MECHANICS OF SOLID AND FLUIDS		Semester	3
Course Code	**BMT301**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	2:2:0	SEE Marks	50
Total Hours of Pedagogy	40 HOURS	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course Learning Objectives:

CLO 1. Gain knowledge of linear elastic properties and stress strain relations.

CLO 2. Derive and solve problems on Principal stresses developed in structures.

CLO 3. Compute the stress strain for bars, beams, shafts, and column and to apply the concept of dynamic similarity and to apply it to experimental modelling.

CLO 4. Gain knowledge of basic properties of fluids, fluid statics.

CLO 5. To apply conservation of mass, momentum and energy equation and to determine the discharge of fluid flow.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
5. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Simple Stress and Strain: Introduction, Concept of Stress and Strain, Linear elasticity, Hooke's Law and Poisson's ratio. Extension / Shortening of a bar, bars with varying cross sections (step and tapering circular and rectangular), Elongation due to self-weight, Principle of super position, St. Venant's Principle**.**

Simple shear stress and Shear strain. Volumetric strain: expression for volumetric strain, Elastic Constants and relations. Stresses in Composite Section

Module-2

Compound Stresses: Introduction, Concept of Plane stress, Stress tensor for plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

Module-3

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.

Elastic Stability of Columns: Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

Module-4

Introduction to Fluid mechanics: Introduction, Properties of fluids-mass density, weight density, specific volume, specific gravity, viscosity, surface tension, capillarity, vapour pressure, compressibility and bulk modulus. Concept of continuum, types of fluids etc., pressure at a point in the static mass of fluid, variation of pressure. Pascal's law, absolute, gauge, atmospheric and vacuum pressures; pressure measurement by simple, differential manometers and mechanical gauges.

Fluid Statics: Total pressure and centre of pressure for horizontal plane, vertical plane surface and inclined plane surface submerged in static fluid

Module-5

Fluid Kinematics: Velocity of fluid particle, types of fluid flow, description of flow, continuity equation, Coordinate free form, acceleration of fluid particle, rotational & irrotational flow, Laplace's equation in velocity potential and Poisson's equation in stream function, flow net.

Fluid Dynamics; Introduction. Forces acting on fluid in motion. Euler's equation of motion along a streamline. Integration of Euler's equation to obtain Bernoulli's equation, Assumptions and limitations of Bernoulli's equation. Major head loss (frictional), Introduction to Navier-Stokes equation. Application of Bernoulli's theorem such as venturi-meter, orifice meter, rectangular and triangular notch, pitot tube.

Course outcome (Course Skill Set)

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

- **CO 1.** Gain the knowledge of properties, and stress-strain relations in linear elastic solid members and fluids. To understand the concepts of fluid statics, kinematics and dynamics.
- **CO 2.** Describe stress-strain equation for axial, bending and torsion loads while addressing problems in engineering.
- **CO 3.** Apply the concepts of fluid statics, kinematics and dynamics while addressing problems in engineering and to determine the fluid flow through open and closed channel.
- **CO 4.** Determine the stress & strain for simple stresses, compound stresses, shafts & columns.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. "Mechanics of Materials", by R.C.Hibbeler, Prentice Hall. Pearson Edu., 2011.
2. "Mechanics of materials", James.M.Gere, Thomson, Eighth edition2013.
3. "Mechanics of materials", in SI Units, Ferdinand Beer & Russell Johston, 5th Ed., TATA McGraw Hill- 2003.
4. A Text Book of Fluid Mechanics and Hydraulic Machines" Dr R.K Bansal Laxmi Publishers.
5. "Fluid Mechanics (SI Units)" Yunus A. Cengel John M.Cimbala, TataMcGraw Hill 3rd Ed.,2014.

Reference Books:

1. "Strength of Materials", S.S. Rattan, Tata McGraw Hill, 2009.
2. "Strength of Materials", S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. "Engineering Mechanics of Solids", Egor.P. Popov, Pearson Edu. India, 2nd, Edition, 1998.

4. "Strength of Materials", W.A. Nash, 5th Ed., Schaum's Outline Series, Fourth Edition-2007.
5. "Fluid Mechanics" F M White, McGraw Hill Publications Eighth Edition.
6. "Introduction to Fluid Mechanics" Fox, McDonald John, Wiley Publications 8th edition.

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

- Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, grey C.I, SG iron, Brass, Bronze & composites.
- Tensile, shear and compression tests of steel, aluminium and cast iron specimens using Universal Testing Machine
- Torsion Test on steel bar. and Izod and Charpy Tests on Mild steel and C.I Specimen.
- Determination of coefficient of friction of flow in a pipe.
- Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades.
- Calibration of flow measuring devices.

NALOG AND DIGITAL ELECTRONICS (IPCC)		Semester	3
Course Code	**BMT302**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course Learning Objectives:

CLO 1. Understand the operation and Learn the Design of Opamp Active Filters.
CLO 2. Understand the Working Principle and Design of Oscillators and Comparators.
CLO 3. Understand the Working Principle and Design of 555 timers and Its applications.
CLO 4. Understand the operation and Design of Combinational Logic.
CLO 5. Understand the Working Principle and Learn the Design of Sequential Logic.

Teaching-Learning Process (General Instructions)

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

1. Lecturer method(L)does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
2. Arrange visits to nearby PSU such as BHEL, BEL, ISRO, etc .and small-scale hardware industries to give brief information about the electronics manufacturing Industry.
3. Show Video/animation films to explain the functioning of various analog and digital circuits.
4. Encourage collaborative (Group)Learning in the class
5. Ask at least three HOTS(Higher-order Thinking)questions in the class, which promotes critical thinking
6. Adopt Problem Based Learning (PBL),which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.

MODULE-1

Op-Amp active filters: Introduction, Active filters, I order low pass filter, Design, frequency scaling, II order low pass filter: Design, I order high pass filters: Design, II order high pass filters: Design, Band Pass Filter: wide Band pass filter, Band reject filter: wide Band reject filter.

Text 1: Chapter 7

MODULE-2
Oscillators and Comparators: Oscillators: Oscillator Principles, Types, Frequency Stability, RC Phase shift oscillator, Wein bridge oscillator. Problems. Comparators: Basic Comparators, Non-Inverting Comparator, Inverting Comparator, Zero Crossing Detector, Schmitt Trigger, Derivation for Hysteresis Voltage. Problems. **Text1: Chapter 7 and 8.**
MODULE-3
555 timers and Its applications: Introduction, the 555-timer Pin diagram, Architecture of 555 timers, 555 timer as Monostable multivibrator, 555 Timers as Astable multivibrator, Derivation for Percentage Duty cycle. Applications of Astable Multivibrator: Square Wave Oscillator. Applications of Monostable Multivibrator: Frequency Divider Problems. **Text1: Chapter 9**
MODULE-4
Combinational Logic: Introduction to K-Maps: 2, 3 and 4 variable maps. Adders: Half adder and Full adder. Subtractor: Half subtractor and Full subtractor. Multiplexers: 4:1 multiplexer, Quadruple 2 to 1 line multiplexer, Boolean function Implementation. Demultiplexers: 1:4 Demux, Implementation using decoder, Encoders: Octal to binary encoder. Decoders: 3-to-8-line decoder, BCD to Decimal decoder and 4X16 Decoder. **Text2: Chapter 3 and 5.**
MODULE-5
Sequential Logic: Introduction, Flip flops: Basic circuits, RS flip flop, D-flipflop,clocked D-flip-flop, JK flip flop, clocked JK flip-flop, T-flip-flop, clocked T-flip-flop, Counters: Synchronous counter-Design of 3 Bit Binary Up counter. **Text 2: Chapter 6.**

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

Sl.NO	Experiments
1	Design and Rig up a Shunt Clipper circuit to limit the Positive Peak Voltage to +2V,Negative Peak Voltage to -2V and and Double Ended Clipper to limit output voltage to +4v and -4v.
2	Design and Rig up a circuit to Realize the operation of Positive and Negative Clampers.
3	Design and Rig up a circuit to Realize the operation of Inverting, Non-Inverting Amplifier and Voltage Follower using Op-Amp.
4	Design and Rig up a circuit to Realize the operation of 555 Timer as Monostable and Astable Multivibrator.
5	Simplification of Boolean Expression using K-maps and Realization of Simplified Boolean Expression using Basic Gates and Universal Gates.
6	Realization of Half Adder and Full Adder using Basic Gates ,Universal Gates and Verify its Truth Table of Operation.
7	Rig up a circuit using IC 74153 and Verify Truth Table of Operation of Multiplexer.
8	Rig up a circuit using IC 74139 and Verify Truth Table of Operation of Demultiplexers.
9	Rig up a circuit using IC 74147 and Verify Truth Table of Operation of Encoders
10	Rig up a circuit using IC 7447 and Verify Truth Table of Operation of Decoders.
11	Rig up a circuit using IC 7495 ,IC7404 and Verify Truth Table of Operation of Ring Counter and Johnson Counter

12	Rig up a circuit using IC 7490 and Verify Truth Table of Operation of Mod-7 Counter.

Course outcomes (Course Skill Set):

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

CO 1. Understand the working principle of Analog & Digital Electronic Circuits.

CO 2. Understand the characteristics & response of Analog & Digital Electronic Circuits.

CO 3. Formulate the relations for Voltage Gain, Frequency of Various Analog Electronic Circuits & Boolean Expressions for Digital Electronic Circuits.

CO 4. Design the Analog & Digital Electronic Circuits for Required Specifications.

CO 5. Design and conduct the experiment on clippers ,clampers, amplifiers, 555 timers for the design specifications.

CO 6. Design and conduct the experiment to verify the truth table operation of combinational and sequential circuit**.**

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

TextBooks:

1. "Opamp and Linear Integrated Circuits", Ramakant A Gayakwad 3rd edition, PHI.
2. "Digital Logic and Computer Design", M Morris Mano, 2001 edition, PHI.

Reference Books:

1. "Digital Electronics: Principles and Integrated circuits", Anil K Maini, 2008, wiley India.
2. "Linear Integrated Circuits", D. Roy Choudhury and Shail B Jain, 2nd edition, Reprint 2006, New Age International.

"Digita l Principles and applications", Malvino& Leach, Tata Mc. Graw Hill.

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

- Group activities
- Presentations
- Quiz

MATERIAL SCIENCE AND MANUFACTURING TECHNOLOGY (IPCC)		Semester	3
Course Code	**BMT303**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	04	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

CLO 1. To understand the structure, behaviour and properties of engineering materials.
CLO 2. To understand processing and types of composite materials and ceramics.
CLO 3. To provide adequate knowledge of Manufacturing technology and casting.
CLO 4. To provide knowledge of various welding process in manufacturing
CLO 5. To introduce students to different machine tools to produce components having different shapes and sizes.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

MODULE-1

Introduction to Crystal Structure: Coordination number, atomic packing factor, Simple Cubic, BCC,FCC and HCP Structures, Crystal imperfections–point, line, surface and volume imperfections. Atomic Diffusion: Phenomen on, Fick's laws of diffusion (First and Second Law); Factors affecting diffusion.

Mechanical Behavior: Stress-strain diagrams showing ductile and brittle behavior of materials, Engineering stress and true strains, Linear and non- linear elastic behavior and properties, Mechanical properties in plastic range: Stiffness, Yield strength, Offset Yield strength, Ductility, Ultimate Tensile strength, Toughness. Plastic deformation of single crystal by slip and twinning, Mechanisms of strengthening in metals.

MODULE-2
Composite materials: Definition, classification, types of matrix materials & reinforcements, Metal Matrix Composites (MMCs), Ceramic Matrix Composites (CMCs) and Polymer Matrix Composites (PMCs), Particulate-reinforced and fiber- reinforced composites, Fundamentals of production of composites, hybrid composites. Applications of composite materials. **Smart Materials:** Piezoelectric Materials, Electrostrictive Materials, Magnetostrictive Materials, Magnetoelectric Materials. Magnetorheological Fluids, Electrorheological Fluids, Shape Memory Materials, Fiber-Optic Sensors.
MODULE-3
Introduction to Manufacturing Process: Concept of Manufacturing process, its importance. Classification of Manufacturing processes. **Casting:** Introduction to Casting process &steps involved. Various components produced by casting process, Advantages &Limitations. **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, thixocasting, and continuous casting processes.
MODULE-4
Welding process: Definition, Principles, classification, application, advantages & limitations of welding. Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW). **Special types of welding**: Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.
MODULE-5
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 tool materials and applications. **Introduction to basic metal cutting machine tools:** Lathe- Parts of lathe machine, accessories of lathe machine, and various operations carried out on lathe. **Milling:** Various Milling operations, classification of milling machines, Vertical & Horizontal milling, up milling& down milling. Indexing: need of indexing, simple, compound & differential indexing. **Drilling**: Difference between drilling, boring & reaming, types of drilling machines. Boring operations & boring machines.

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

Sl.NO	Experiments
1	To determine the tensile strength of the metallic specimen using Universal Testing Machine.
2	To determine the compressive strength of the metallic specimen using Universal Testing Machine
3	To determine the shear strength of the specimen using Universal Testing Machine
4	To determine the torsional strength of the specimen.
5	To determine Maximum Bending Moment on Non-metallic specimens.
6	To determine Impact strength of the specimen using Izod impact testing machine.
7	To determine Impact strength of the specimen using Charpy impact testing machine.
8	To determine the hardness of the specimen using Brinell hardness setup
9	To determine the hardness of the specimen using Rockwell hardness setup
10	To Study of Microstructure of the metallic specimen using optical Microscope.
11	Demonstration of one model on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling.
12	Demonstration of one model models on Milling Machine involving Upmilling, Downmilling and Indexing

Course outcomes (Course Skill Set):

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

CO 1. Understand mechanical properties of metals, alloys and composites.

CO 2. Describe the process of casting, different methods to process composite materials.

CO 3. Determine the mechanical properties of given materials through material testing experiments

CO 4. Develop components of different shapes involving conventional machining operations

CO 5. Prepare/ develop a physical model by performing different machining operations

CO 6. Determine the mechanical properties of given materials and visualize the micro structure of the specimen

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Book:

1. Materials Science and Engineering, William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.
2. Mechanics of Composite Materials, Second Edition, Autar K. Kaw, CRC Press, 2005.
3. Smart Materials and Structures - M. V. Gandhi and B. So Thompson - Chapman & Hall, London; New York - 1992 (ISBN: 0412370107).
4. Principles of metal casting Rechard W. Heine, Carl R. Loper Jr., Philip C. Rosenthal Tata McGraw Hill Education Private Limited 1976

Reference Books:

1. An Introduction to Metallurgy; Alan Cottrell, Universities Press India Oriental Longman Pvt. Ltd., 1974.
2. "Manufacturing Technology Serope"Kalpakjian Steuen. R Sechmid Pearson Education Asia 5th Ed. 2006

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

1. Preparation of specimen for Metallographic examination of different engineering materials. To report microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Preparation of two models on lathe involving Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling.

COMPUTER ORGANIZATION AND ARCHITECTURE		Semester	3
Course Code	**BMT304**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	Theory		

Course Learning Objectives:

CLO 1. Explain the basic sub systems of a computer, their organization, structure and operation.
CLO 2. Illustrate the concept of programs as sequences of machine instructions.
CLO 3. Demonstrate different ways of communicating with I/O devices
CLO 4. Describe memory hierarchy and concept of virtual memory.
CLO 5. Illustrate organization of simple pipelined processor and other computing systems

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation **(upto 1.6.2 of Chap 1 of Text).**
Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters, number representations, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing **(upto 2.4.6 of Chap 2 of Text).**

Module-2

Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions **(from 2.4.7 of Chap 2, except 2.9.3, 2.11 & 2.12 of Text).**

Module-3

Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access **(upto 4.2.4 and 4.4 except 4.4.1 of Chap 4 of Text).**

Module-4

Memory System: Basic Concepts, Semiconductor RAM Memories- Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks **(5.1, 5.2, 5.2.1,5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).**

Module-5

Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control **(upto 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).**

Course outcome (Course Skill Set)

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

CO 1. Explain the basic organization of a computer system.

CO 2. Explain different ways of accessing an input / output device including interrupts.

CO 3. Illustrate the organization of different types of semiconductor and other secondary storage memories.

CO 4. Illustrate simple processor organization based on hardwired control and micro programmed control.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Books:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware /Software Interface ARM Edition, 4th Edition, Elsevier, 2009.
2. William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.
3. Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

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

- Group discussion
- Presentation
- Quiz

COMPUTER AIDED MACHINE DRAWING		Semester	3
Course Code	**BMT305**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0:0:2**	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	**01**	Exam Hours	3
Examination type (SEE)	**Practical**		

Course objectives:

CLO 1. To acquire the knowledge of limits, tolerance and fits and indicate them on machine drawings.

CLO 2. To make drawings using orthographic projections and sectional views

CLO 3. To impart knowledge of thread forms, fasteners, keys, joints, couplings and clutches.

CLO 4. To understand and interpret drawings of machine components leading to preparation of assembly drawings manually and using CAD packages.

Module-1

Review of basic concepts of Engineering Visualization

Geometrical Dimensioning and Tolerances (GD&T): Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, machining symbols, types of fits with symbols and applications, geometrical tolerances on drawings. Standards followed in industry.

Module-2

Sections of Simple and hollow solids: True shape of sections.

Module-3

Thread Forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal & External) square and Acme. Sellers thread, American Standard thread, Helicoil thread inserts

Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly), simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, countersunk head screw, grub screw, Allen screw

Rivets

Keys: Parallel key, Taper key, Feather key, Gib-head key and Woodruff key.

Module-4

Assembly of Joints, couplings and clutches (with GD&T) using 2D environment

Joints: Like Cotter joint (socket and spigot), knuckle joint (pin joint).

Couplings: Like flanged coupling, universal coupling

Clutches: Like Single Plate clutch, cone clutches

Module-5

Assembly of Machine Components (with GD&T) using 3D environment

(Part drawings shall be given)

1. **Bearings**
2. **Valves**
3. **Safety Valves**
4. **I.C. Engine components**
5. **Lifting devices**
6. **Machine tool components**
7. **Pumps**

Course outcome (Course Skill Set)

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

CO1. Interpret the Machining and surface finish symbols on the component drawings.

CO2. Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.

CO3. Illustrate various machine components through drawings

CO4. Create assembly drawings as per the conventions.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks) and that for SEE minimum passing mark is 35% of the maximum marks (18 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

- CIE shall be evaluated for max marks 100. Marks obtained shall be accounted for CIE final marks, reducing it by 50%.
- CIE component should comprise of
  - Continuous evaluation of Drawing work of students as and when the Modules are covered.
  - At least one closed book **Test** covering all the modules on the basis of below detailed weightage.
  - ***Weightage for Test and Continuous evaluation shall be suitably decided by respective course coordinators***.

Module	**Max. Marks weightage**	**Evaluation Weightage in marks**	
		Computer display & printout	**Preparatory sketching**
Module 1	10	05	05
Module 2	15	10	05
Module 3	25	20	05
Module 4	25	20	05
Module 5	25	25	00
Total	**100**	**80**	**20**

SEE Evaluation:

Module	**Max. Marks Weightage**	**Evaluation Weightage in marks**	
		Computer display & printout	**Preparatory sketching**
Module 4	40	30	10
Module 5	60	50	10
Total	**100**	**80**	**20**

Text Books

- K L Narayana, P Kannaiah, K Venkata Reddy, "Machine Drawing", New Age International, 3rd Edition. ISBN-13: 978-81-224-2518-5, 2006
- N D Bhatt , "Machine Drawing", Charotar Publishing House Pvt. Ltd.,50th Edition, ISBN-13: 978-9385039232, 2014

Reference Books:

- Sadhu Singh, P. L. Sah, "Fundamentals of Machine Drawing", PHI Learning Pvt. Ltd, 2nd Edition, ISBN: 9788120346796, 2012
- Ajeet Singh, "MACHINE DRAWING", Tata McGraw-Hill Education, , ISBN: 9781259084607, 2012

ANALOG COMMUNICATION SYSTEMS		Semester	3
Course Code	**BMT306A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination type (SEE)	Theory		

Course Learning Objectives:

1. Explain the fundamentals of Communication System.
2. Illustrate the various processes involved in Pulse Modulation.
3. Explain the various processes involved in Pulse Position Modulation.
4. Explain the various processes involved in The Quantization Process.
5. Explain the various processes involved in Delta Modulation.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Introduction: Historical Background, Applications, Primary Resources and Operational Requirements, Underpinning Theories of Communication Systems, Concluding Remarks.

Module-2

Pulse modulation: Introduction, The Sampling Process, Pulse-Amplitude Modulation, Time-Division Multiplexing.

Module-3

Pulse Position Modulation: Introduction, Generation of PPM Waves, Detection of PPM Waves, Noise in Pulse-Position Modulation, Examples, Bandwidth-noise Trade OFF.

Module-4

The Quantization Process: Introduction, Quantization noise, Pulse code Modulation-Introduction, Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing, Synchronization, Noise Consideration In PCM Systems, Virtues, Limitations and Modifications of PCM.

Module-5

Delta Modulation: Introduction, Illustration of Delta Modulation, Delta-sigma modulation-Introduction, Two Equivalent versions of Delta-sigma modulation, Differential Pulse-code Modulation – Introduction, Coding speech at low bit rates, Adaptive Differential Pulse-code Modulation, Adaptive sub band Coding.

Course outcome (Course Skill Set):

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

1. Analyse the fundamentals of Communication System.
2. Recognize the various processes involved in Pulse Modulation.
3. Identify the various processes involved in Pulse Position Modulation.
4. Quantify the various processes involved in The Quantization Process.
5. Analyse the various processes involved in Delta Modulation.

Assessment Details (both CIE and SEE) :

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. **Communication Systems**, Simon Haykins, 3rd Edition, John Willey & sons, India Pvt. Ltd, 2009.
2. **An Introduction to Analog and Digital Communication**, Simon Haykins, Michael Moher, 2nd edition, John Wiley, India Pvt. Ltd., 2008.
3. **Modern digital and analog Communication systems,** B. P. Lathi, Oxford University Press., 4th ed, 2010,
4. **Communication Systems**, Harold P.E, Stern Samy and A Mahmond, Pearson Edn, 2004.
5. **Communication Systems:** Singh and Sapre: Analog and digital TMH 2nd , Ed 2007.

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

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

- Gaining hands on Knowledge to work on Mat Lab Tool
- Simulation on Mat Lab tool for various Analog Communication operations.

SIGNAL & SYSTEMS		Semester	3
Course Code	**BMT306B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course Learning Objectives:

1. Explain the fundamentals of Signals and its Properties.
2. Explain the time Representation of LTI Systems and various Signal Operations.
3. Explain the time Representation of LTI Systems and various Signal Properties.
4. Explain the Fourier Series representation of signals and its properties.
5. Explain the Fourier Transform of signals and its properties.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Arrange visits to show the live working models other than laboratory topics.
4. Adopt collaborative (Group Learning) Learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analysing information.
6. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Introduction: Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems.

Module-2

Time-domain representations for LTI systems – 1: Convolution, impulse response representation, Convolution Sum and Convolution Integral.

Module-3

Time-domain representations for LTI systems – 2: properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.

Module-4

Fourier representation for signals – 1: Introduction, Discrete time and continuous time Fourier series (derivation of series excluded) and their properties.

Module-5

Fourier representation for signals – 2: Discrete and continuous Fourier Transforms (derivations of transforms are excluded) and their properties.

Course outcome (Course Skill Set)

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

1. Identify the Importance of Signals and its Properties.
2. Analyze the time Representation of LTI Systems and various Signal Operations.
3. Analyze the time Representation of LTI Systems and various Signal Properties.
4. Analyze the Fourier Series representation of signals and its properties.
5. Analyze the Fourier Transform of signals and its properties.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons,2001.
2. Simon Haykin, "Signals and Systems", John Wiley India Pvt. Ltd., 2 nd Edn, 2008.
3. Michael Roberts, "Fundamentals of Signals & Systems", 2nd ed, Tata McGraw-Hill, 2010
4. Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
5. H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
6. B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005
7. Ganesh Rao and Satish Tunga, "Signals and Systems", Pearson/Sanguine Technical Publishers, 2004

Web links and Video Lectures (e-Resources):

- VTU e-Shikshana Program
- VTU EDUSAT Program.

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

- Gaining hands on Knowledge to work on Mat Lab Tool
- Simulation on Mat Lab tool for various signal processing operations.

PYTHON PROGRAMMING		Semester	3
Course Code	**BMT306C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course Learning Objectives:

- **CLO 1.** Understand the need of python programming and use different variables and expressions
- **CLO 2.** Understand the working of conditional statements and functions
- **CLO 3.** Demonstrate proficiency in iterating the programs and handling strings
- **CLO 4.** Demonstrate proficiency in handling file systems and regular expressions
- **CLO 5.** Understand methods to use lists, dictionaries and tuples

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
5. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Introduction to Python:

Why should you learn to write programs, Variables, expressions and statements

Text book 1: Chapter 1 and 2

Module-2

Conditional execution, Functions: Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, catching exceptions using try and except, Short-circuit evaluation of logical expressionsFunction calls, Built-in functions, Type conversion functions, Math functions, Random numbers, Adding new functions, Definitions and uses, Flow of execution, Parameters and arguments, Fruitful functions and void functions, Why functions?

Text book 1: Chapter 3 and 4

Module-3

Iteration and Strings:

Updating variables, The while statement, Infinite loops, Finishing iterations with continue, Definite loops using for, Loop patterns. A string is a sequence, Getting the length of a string using len, Traversal through a string with a loop, String slices, Strings are immutable, Looping and counting, The in operator, String comparison, String methods, Parsing strings, Format operator

Text book 1: Chapter 5 and 6

Module-4
File and Regular Expressions: Persistence, Opening files, Text files and lines, Reading files, Searching through a file, Letting the user choose the file name, Using try, except, and open, Writing files Character matching in regular expressions, Extracting data using regular expressions, Combining searching and extracting, Escape character Text book 1: Chapter 7 and 11
Module-5
Lists, Dictionaries, Tuples: A list is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Deleting elements, Lists and functions, Lists and strings, Parsing lines, Objects and values, Aliasing, List arguments Dictionary as a set of counters, Dictionaries and files, Looping and dictionaries, Advanced text parsing Tuples are immutable, Comparing tuples, Tuple assignment, Dictionaries and tuples, Multiple assignment with dictionaries, The most common words, Using tuples as keys in dictionaries Text book 1: Chapter 8, 9 and 10
Course outcome (Course Skill Set) At the end of the course, the student will be able to : **CO 1.** Understand the need of python programming and use different variables and expressions **CO 2.** Understand the working of conditional statements and functions **CO 3.** Demonstrate proficiency in iterating the programs and handling strings **CO 4.** Demonstrate proficiency in handling file systems and regular expressions, lists, dictionaries and tuples

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3", 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Download pdf files from the above links)

Reference Books:

1. Charles Dierbach, "Introduction to Computer Science Using Python",1 st Edition, Wiley India Pvt Ltd, 2015. ISBN-13: 978-8126556014
2. Gowrishankar S, Veena A, "Introduction to Python Programming", 1 st Edition, CRC Press/Taylor & Francis, 2018. ISBN-13: 978-0815394372
3. Mark Lutz, "Programming Python",4 th Edition, O"Reilly Media, 2011.ISBN-13: 978- 935023287

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

- Group activity
- Presentation

PRODUCT LIFE CYCLE MANAGEMENT		Semester	3
Course Code	**BMT306D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40 Hrs**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course Learning Objectives:

This course enables students to:

CLO 1. Familiarize with various strategies of PLM

CLO 2. Understand the concept of product design and simulation.

CLO 3. Develop New product development, product structure and supporting systems

CLO 4. Interpret the technology forecasting and product innovation and development in business processes.

CLO 5. Understand product building and Product Configuration.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

INTRODUCTION TO PLM AND PDM

Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems.

Module-2

PRODUCT DESIGN

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modelling and simulation in product

Module-3

PRODUCT DEVELOPMENT

New Product Development, Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

Module-4

TECHNOLOGY FORECASTING

Technological change, methods of technology forecasting, relevance trees, morphological methods, flow diagram and combining forecast of technologies Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process according to the situation, methods and tools in the innovation process according to the situation.

Module-5

PRODUCT BUILDING AND STRUCTURES

Virtual product development tools for components, machines, and manufacturing plants: 3D CAD systems, digital mock-up, model building, model analysis, production (process) planning, and product data technology,

Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items

Course outcome (Course Skill Set)

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

- **CO 1.** Explain the various strategies of PLM and Product Data Management
- **CO 2.** Describe decomposition of product design and model simulation
- **CO 3.** Apply the concept of New Product Development and its structuring.
- **CO 4.** Analyze the technological forecasting and the tools in the innovation.
- **CO 5.** Apply the virtual product development and model analysis.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Stark, John. Product Lifecycle Management: Paradigm for 21st Century ProductRealisation, Springer-Verlag, 2004. ISBN 1852338105
2. Fabio Giudice, Guido La Rosa, Product Design for the environment-A life cycle approach, Taylor & Francis 2006.
3. Saaksvuori Antti / Immonen Anselmie, product Life Cycle Management, Springer, Dreamtech, 3-540-25731-4.
4. Product Lifecycle Management, Michael Grieves, Tata McGraw Hill.

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/112/107/112107258/
- https://archive.nptel.ac.in/courses/105/105/105105157/
- https://www.coursera.org/projects/the-product-life-cycle

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

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

PROGRAMMING IN PYTHON		Semester	3
Course Code	**BMT358A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

CLO 1. Demonstrate the use of Anaconda or PyCharm IDE to create Python Applications

CLO 2. Develop Python programming language to develop programs for solving real-world problems

CLO 3. Utilize Object-Oriented Programming concepts in Python.

CLO 4. Analyse the working of various documents like PDF, Word file

Sl.NO	**Experiments**
1	Develop a python program to find the best of two test average marks out of three test's marks accepted from the user.
2	Develop a python program to find the smallest and largest number in a list
3	Develop a python program to arrange the numbers in ascending and descending order
4	Develop a binary search program in python
5	Develop a bubble sort program in python
6	Develop a Python program to check whether a given number is palindrome or not and also count the number of occurrences of each digit in the input number.
7	Write a Python program that accepts a sentence and find the number of words, digits, uppercase letters and lowercase letters.
8	Write a Python program for pattern recognition with and without using regular expressions
	Demonstration Experiments (For CIE)
9	Demonstrate python program to read the data from the spreadsheet and write the data in to the spreadsheet
10	Demonstration of reading, writing and organizing files.
11	Demonstration of the concepts of classes, methods, objects and inheritance
12	Demonstration of working with PDF and word files

Course outcomes (Course Skill Set):

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

CO 1. Demonstrate proficiency in handling of loops, lists and creation of functions.

CO 2. Identify the commonly used operations involving regular expressions and file system.

CO 3. Examine working of PDF and word file formats

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.
The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. Charles R. Severance, "Python for Everybody: Exploring Data Using Python 3" 1st Edition, CreateSpace Independent Publishing Platform, 2016. (http://do1.drchuck.com/pythonlearn/EN_us/pythonlearn.pdf)
2. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd Edition, Green Tea Press, 2015. (http://greenteapress.com/thinkpython2/thinkpython2.pdf) (Download pdf files from the above links)
3. Al Sweigart, "Automate the Boring Stuff with Python",1stEdition, No Starch Press, 2015. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)
   Reema Thareja "Python Programming Using Problem Solving Approach" Oxford University Press.

TRENDS IN DIGITAL MANUFACTURING		Semester	3
Course Code	**BMT358B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0:2:0:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01
Examination type (SEE)	**Theory**		

Course objectives:

CLO 1. To understand the basic design process and Product life cycle
CLO 2. To know the steps involved in Computer sided design
CLO 3. To understand basics of Additive manufacturing
CLO 4. To gain knowledge on different additive manufacturing techniques
CLO 5. To know the process of Reverse Engineering

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Using different ICT tools in teaching
2. Encourage collaborative (Group)Learning in the class
3. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.

Module-1

Design processes and methods, Introduction to CAD/CAM/CAE technologies and product lifecycle management (PLM).

Module-2

Computer Aided Design (CAD): applications of computers in design, software configuration, functions of graphics package, constructing the geometry.

Module-3

Additive manufacturing- General methodology, stages and components of the process. Main technologies, principles and applications. Strengths, weaknesses, challenges, and limitations of additive manufacturing technologies.

Module-4

Additive manufacturing processes: Photo polymerization, material jetting, binder jetting, material extrusion, Powder bed sintering techniques, sheet lamination, direct energy deposition techniques, applications of AM.

Module-5

Reverse Engineering- applications and selection of reverse engineering systems. Hardware and software involved.

Course outcome (Course Skill Set)

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

CO 1. To understand the meaning of digital manufacturing, and different techniques involved in it

CO 2. To describe the digital manufacturing techniques in reverse engineering

CO 3. To apply the knowledge of additive manufacturing process in choosing particular method.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

- The question paper will have ten questions. Each question is set for 10 marks.
- There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. Automation, Production Systems and Computer-Integrated Manufacturing Mikell P Groover Pearson Learning, 4th Edition,2015
2. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Ian Gibson, David W. Rosen, Brent Stucker 2nd Ed. (2015)
3. CAD / CAM Principles and Applications P N Rao Tata McGraw-Hill 3rd Edition, 2015
4. CAD/CAM Ibrahim Zeid Tata McGraw Hill,
5. "Understanding Additive Manufacturing", Andreas Gebhardt, Hanser Publishers, 2011

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

- Group task
- Quiz
- Projects on 3D Printers

PCB Design Technologies		Semester	3
Course Code	**BMT358C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

1. Students will be learning to work on PCD design tools.
2. Students will be constructing various electronic circuits on PCD design tools.
3. Students will be implementing various electronic circuits on PCD design tools.
4. Students will understand the structure of various electronic circuits on PCD design tools.

Sl.NO	Experiments
1	Ohm's Law Verification: Build a simple circuit using a resistor, a power supply, and a voltmeter and ammeter to verify Ohm's Law relationship (V = IR).
2	Series and Parallel Circuits: Construct circuits with resistors and measure voltage and current to understand the behaviour of series and parallel circuits.
3	Capacitor Charging and Discharging: Investigate the charging and discharging characteristics of a capacitor by connecting it to a power supply through a resistor and observing the voltage across the capacitor.
4	Transistor Amplifier: Design a transistor amplifier circuit using a small-signal transistor and measure the voltage gain to understand the basic principles of amplification.
5	LED Blinking Circuit: Build a simple circuit using a resistor, a transistor, and an LED to create an electronic circuit that blinks an LED at a certain frequency.
6	Diode Rectifier Circuit: Construct a diode bridge rectifier circuit using diodes, capacitors, and resistors to convert an AC signal to DC signal and measure the output voltage.
7	Digital Logic Gates: Construct circuits using basic digital logic gates (AND, OR, NOT) and observe the output behaviour for different input combinations.
8	Op-Amp Applications: Explore various applications of operational amplifiers (op-amps) such as inverting and non-inverting amplifiers.
	Demonstration Experiments (For CIE)
9	555 Timer IC: Build a circuit using the versatile 555 timer IC to create different types of signals, such as a square wave and ramp wave.
10	Microcontroller Projects: Utilize a microcontroller, such as Arduino, to build more complex projects like temperature-controlled fan, light-sensitive LED, or a digital thermometer.
11	Op-Amp Applications: Explore various applications of operational amplifiers (op-amps) such as voltage followers and summing amplifiers.
12	555 Timer IC: Build a circuit using the versatile 555 timer IC to create different types of signals, such as a square wave, a pulse wave, or a timer.

Course outcomes (Course Skill Set):

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

- To work on PCB design tools.
- Construct various electronic circuits on PCD design tools for required specifications.
- Implement various electronic circuits on PCD design tools for required applications
- Analyze the structure of various electronic circuits on PCD design tools.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. Implement various electronics circuits on open source KiCad PCB Design Tool
2. Implement various electronics circuits on open source Circuit maker(online)

ROBOTICS ECOSYSTEM		Semester	3
Course Code	**BMT358D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**30**	Total Marks	100
Credits	**01**	Exam Hours	01
Examination type (SEE)	**Theory**		

Course objectives:

CLO 1. To introduce the functional elements of Robots

CLO 2. To educate on carious concepts in robot anatomy and control

CLO 3. To impart knowledge on end effectors and drive systems in robots

CLO 4. To know about different types and functions of sensors in robotics

CLO 5. To describe different applications of robots.

Teaching-Learning Process (General Instructions)

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

1. Show Video/animation films to explain the functioning of elements of Robotics
2. Encourage collaborative(Group)Learning in the class
3. Ask at least three HOTS (Higher-order Thinking)questions in the class, which promotes critical thinking
4. Adopt Problem Based Learning(PBL),which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.

Module-1

Robotics Definition, Robot-Basic concepts, Need, Laws of Robotics, History, Types of Robots, Classification, specifications of Robotics.

Module-2

Anatomy of Robots, Types of Joints, Robot configurations- cartesian, cylinder, polar and articulate.
Basics of control: open loop- closed loop, Transfer functions, Control laws: P, PD, PID

Module-3

End effectors-Classification, Types of Mechanical actuation, Gripper design, Robot drive system- Hydraulic, Pneumatic and Electrical Drive systems.

Module-4

Sensors in robotics- Touch Sensors, Tactile sensor, Proximity and range sensors, Force sensor, Pressure sensors,

Module-5

Applications: Industrial applications of robots, Medical, Household, Entertainment, Space, Underwater, Defence, Disaster management

Course outcome (Course Skill Set)

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

CO 1. Understand the functions of different elements of robots.

CO 2. Apply the knowledge of sensors and end effectors in robotics

CO 3. Analyze the use of different types of robots for different applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

OR

MCQ (Multiple Choice Questions) are preferred for 01 credit courses, however, if course content demands the general question paper pattern that followed for 03 credit course, then

- The question paper will have ten questions. Each question is set for 10 marks.
- There will be 2 questions from each module. Each of the two questions under a module may or may not have the sub-questions (with maximum sub-questions of 02, with marks distributions 5+5, 4+6, 3+7).
- The students have to answer 5 full questions, selecting one full question from each module.

Suggested Learning Resources:

Books

1. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.
2. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
3. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.

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

- Group discussion
- Presentations
- Quiz

MICROCONTROLLER AND APPLICATIONS		Semester	4
Course Code	**BMT401**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03
Examination type (SEE)	**Theory**		

Course learning objectives: To Gain the knowledge of

CLO1. Microcontrollers, microprocessors, Different memory Architecture, interfacing techniques and 8051 architectures.

CLO2. Assembly language instructions, data types and application programming.

CLO3. C language instructions, data types and application programming, generating delays for different time delay.

CLO4. Serial communication between two devices using assembly and C language programming, Interrupt handling and counter application using assembly and C language.

CLO5. The controller to real-world devices such as switches, display devices, motors, converters etc.

Teaching-Learning Process (General Instructions)

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

1. Show Video/animation films to explain the functioning of various functions.
2. Encourage collaborative (Group) Learning in the class
3. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes criticalthinking
4. Project based learning: Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather thansimply recall it.

Module-1

Microprocessors and microcontroller

Introduction, Microprocessors and Microcontrollers, A Microprocessors survey. RISC & CISC CPU Architectures, Harvard & Von-Neumann CPU architecture. The 8051 Architecture: Introduction, 8051 Microcontroller Hardware, Input / Output Pins, Ports and Internal Memory organization. External Memory (ROM & RAM) interfacing

Module-2

Addressing Modes and Operations:

Introduction, addressing modes, External data Moves, Code Memory, Read Only Data Moves / Indexed Addressing mode, PUSH and POP Opcodes, Data exchanges, Byte level logical Operations, Bit level Logical Operations, Rotate and Swap Operations, Arithmetic Operations: Flags, Incrementing and Decrementing, Addition, Subtraction, Multiplication and Division, Decimal Arithmetic.

Jump and Call Instructions: The JUMP and CALL Program range, Jumps, calls and Subroutines, Interrupts and Returns.

Module-3

8051 programming in C and Timers:

Data types and time delays in 8051C, I/O programming, logic operations, data conversion programs, data serialization.

Timer / Counter Programming in 8051: Programming 8051 Timers, modes of Timer

Module-4

8051 Serial Communication and Interrupts: Basics of Serial Communication, 8051 connections to RS-232, 8051 Serial communication Programming, Programming the second serial port, Serial port programming in C. Interrupts Programming,8051 Interrupts, Programming Timer Interrupts, Interrupt Priority in the 8051/52.

Module-5

8051 Interfacing and Applications: Hardware & Software (Assembly code / C code) Interfacing of 8051 to simple switches and LEDs, LCD, ADC, Stepper motor, DC motor, Temperature sensor, Wave form generation

Course outcome (Course Skill Set)

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

CO1. Describe the architecture of 8051 Microcontroller, microprocessor and internal memory organization, types of memory architecture, Concept of Addressing modes and Assembly and C instruction set.

CO2. Apply various instruction set of assembly and C language for different software and hardware applications.

CO3. Calculate time delays, baud rates and analyse Timer. Counter operation and Transmission of data serially for different modes of operation.

CO4. Design the hardware interface between microcontroller and memories of different size, external peripheral devices for real time application.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

Recommended Text Books

1. "The 8051 Microcontroller Architecture, Programming & Applications", 2e Kenneth J. Ayala;Penram International, 1996 / Thomson Learning 2005
2. "The 8051 Microcontroller and Embedded Systems – using assembly and C "-, Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006 / Pearson, 2006

Reference Books:

1. "Programming and Customizing the 8051 Microcontroller" Predko ;–, TMH
2. Microcontrollers: Architecture, Programming, Interfacing and System Design",Raj Kamal, "Pearson Education, 2005
3. "Microcontrollers- Theory and Applications", Aja y V.Deshmukh; TMH,2005
4. "Microcontroller and its applications", Dr.Ramani Kalpathi and Ganesh Raja; Sanguine Technical publishers, Bangalore-2005.

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

- Group Activity
- Presentation
- Quiz

Electrical Drives and Controls (IPCC)		Semester	4
Course Code	**BMT402**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**3:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	Total Marks	100
Credits	**04**	Exam Hours	03
Examination nature (SEE)	**Theory**		

Course learning objectives:

The course will enable the students to

CLO 1. To define electric drive, its parts, advantages and explain choice of electric drive.

CLO 2. To explain dynamics and modes of operation of electric drives.

CLO 3. To explain selection of motor power ratings and control of DC motor using rectifiers.

CLO 4. To explain the control of induction motor and synchronous motor drives.

CLO 5. To study the control characteristics and speed control methods of AC and DC drives through experiments

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes throughPowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Conduct Laboratory Demonstrations and Practical Experiments to enhance Experiential skills.

MODULE-1

Electrical Drives: Electrical Drives, Advantages of Electrical Drives. Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and ac Drives.

Dynamics of Electrical Drives: Fundamental Torque Equations, Speed Torque Conventions and Multi-quadrant Operation, Components of Load Torques, Nature and Classification of Load Torques,

MODULE-2

Control of Electric Drives: Modes of Operation, Speed Control and Drive Classifications, Closed loop Control of Drives.

Selection of Motor Power Rating, Thermal model of motor for heating and cooling, classes of motor duty determination of motor rating (Inclusive of problems)

MODULE-3

Direct Current Motor Drives: DC motors and their performance, Starting, Braking, Speed control, methods of armature voltage control, Controlled rectifier fed DC drives, Single phase fully controlled rectifier control of DC separately excited motor inclusive of problems, Multi quadrant operation of DC separately excited motor fed from fully controlled rectifier, Chopper Control of Separately Excited DC Motor, Chopper Control of Series Motor. (Inclusive of problems)

MODULE-4

Induction Motor Drives: Single phase induction motors, starting methods and types of induction motor, braking of single phase induction motor, Speed control of single phase induction motors. (Inclusive of problems)

Synchronous motor variable speed drive, Permanent magnet AC motor drives, Brushless DC motor drive

MODULE-5
Microprocessors and Control of Electrical Drives: dedicated hardware systems versus Microprocessor control Application, Areas and Functions of Microprocessors in Drive Technology, Control of Electric Drives Using Microprocessors, Some Aspects of Control System Design of Microprocessor Based Variable Speed Drives, Stepper Motors

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

Sl.NO	Experiments
1	Conduct an Experiment to draw the speed-torque characteristics of AC servo motor
2	Conduct an Experiment to draw the speed-torque characteristics of DC servo motor
3	Conduct an experiment to control the speed of DC motors using chopper and draw the characteristics curve between duty cycle and speed
4	Conduct an experiment to control the speed of Universal motor using AC voltage regulator and draw the speed characteristics.
5	Conduct an experiment to control the speed of dc shunt motor by armature control method and to draw its speed characteristics
6	Conduct an experiment to control the speed of dc shunt motor by field control method and draw its speed characteristics.
7	Conduct an experiment to control the speed of DC series motor and draw the speed characteristics.
8	Conduct an experiment to control the speed of DC compound motors and draw the speed characteristics.
9	Conduct an experiment on Load test of single phase induction motor to draw the output versus torque, current, power and efficiency characteristics.
10	Conduct an experiment to control the speed of three phase induction motor draw its characteristics

Course outcomes (Course Skill Set):

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

- **CO 1.** Understand the basic concept of Electric drives and controls.
- **CO 2.** Explain the characteristics of AC and DC Motor drives.
- **CO 3.** Apply conventional control methods for AC and DC drives.
- **CO 4**. Apply solid-state speed control methods for AC and DC drives
- **CO 5.** Conduct experiment to determine control characteristics of DC motors
- **CO 6.** Conduct experiment to determine control characteristics of AC motors

.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. Vedam subramaniam "Electric drives (concepts and applications)", Tata McGraw-Hill.2001
2. Nagrath.i.j & Kothari.D.P,"Electrical machines", Tata McGraw-Hill.1998

Additional References:

1. Pillai.s.k "A first course on Electric drives", Wiley Eastern Limited, 1998
2. M.d.singh, K.b.khanchandani,"Power electronics," Tata McGraw-Hill.1998
3. H.Partab,"Art and science and utilization of electrical energy,"Dhanpat Rai and sons, 1994

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

- Group activity
- Presentation
- Quiz

Hydraulics and Pneumatics		Semester	4
Course Code	**BMT403**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**3:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**40 hours Theory + 8-10 Lab slots**	Total Marks	100
Credits	**04**	Exam Hours	03
Examination nature (SEE)	**Theory**		

Course learning objectives:

CLO 1. To gain basic knowledge of hydraulic and pneumatic systems.

CLO 2. To Understanding the working principles of hydraulics and pneumatics components.

CLO 3. To Apply the knowledge of hydraulic systems to design hydraulic circuits for different application.

CLO 4. To Apply the knowledge of pneumatic systems to design pneumatic circuits for different application.

CLO 5. To Design hydraulic and pneumatic circuits with multicylinder applications using solenoid control.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes throughPowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Show Video/animation films to explain the functioning of various hydraulic and pneumatic circuits.
4. Encourage collaborative (Group) Learning in the class.
5. Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes criticalthinking.
6. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather thansimply recall it.

MODULE-1

Introduction to Hydraulic and Pneumatic Systems: Definition of hydraulic system, structure of hydraulic control system. Structure of Pneumatic control System, fluid conditioners and FRL unit. Pneumatic. advantages, limitations, applications

The source of hydraulic power: Pumps, classification of pumps, pumping theory of positive displacement pumps, construction and working of gear pumps, vane pumps, piston pumps, fixed and variable displacement pumps, pump performance characteristics, pump selection factor, problems on pumps

MODULE-2

Hydraulic Actuators and Motors: Classification: cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Cylinder cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators.

Control Components in Hydraulic and Pneumatic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve

Flow Control Valves -compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation

MODULE-3

Hydraulic Circuit Design And Analysis: Control of Single and Double -Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

Maintenance of Hydraulic System: General type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid - particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.

MODULE-4
Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols. **Pneumatic Control Valves:** DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling
MODULE-5
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependent controls- types - construction - practical applications, Time dependent controls principle, Construction, practical applications. **Multi- Cylinder Application:** Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves). **Electro- Pneumatic Control:** Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.

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

Sl.NO	Experiments
1	To determine the performance of reciprocating hydraulic pump.
2	To determine the performance of Centrifugal hydraulic pump.
3	To control speed of single acting cylinder actuation on Hydraulic/Pneumatic Trainer
4	To control speed of double acting cylinder actuation on Hydraulic/Pneumatic Trainer
5	To develop sequencing circuit on Hydraulic/Pneumatic Trainer
6	To develop regenerative circuit on Hydraulic/Pneumatic Trainer
7	To design and develop synchronizing circuit on Hydraulic/Pneumatic Trainer
8	To design and analysis of Hydraulic Regenerative Circuit using Software (like SIMULINK)
9	To design and analysis of Hydraulic Synchronizing circuit using Software (like SIMULINK)
10	To design and analysis of pneumatic circuits using Software (like SIMULINK)
11	To Demonstrate the working of air compressor.
12	To demonstration of working of different types of valves.
13	To demonstration of working of solenoids.

Course outcomes (Course Skill Set):

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

CO 1. Understand different components of pneumatic and hydraulic circuits.
CO 2. Demonstrate working of valves, solenoids, and pumps.
CO 3. Apply concepts of pneumatic and hydraulic to design and develop respective circuits.
CO 4. Design and analyse Hydraulic/pneumatic circuits.
CO 5. Design pneumatic circuits for various industrial applications using experimental pneumatic kits
CO 6. Create the graphical simulation for pneumatic and hydraulic circuits

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scoredby the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. "Fluid Power with Applications", Anthony Esposito, Sixth edition, Pearson Education,Inc,2000. 'Pneumatics and Hydraulics', Andrew Parr, Jaico Publishing Co.
2. Fluid Mechanics and Fluid Machines, Dr. Bansal, R.K.Lakshmi Publications, 2004
3. 'Oil Hydraulic systems', Principles and Maintenance S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. – 2001
4. 'Industrial Hydraulics', Pippenger, Hicks" McGraw Hill, New York.
5. 'Hydraulic & Pneumatic Power for Production', HarryL. Stewart.

'Pneumatic Systems', S. R. Majumdar, Tata McGraw Hill Publish 1995.

'Hydraulic & Pneumatics' CMTI Data Book.

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

1. To design and construct simple experiment to demonstrate Hydrostatic law
2. Demonstration of Pascal's law with laboratory setup.
3. Industrial visit to understand the applications of hydraulic and Pneumatic systems.
4. Design and demonstration of working of hydraulic/pneumatic systems for different day today application.

MECHATRONICS LABORATORY		Semester	**4**
Course Code	**BMT404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:0:2:0**	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	**01**	Exam Hours	03
Examination type (SEE)	**Practical**		

Course learning objectives:

After studying this course, students should be able to

CLO 1. study assembly language and C programming in 8051 for different applications

CLO 2. study interfacing of various peripherals using 8051

CLO 3. develop applications like generating waveforms, LCD display, stepper and DC motor control, temperature control etc. using 8051

CLO 4. calibrate the sensors like LVDT, load cell and Thermo couple

Sl.NO	**Experiments**
1	Conduct an experiment to calibrate LVDT
2	Conduct an experiment to calibrate Load cell
3	Conduct an experiment to calibrate Thermo couple
4	Write an ALP to execute the following Data Transfer operation – Block move, Exchange, Sorting, Largest and smallest element in an array.
5	Write an ALP to execute Arithmetic– Addition/subtraction, multiplication and division, square, cube – (16bit number)
6	Write an ALP to perform following Code conversions: BCD – ASCII; ASCII – Decimal; Decimal – ASCII; HEX-Decimal and Decimal – HEX

7	Write an ALP to execute Logical Instructions –Byte and bit addressable operation
8	Write an ALP to generate delay, serial data transfer at different Baud rates.
9	Interface 8051 to DAC to Generate different waveforms Sine, Square, Triangular, Ramp, sawtooth, step wave.
10	Interface 8051 to Alphanumeric LCD, HEX keypad input to display the message" WELCOME"
11	Interface 8051 to Stepper motor and DC motor to rotate the motor at different step angle, clockwise and antilock wise direction.
12	Interface 8051 to DC motor to rotate the motor at different step angle, clockwise and antilock wise direction.
13	Interface 8051 to temperature control to measure and monitor the temperature.

Course outcomes (Course Skill Set):

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

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

CO1. Evaluate the performance of the sensors like LVDT, load cell and Thermo couple by Calibrating.

CO2. Develop a various data transfer, arithmetic, logical and code conversion applications using Assembly Language.

CO3. Design a interface between 8051 and external peripherals for real time applications

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

ROBOT OPERATING SYSTEM		Semester	4
Course Code	**BMT405A**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03
Examination type (SEE)	**Theory**		

Course objectives:

- Understand fundamentals, including key ROS concepts, tools and patterns
- Use of Powerfull ROS packages to program the robot
- Integrate sensors, actuators, software libraries into ROS ecosystem

Teaching-Learning Process (General Instructions)

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

1. Through Power Point Presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three higher order Thinking questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

Module-1

ROS Introduction: Introduction, Brief History Philosophy, Summary

Preliminaries: The ROS Graph, roscore, catkin, Workspaces, and ROS Packages, Names, Namespaces, and Remapping, Poses, Positions, and Orientations

Module-2
Robots and Simulators: Subsystems, Actuation: Mobile Platform, Actuation: Manipulator Arm, Sensors, Computation, Complete Robots, Fetch, Robonaut 2, TurtleBot, Simulators: Stage, Gazebo, Other Simulators **Wander-bot:** Creating a Package, Reading Sensor Data, Sensing and Actuation: Wander-bot, Summary
Module-3
Building Maps of the World: Maps in ROS, Recording Data with rosbag, Building Maps, starting a Map Server and Looking at a Map, Summary **Navigating About the World:** Localizing the Robot in a Map, Getting a Good Initial Localization, What's Going on Behind the Scenes, Tips for Setting a Better Initial Pose, Using the ROS Navigation Stack, The ROS Navigation Stack, Navigating in rviz, Seeing, What's Going On, Navigating in Code, Summary
Module-4
Teleop-bot: Development Pattern, Keyboard Driver, Motion Generator, Parameter Server, Velocity Ramps, Let's Drive, rviz, Summary **Follow-bot:** Acquiring Images, Detecting the Line, Following the Line, Summary
Module-5
Your Own Mobile Robot: TortoiseBot, ROS Message Interface Hardware Driver, Modeling the Robot: URDF Simulation in Gazebo Summary
Course outcome (Course Skill Set) At the end of the course, the student will be able to : **CO 1:** Understand fundamentals, including key ROS concepts, tools and patterns **CO 2:** Use of Powerful ROS packages to program the robot **CO 3:** Integrate sensors, actuators, software libraries into ROS ecosystem **CO 4:** Create simulation of application using ROS system

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Programming Robots with ROS: a practical introduction to the robot operating system by Morgan Quigley, Brian Gerkey & William D. Smart Published by O'Reilly Media, Inc., 1005 Gravenstein Highway North, Sebastopol, CA 95472
2. Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, Apress, 2018
3. Aaron Martinez, Enrique Fernández, "Learning ROS for Robotics Programming", Packt Publishing Ltd, 2013
4. Jason M O'Kane, "A Gentle Introduction to ROS", CreateSpace, 2013
5. Wyatt Newman, "A Systematic Approach to learning Robot Programming with ROS", CRC Press, 2017.
6. Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.

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

- Install and use open sourse ROS software
- Explore the use of ROS and implementing and integrating different devices to ROS
- Develop simulation of different application of Robots in ROS

INDUSTRIAL IoT		Semester	4
Course Code	**BMT405B**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

CLO 1. To provide students with good depth of knowledge of Industrial IoT systems for various applications.

CLO 2. Knowledge for the design and analysis of industry 4.0systems

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt collaborative (Group Learning) Learning in the class.
4. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.
5. Conduct Laboratory Demonstrations and Practical Experiments to enhance experiential skills.

Module-1

Introduction to Industrial IoT (IIoT) Systems: The Various Industrial Revolutions, Role of Internet of Things (IoT) & Industrial Internet of Things (IIoT) in Industry, Industry 4.0 revolutions, IIOT architecture, Support System for Industry 4.0 Smart Factories.

Module-2

Implementation systems for IIoT:

Sensors and Actuators for Industrial Processes, Sensor categories, actuators categories, Process automation and Data Acquisitions on IoT Platform, Micro controllers and Embedded PC roles in IIoT,

Module-3

IIoT Technologies: introduction, augmented reality, virtual reality, big data and advanced analytics, smart factories, lean manufacturing system.

Module-4

Industrial Transmission: Introduction Profibus- features,components, Fiels bus-features,components, HART-features,components, CAN-features,components

Module-5

IIOT case studies: Health care and applications, Oil and Gas Industry, Smart Office, manufacturing industry, automotive industry.

Course outcome (Course Skill Set)

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

CO1. Gain the Knowledge of architecture , revolution of Industrial IoT System,

CO2. Identify, formulate and solve engineering problems by using Industrial IoT.

CO3. Identify the technologies for IIOT

CO4. Analyse the different communication protocols fro IIOT applications

CO5. Ability to implement real field problem by gained knowledge of Industrial applications with IoT capability.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Misra, S., Mukherjee, A., & Roy, A. (2021). Forntmatter. In Introduction to IoT , Cambridge University Press.

List of References:

1. Industry 4.0: The Industrial Internet of Things Alasdair GilchristPublications: Apress
2. . The Concept Industry 4.0 An Empirical Analysis of Technologies and Applications in Production Logistics Authors: Bartodziej, Christoph Jan Springer: Publication in the field of economic science.
3. 3. Embedded System: Architecture, Programming and Design by Rajkamal, TMH3.

RENEWABLE SOURCES OF ENERGY		Semester	4
Course Code	**BMT405C**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40 Hrs**	Total Marks	100
Credits	**03**	Exam Hours	3
Examination type (SEE)	**Theory**		

Course objectives:

This course enables students to

1. To introduce the concepts and principles of solar energy, its radiation, collection, storage and application.
2. To understand application aspects of Wind, Biomass, Geothermal, hydroelectric and Ocean energy.
3. To examine alternate energy sources and systems.

Teaching-Learning Process (General Instructions)

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

1. Adopt different types of teaching methods to develop the outcomes through PowerPoint presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Adopt flipped classroom teaching method.
4. Adopt collaborative (Group Learning) learning in the class.
5. Adopt Problem Based Learning (PBL), which fosters students' analytical skills and develops thinking skills such as evaluating, generalizing, and analyzing information.

Module-1

Introduction: Energy sources (including fossil fuels and nuclear energy), India's production and reserves of commercial energy sources, need for nonconventional energy sources, energy alternatives, Indian and global energy scenario.

Solar Radiation & Measurement: Extra-Terrestrial radiation, spectral distribution of extra-terrestrial radiation, solar constant, solar radiation at the earth's surface, beam, diffuse and global radiation, solar radiation data. Pyrometer, shading ring Pyrheliometer, sunshine recorder, schematic diagrams, and principle of working.

Module-2

Solar Thermal Systems: Flat plate collector, Evacuated Tubular Collector, Solar air collector, Solar concentrator, Solar distillation, Solar cooker, Thermal energy storage systems, Solar Pond, Solar Chimney (Tower).

Solar Photovoltaic Systems: Introduction, Solar cell Fundamentals, Characteristics and classification, Solar cell: Module, panel and array construction.

Module-3

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. **Ocean Thermal Energy Conversion**: Principle of working, Rankine cycle, problems associated with OTEC. **Geothermal Energy Conversion**: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy.

Module-4

Bio Energy From Biomass: Photosynthesis, photosynthetic oxygen production, energy plantation. **Bio Chemical Route**: Biogas production from organic wastes by anaerobic fermentation, classification of bio gas plants, factors affecting bio gas generation. **Thermo Chemical Route**: Thermo chemical conversion on bio mass, types of gasifiers. **Wind Energy**: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor.

Module-5

Hydro-Electric Plants: Hydrographs, flow duration and mass curves, unit hydrograph and numericals. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.

Hydrogen Energy: Benefits of Hydrogen Energy, Hydrogen Production Technologies, Hydrogen Energy Storage, use of Hydrogen Energy, Advantages and Disadvantages of Hydrogen Energy, Problems Associated with Hydrogen Energy.

Course outcome (Course Skill Set)

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

1. Describe the various forms of non-conventional energy resources.
2. Apply the fundamental knowledge of mechanical engineering to design various renewable energy systems.
3. Analyze the implications of renewable energy forms for selecting an appropriate system for a specific application.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

4. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., NewDelhi.
5. Non-Conventional Energy Sources, G.D.Rai, NewDelhi.
6. Renewable Energy, power for a sustainable future, Godfrey Boyle,2004,
7. The Generation of electricity by wind, E.W.Golding.
8. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub.,2009.

Reference Books

1. Fundamentals of Renewable Energy Resources by G.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.
2. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
3. Non-Conventional Energy Resources by Shobh Nath Singh, Pearson India., 2016

Web links and Video Lectures (e-Resources):

- https://archive.nptel.ac.in/courses/121/106/121106014/
- https://archive.nptel.ac.in/courses/108/105/108105058/
- https://archive.nptel.ac.in/courses/109/101/109101171/

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

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

OPERATIONS RESEARCH		Semester	4
Course Code	**BMT405D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	**3:0:0**	SEE Marks	50
Total Hours of Pedagogy	**40**	Total Marks	100
Credits	**03**	Exam Hours	03
Examination type (SEE)	**Theory**		

Course learning objectives:

- Gain knowledge of basics of operation research.
- Understanding various techniques of operation research for solving business decision and engineering problems.
- Determination of optimization solutions, effective decision making, model formulation and applications.

Teaching-Learning Process (General Instructions)

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

1. Through Power Point Presentations and Video demonstrations or Simulations.
2. Chalk and Talk method for Problem Solving.
3. Encourage collaborative (Group) Learning in the class.
4. Ask at least three higher order Thinking questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.

Module-1

Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.

Solution of Linear Programming Problems: The simplex method canonical and standard form of an LP problem.

Module-2

Transportation Problem: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases.

Module-3

Pert-CPM Techniques: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

Module-4

Queuing Theory: Queuing systems and their characteristics, Pure-birth and Puredeath models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.

Module-5

Game Theory: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

Sequencing: Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

Course outcome (Course Skill Set)

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

CO 1: have knowledge of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory.

CO 2: understanding the techniques of linear programming, Transportation, PERT-CPM, Sequencing, Queuing Theory, and Game theory for various engineering problems.

CO 3: Applying optimization of solutions, effective decision making model formulation and applications that are used in solving business decision problems.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books

1. Operations Research P K Gupta and D S Hira S. Chand and Company LTD. Publications, New Delhi 2007
2. Operations Research, An Introduction Hamdy A. Taha PHI Private Limited Seventh Edition, 2006
3. Operations Research S.D. Sharma, LedarnathRamanath& Co,

Reference Books

1. Operations Research, Theory and Applications J K Sharma Trinity Press, Laxmi Publications Pvt.Ltd. Sixth Edition, 2016
2. Operations Research Paneerselvan PHI
3. Operations Research A M Natarajan, P Balasubramani Pearson Education, 2005
4. Introduction to Operations Research Hillier and Lieberman McGraw Hill 8thEd

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

- Case studies
- Quiz
- Topic Seminar presentation
- Assignments

Mechanism Design and Animation		Semester	**4**
Course Code	**BMT456A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	**Practical**		

Course objectives:

1. To understand various mechanisms and its working principles.
2. Understand the basics of designing and animating mechanisms used in engineering fields like robotics and aerospace.
3. To effectively explain design principles for mechanical systems and to produce appealing animations.
4. Learn how to analyse the motion and forces in mechanisms.
5. To understand the working of gears and gear trains.

Sl.NO	**Experiments**
1	Investigate various components for designing a simple four-bar linkage
2	Investigate various components for designing a slider-crank mechanism.
3	Investigate various components for designing a pantograph.
4	Investigate various components for designing a Geneva drive.
5	Examine the effects of various mechanical joint types, including rotating, revolute, and prismatic joints, on the behaviour and motion of mechanisms
6	Design and analyse basic and compound gear trains.
7	Design and analyse movement of a cam-follower mechanism such as rollers, knives, etc.
8	Design and analyse Klann mechanism.
9	Using Python language, animate a series of boxes and spheres in random directions.
10	Using Python language, rig various operations for robotic arms, walking robots, etc.

11	Using Blender, create keyframes in the timelines for robotic arms for movements.
12	Animating basic mechanical components such as gears, levers, pistons, etc

Course outcomes (Course Skill Set):

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

CO 1: To understand various mechanisms and its working principles
CO 2: To gain knowledge in gears and gear trains
CO 3: To develop animations for simple mechanisms
CO 4: To analyse the forces and motions in a mechanism

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. **Reference books:**
   a. Book name: Theory of Machines
      Edition: 5th Edition
      Author: S S Rattan
      Published: July 10, 2019
      Publisher: McGraw Hill
   b. Book name: Mechanisms and Machines: Kinematics, Dynamics, and Synthesis
      Edition: 1st Edition
      Author: Michael M. Stanisic
      Published: 1 January 2015
      Publisher: Cengage Learning India Private Limited
2. **Software tools:**
   a. Free:
      i. Blender ▶ https://www.blender.org/download/
      ii. RoKiSim ▶ https://www.parallemic.org/RoKiSim.html
      iii. Linkage ▶ https://linkage.software.informer.com/3.4/
   b. Proprietary (Paid):
      i. MSC ADAMS
      ii. FuntionBay RecurDyn
      iii. SolidWorks
      iv. Autodesk Inventor
3. **Web links and Video Lectures:**
   a. https://www.blender.org/support/tutorials/
   b. https://www.youtube.com/watch?v=3QAGpxV36wM
   c. https://www.youtube.com/watch?v=nIoXOplUvAw

3D-Printing Technology		Semester	4
Course Code	**BMT456B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	**Practical**		

Course objectives:

CLO 1. Familiarize students with 3D printing technology
CLO 2. Develop the ability to assess printing methods and materials for specific applications
CLO 3. Develop ability to design and 3D print complex devices/tools
CLO 4. Design and development of 3D printer

Sl.NO	Experiments
1	Demonstration of different 3D Printer components
2	Hands on CAD and slicing software
3	Selection of Elements and Materials used in simple 3D printer.
4	Integration of 3D printers with open-source software
5	Hands on training on CAD / Design software (Project I)- Rectangular model
6	Developing the program for 3D printer for Project I using open-source software
7	Hands on training on CAD / Design software (Project II)- circular model
8	Developing the program for 3D printer for Project II using open-source software
	Demonstration Experiments (For CIE)
9	Troubleshooting
10	Integration of 3D printing software with hardware
11	Produce different shapes of products through the Developed 3D printer
12	3D printer Troubleshooting

Course outcomes (Course Skill Set):

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

CO 1. Understand steps, software and different key elements used in 3D printer.
CO 2. Develop a program using open-source software to use 3D printer
CO 3. Apply the knowledge of 3D printers in building model.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

1. Additive Manufacturing Technologies – 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, by Ian Gibson, David Rosen, and Brent Stucker, Second Edition, Springer, New York.
2. Fabricated: The New World of 3D Printing by Hod Lipson and Melba Kurman

3. Design and Modeling for 3D Printing by Matthew Griffin
4. AutoDesk 123D Gallery: http://www.123dapp.com/Gallery/content/all
5. SketchUp Gallery: https://3dwarehouse.sketchup.com/
6. SolidWorks Gallery: http://www.3dcontentcentral.com/default.aspx

CNC Programming and Simulation		Semester	**4**
Course Code	**BMT456C**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	**0:0:2**	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	**01**	Exam Hours	03
Examination type (SEE)	**Practical**		

Course objectives:

1. Learn the fundamentals of CNC machines, their components, and their applications.
2. Understand the syntax of several CNC programming languages.
3. Learn how to use simulation software for virtual machining processes.
4. Learn to write CNC programmes for a variety of machining processes.
5. Use problem-solving abilities to troubleshoot common CNC programming and simulation challenges.
6. Develop critical thinking and decision-making abilities in the context of CNC operations.

Sl.NO	**Experiments**
1	Using a CAD software, design a rectangular profile with specified dimensions.
2	Perform a facing operation to create a flat surface on the workpiece.
3	Perform external turning to reduce the diameter of the workpiece.
4	Perform internal turning to create a bore in the workpiece.
5	Perform grooving to create a groove on the workpiece.
6	Perform threading to create threads on the workpiece.

7	Perform taper turning to create a tapered surface on the workpiece.
8	Perform drilling to create a hole in the workpiece
9	Combine all the CNC operations and create a workpiece that is used in manufacturing automobile components.
10	Create a CNC program to mill a basic rectangular profile.
11	Write a CNC program in G-code to drill the holes.

Course outcomes (Course Skill Set):

CO 1: To understand and gain fundamental knowledge on CNC machines and their components
CO 2: To use simulation software to simulate different machining operations
CO 3: To create CNC program for various machining operations
CO 4: To troubleshoot CNC programming and simulation challenges

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.

- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

4. **Software tools:**
   a. Carbide Create ▶ https://carbide3d.com/carbidecreate/
   b. Easel Pro ▶ https://www.inventables.com/technologies/easel
5. **Web links and Video Lectures:**
   a. https://www.digimat.in/nptel/courses/video/112105211/L01.html
   b. https://www.digimat.in/nptel/courses/video/112102101/L01.html

IoT		Semester	4
Course Code	**BMT456D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Total Hours of Pedagogy	**15 sessions**	Total Marks	100
Credits	01	Exam Hours	03
Examination type (SEE)	**Practical**		

Course objectives:

CLO 1. Demonstrate to install IDE to create IoT application
CLO 2. Illustrate diverse methods of deploying smart objects and connect them to network.
CLO 3. Develop Python programming language to develop programs for solving real-world problems
CLO 4. Analyse sensor technologies for sensing real world entities

Sl.NO	Experiments
1	Design a smart bin using IoT with Arduino / Raspberry Pi
2	Design water level monitoring system using IoT with Arduino / Raspberry Pi
3	Design temperature monitoring system using IoT with Arduino / Raspberry Pi
4	Design car parking management system using IoT with Arduino / Raspberry Pi
5	Design automated pet feeder using IoT with Arduino / Raspberry Pi
6	Design smart agriculture system using IoT with Arduino / Raspberry Pi
7	Design smart street light monitoring system using IoT with Arduino / Raspberry Pi
8	Design smart anti-theft system using IoT with Arduino / Raspberry Pi
	Demonstration Experiments (For CIE)
9	Demonstrate Alexa based smart home monitoring system using IoT
10	Demonstration ECG monitoring using IoT
11	Demonstration home automation system using IoT
12	Demonstration of face recognition bot using IoT

Course outcomes (Course Skill Set):

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

CO 1. Understand basic concepts of IoT, Arduino / Raspberry Pi
CO 2. Build application-oriented projects using IoT
CO 3. Develop algorithm to solve real time problems by interface sensors and controller

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

The minimum duration of SEE is 02 hours

Suggested Learning Resources:

Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry,"IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1 stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
2. Srinivasa K G, "Internet of Things",CENGAGE Leaning India, 2017

Reference Books:

1. Vijay Madisetti and ArshdeepBahga, “Internet of Things (A Hands-on-Approach)”, 1 stEdition, VPT, 2014. (ISBN: 978-8173719547)
2. Raj Kamal, “Internet of Things: Architecture and Design Principles”, 1 st Edition, McGraw Hill Education, 2017. (ISBN: 978-9352605224)