applies sustainability principles in a mechanical context.

1 and 2-Credit Theory Courses (MCQs for assessment)			
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 2hours.**
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:

Test Books (Title of the Book/Name of the author/Name of the publisher/Edition and Year)

- Texts on Sustainable Engineering (e.g., *"Sustainability in Engineering Design"* by Anthony Johnson)
- R. L. Rag and Lekshmi Dinachandran Remesh. *Introduction to Sustainable Engineering*. 2nd Edition,
  PHI Learning Pvt. Ltd., 2016.

References:

1. D. T. Allen and D. R. Shonnard. *Sustainability Engineering: Concepts, Design and Case Studies*, 1st Edition, Prentice Hall, 2011.
2. A.S. Bradley, A. O. Adebayo, P.Maria. *Engineering applications in sustainable design and development*, 1st Edition, Cengage learning, 2016.

ACTIVITY BASED LEARNING (SUGGESTED ACTIVITIES IN CLASS)/ PRACTICAL BASED LEARNING

- IS/ISO standards related to environment (e.g., ISO 14001, ISO 50001)
- Online platforms: NPTEL, Coursera, and UN SDG Toolkit for Engineers

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

Course Title:	**INTRODUCTION TO DATA ANALYTICS**		
Course Code:	**BMEL456D**	**CIE MARKS**	**50**
L : T : P + (SL)	**0 : 0 : 2**	**SEE MARKS**	**50**
Credits:	**1**	**EXAM HOURS**	**3**
Total hours of Pedagogy	**15 sessions**	**TOTAL MARKS**	**100**

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

1-Credit Lab Course			
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

B.E. (Common to All Branches) Outcome Based Education(OBE) and Choice Based Credit System(CBCS) SEMESTER – IV			
Course Title:	**Environmental Studies**		
Course Code:	**BENS407 / 507**	**CIE MARKS**	**50**
(L : T : P)+ SL	**(2:0:0) + (30 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**2**	**EXAM HOURS**	**2**

COURSE LEARNING OBJECTIVES:

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

1. Introduce the basic concepts of ecology and ecosystem functioning, including biodiversity and biogeochemical cycles.
2. Understand various types of environmental pollution, their sources, impacts, and preventive measures.
3. Explore causes of environmental degradation and methods of conservation with special emphasis on Indian biodiversity.
4. Create awareness about climate change, global warming, environmental legislation, and significant environmental movements in India.

Module-1 **6Hours**

Ecology: Basic concepts of ecosystem. Ecosystems (structure and function)- forest, desert, wetlands, river, oceanic and lake. Biotic and Abiotic components; Food chain; Ecological pyramid.

Biogeochemical Cycles:carbon cycle, nitrogen cycle, phosphorus cycle, water cycle

Sustainability: 17 Sustainable Development Goals (SDG)- history, targets, implementation, capacity development.

Module-2 **6Hours**

Environmental Pollution: Surface and ground water pollution, noise pollution, soil pollution, air pollution and marine pollution - sources, impacts on living beings, impacts on environment, preventive measures. case-study on marine pollution.

Water Chemistry: Significance and effect of pH, total dissolved solids and hardness. Case study on impact of fluoride on human health.

Module-3 **6Hours**

Environmental Degradation: Causes and effects of deforestation, desertification, soil erosion and glacier melting.

Environmental Conservation: Significance and key features of national parks, wildlife sanctuaries, reserved forest and mangrove forest. Importance of western ghats as biodiversity hotspot (flora and fauna)

Module-4 **6Hours**

Indian Monsoon and Global Warming

Climate- Impact on monsoons, significance of El Nino and La Nina on India climate.

Global warming: causes, greenhouse gases, effects on environment and human health. Causes and effects of acid rain and ozone depletion. Air sampler and its importance in assessing pollutants.	
Module-5	**6Hours**
Environmental Legislation: Environmental Protection Act 1984: Definition, Significance and key features. **Indian Environmental Movements:**Bishnoi Movement,Chipko &Appiko movement.	

COURSE OUTCOMES:

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

CO1	Describe the components and functions of ecosystems and explain major biogeochemical cycles and sustainability goals.
CO2	Understand various forms of pollution and environmental degradation, along with their impacts on ecosystems and human health.
CO3	Demonstrate awareness of climate issues, Indian environmental legislation, and the role of community-based movements in environmental protection.

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 each of 50 marks, 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 should 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 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Textbooks

1. BennyJoseph, “Environmentalstudies”, 3rded.,TataMcGraw-Hill, 2017.
2. SMPrakash, “Environmentalstudies”, 3rd ed.,Pristinepublishinghouse, 2018.

ReferenceBooks:-

1. M.AnjiReddy,"TextbookofenvironmentalscienceandTechnology", revised ed.,BSpublications, 2014.
2. Dr.B.SChauhan,"Environmentalstudies",1st ed., Universityofsciencepress, 2008.

B.E. (Common to all branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV / V			
Course Title:	**BIOLOGY FOR ENGINEERS**		
Course Code:	**BBOE407/507**	**CIE MARKS**	**50**
(L: T: P) + SL	**(2:0:0) + (30 Hours/Sem)**	**SEE MARKS**	**50**
Credits:	**2**	**EXAM HOURS**	**2**

COURSE LEARNING OBJECTIVES:

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

1. Familiarize the students with the basic biological concepts and their engineering applications.
2. Enable the students with an understanding of bio design principles to create novel devices and structures.
3. Provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
4. 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 production, Nucleic acids in vaccines and diagnosis, Proteins in food production, Enzymes in biosensors fabrication, food processing, enzymes in biobleaching, Lipids in biodiesel and detergents production.

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, Plant burrs, Shark skin, Kingfisher beak. Artificial blood - haemoglobin-based oxygen carriers (HBOCs) and perflourocarbons (PFCs).

Module-5 — **6 Hours**

Introduction to trends in bioengineering, Tissue engineering, stem cells and their applications, Bioprinting techniques and materials. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Bioconcrete.

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. adaptation.
CO3	Evaluate the principles of design and development, for exploring engineering knowledge in biological
CO4	Think critically towards exploring 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 each of 50 marks, 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 should 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 out of allotted 50 marks to appear for SEE, with minimum 40 % scored in every component of CIE.			

Textbooks

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 Edition, 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, Prentice Hall 2011.
6. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.

7. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
8. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
9. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha, A C Udayashankar, Lambert Academic Publishing, 2019.

B.E. (Common to All branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**UniversalHumanValues(UHV)**		
Course Code:	**BUHV408**	**CIE MARKS**	**50**
(L: T: P) + SL	**(1:0:0) + (15 HOURS / SEM)**	**SEE MARKS**	**50**
Credits:	**01**	**EXAM HOURS**	**02**

COURSE LEARNING OBJECTIVES:

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

4. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
5. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
6. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.
7. This course is intended to provide a much-needed orientation input in value education tothe young enquiring minds.

Module-1 — **3 Hours**

Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education) Understanding Value Education, Self-exploration as the Process for Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, Happiness and Prosperity – Current Scenario, Method to Fulfil the Basic Human Aspirations.

Self-Learning Activity: Self-exploration exercise where students write about their understanding of happiness and prosperity.

Module-2 — **3 Hours**

Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, distinguishing between the Needs of the Self and the Body, The Body as an Instrument of the Self, Understanding Harmony in the Self, Harmony of the Self with the Body, Programme to ensure self-regulation and Health.

Self-Learning Activity: Students will categorize their daily needs into 'self' and 'body' to understand their coexistence.

Module-3 — **3 Hours**

Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, 'Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Other Feelings, Justice in Human-to- Human Relationship, Understanding Harmony in the

Society, Vision for the Universal Human Order. **Self-Learning Activity**: Students will write and share a personal story where trust or respect played a key role in a relationship.	
Module-4	**3 Hours**
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfilmentamong the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. **Self-Learning Activity**: Students will have a nature walk to observe and reflect on coexistence and mutual fulfilment in nature.	
Module-5	**3 Hours**
Implications of the Holistic Understanding – a Look at Professional Ethics: Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics Holistic Technologies, Production Systems and Management Models-TypicalCase Studies, Strategies for Transition towards Value-based Life and Profession. **Self-Learning Activity**: Students are engaged in drafting their personal code of professional ethics aligned with human values.	

COURSE OUTCOMES:

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

CO1	Identify and describe the role of self, family, society, and nature in achieving holistic human well-being.
CO2	Analyze real-life personal and societal problems through the lens of human values and ethical reasoning.
CO3	Apply human values to interpersonal and professional situations to ensure harmony in relationships and society.
CO4	Integrate sustainability, ethics, and lifelong learning into personal and professional practices.

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 25 marks.
Alternate Assessment (B)	20	-	Any two Assessment methods as per 24RNBE4.2, scaled to 25 marks.
Total CIE (A+B)	50	20	The sum of two tests, two assignments, will be out of 100 marks and will be scaled down to 50 marks.

SEE (C)	50	18	Question papers having 50 MCQs with each question carrying 01 mark, and Examination duration is 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 are 20 out of allotted 50 marks to appear for SEE.			

Textbooks

1. The Textbook A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978- 93- 87034- 47-1
2. The Teacher's Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G

Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.
6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J C Kumarappa
8. Bharat Mein Angreji Raj – Pandit Sunderlal
9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)
14. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
15. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
16. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
17. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
18. A N Tripathy, 2003, Human Values, New Age International Publishers.
19. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.

20. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
21. M Govindrajan, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
22. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
23. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

B.E. (Common to All Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**NSS-NationalService Scheme**		
Course Code:	**BNSK459**	**CIE MARKS**	**100**
(L : T : P)+SL	**0:0:0:30**	**SEE MARKS**	**0**
Credits:	**0**	**EXAM HOURS**	**-**

COURSE LEARNING OBJECTIVES:

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

1. Understand the community in general in which they work.
2. Identify the needs and problems of the community and involve them in problem –solving.
3. Develop among themselves a sense of social & civic responsibility & utilize their knowledge in finding practical solutions to individual and community problems.
4. Develop competence required for group-living and sharing of responsibilities & gain skillsin mobilizing community participation to acquire leadership qualities and democratic attitudes.
5. Develop capacity to meet emergencies and natural disasters & practice national integration and social harmony in general.

Module-1
Water conservation techniques – Role of different stakeholders– Implementation.
Module-2
Preparing an actionable business proposal for enhancing the village income and approach for implementation.
Module-3
Helping local schools to achieve good results and enhance their enrolment in Higher/technical/ vocational education.
Module-4
NSS Activity-1
Module-5
NSS Activity-2

COURSE OUTCOMES:

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

CO1	Understand the significance of individual responsibilities towards society and contribute meaningfully to community welfare.
CO2	Analyze environmental and societal issues, and design feasible solutions to address them effectively
CO3	Critically evaluate existing systems and propose practical, sustainable solutions for long-term development.
CO4	Plan and implement government initiatives or self-driven projects effectively in real-life community settings.
CO5	Develop the capacity to respond to emergencies and natural disasters, while practicing national integration, social harmony, and unity in diversity.

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

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. (Common to All Branches) Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER – IV			
Course Title:	**Physical Education**		
Course Code:	**BPEK459**	**CIE MARKS**	**100**
L: T: P: S	**0:0:1: 0**	**SEE MARKS**	**---**
Credits:	**---**	**EXAM HOURS**	**---**

COURSE LEARNING OBJECTIVES:

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

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

Module-1 — **5 Hours**

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 — **5 Hours**

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 **5 Hours**
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	UnderstandthefundamentalconceptsofPhysicalEducation, games and sports skills,Health,Nutrition and Fitness
CO2	Familiarizationofhealth-relatedExercises,Sportsforoverallgrowthanddevelopment
CO3	Participateinthecompetitionatregional/state/national/internationallevels.
CO4	CreateconsciousnessamongthestudentsonHealth,FitnessandWellnessin developing and maintaining a healthy lifestyle.

ASSESSMENT DETAILS (Both CIE and SEE)

Zero-credit NCMC courses (MCQs for assessment)			
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.			

Textbooks

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
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.

<table>
<tr><td colspan="4" align="center">B.E. (Common to All Branches)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER – IV</td></tr>
<tr><td>Course Title:</td><td colspan="3">Yoga</td></tr>
<tr><td>Course Code:</td><td>BYOK459</td><td>CIE MARKS</td><td>100</td></tr>
<tr><td>L: T: P: S</td><td>0:0:1:0</td><td>SEE MARKS</td><td>---</td></tr>
<tr><td>Credits:</td><td>---</td><td>EXAM HOURS</td><td>---</td></tr>
<tr><td colspan="4">COURSE LEARNING OBJECTIVES:
The purpose of the course is to facilitate the learner to:
1. Physical, Mental & spiritual Objectives of Yoga
2. Explain the meaning of Yoga.
3. Discuss the importance of the Yoga and its scope.
4. Describe the aims and objectives of Yoga.
5. Clarify the misconceptions on Yoga</td></tr>
<tr><td colspan="3" align="center">Module-1</td><td align="right">5 Hours</td></tr>
<tr><td colspan="4">Patanjali Ashtanga Yoga
A. Yama: Ahimsa, satya, asteya, brahmacarya, aparigraha
B. Niyama: shoucha, santosh, tapa, svaadhyaya, Eshvarapranidhan
C. Suryanamaskara: 12 Counts, 4 Rounds</td></tr>
<tr><td colspan="3" align="center">Module-2</td><td align="right">5 Hours</td></tr>
<tr><td colspan="4">Asana
a) Meaning, Need & Importance of Asana
b) DifferentTypesofAsanas:
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</td></tr>
<tr><td colspan="3" align="center">Module-3</td><td align="right">5 Hours</td></tr>
<tr><td colspan="4">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.</td></tr>
</table>

COURSE OUTCOMES

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

CO1	UnderstandthefundamentalconceptsofYoga
CO2	improvesofhealth and related aspects, overallgrowthanddevelopment
CO3	Participateinthecompetitionatregional/state/national/internationallevels.
CO4	CreateconsciousnessamongthestudentsonHealth,FitnessandWellnessin 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.			

Textbooks

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” bySwamiSatyanandaSaraswati.

VISION

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

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