NOTIFICATION

No. 88 /2022 Date : 21 /07/2022

Subject : Revised Syllabi of Semester V to VIII of B.E. Mechanical Engineering (C.B.C.S.) as per A.I.C.T.E. Model Curriculum.

It is notified for general information of all concerned that the authorities of the University have accepted to implement revised syllabi of Semester **V to VIII of B.E. Mechanical Engineering (C.B.C.S.)** as per A.I.C.T.E. Model Curriculum to be implemented from the academic session 2022-23 onwards as per ñ**Appendix – A**ò as given below:

Sd/-
(Dr.T.R.Deshmukh)
Registrar

ñ**Appendix – A**ò

SYLLABUS OF B.E. SEM. V TO VIII (MECHANICAL ENGINEERING) [C.B.C.S.]

(5ME05) OPEN ELECTIVE – I (i) INDUSTRIAL ROBOTICS & APPLICATIONS

Course Learning Objectives (Clos) :
1. To understand basics of robotics, evolution of robots and their role in industrial automation.
2. To study the Robot's anatomy, joints types, wrist construction, robot standard configurations and their work space.
3. To study the construction and working of different types of end Effectors.
4. To study various robot drives, robot motion control and its levels.
5. To understand various methods of teaching and programming the robots.
6. To study principle of working and applications of different types of robot sensors.
7. To study different applications of robots in manufacturing and to understand importance of robot features for a particular application.

Course Outcomes (Cos):
1. Understand the concept of robotics, its history.
2. Remember robot anatomy and various configurations for different industrial applications
3. Understand the need of a particular type of robot depending on the its application in manufacturing.
4. Remember the concept of robot programming, their methods and programming languages.

SYLLABUS

Unit I : Fundamentals of Robotics : Introduction, Automation & Robotics- robot applications robotic systems, robot anatomy and robot configurations, Joint types used in robots, robot wrists, joint notation schemes, work value for various robot anatomies, robot Specifications**.** (8 Hrs.)

Unit II : Robots end-effectors :Classification of end-effectors, mechanical grippers, hooking or Lifting grippers, grippers for molten metal , plastics, vacuum cups, magnetic grippers Electrostatic grippers, multiple grippers, internal & external grippers, drive systems for gripers, active & passive grippers. Design consideration in gripper. (7 Hrs.)

Unit III: Robot drives & control-pneumatic power drives, hydraulic systems, electric drives, robot controllers-servo and non servo systems, motion control of robots, point to point and continuous path control. (7 Hrs.)

Unit IV: Robot Sensors: Contact type sensors- wrist force sensor, binary & analog touch sensor, , force, torque, encoders, position, velocity sensors, Non contact type sensors- vision sensor, proximity, range sensors. (7 Hrs.)

Unit V:.Robot Programming: Programming Methods for Industrial Robot, Robot programming languages, VAL Commands, robot programming in Val & RAIL. (6-Hrs)

Unit VI: Robot Applications: Robot Applications in Industry- Material Handling, Part Processing, Assembly, Inspection and Quality Control, Feature requirements of Machine Loading-Unloading & Palletizing Robot, Welding Robot, Assembly Robot, Painting Robot, Part Sorting & Inspection Robot.
Robot Applications in electronic component fabrication, assembling miniature components on PCBs, applying ad hesives, inspections, testing (7 Hrs.)

RECOMMENDED BOOKS:

Text Books:
1) Industrial Robotics by M.P.Groover, McGraw Hill.
2) Robotics and Automation by R. K. Rajput, S. Chand Publications Ltd.
3) Robotics Technology & Flexible Automation by S.RDeb, Tata McGraw Hill.

Reference Books:
1. Robotics for Engineering, Korean Yoram, McGraw Hill.
2. Robots & Manufacturing automation by Asfahal, C.Ray, John Wiley.
3. Robotic Engineering by Richard D.Klafter, PHI.

5ME05 OPEN ELECTIVE –I (ii) MODERN MANUFACTURING TECHNIQUES

Course Learning Objectives (Clos) :
1. able to understand importance of nontraditional machining processes.
2. able to understand knowledge of Rapid Prototyping methods.
2. able to study the process of USM, AJM& ECM.
3. able to study and understand the process of surface finish and its applications.
4. to study the principle of working of EBM and its applications.

Course Outcomes (Cos) :
1. To make the students to understand the concept of advanced manufacturing techniques evolved in industrial manufacturing scenario.
2. To remember, learn and understand the advanced manufacturing techniques f USM, AJM, ECM, CM, EDM, PM, EBM & LSB.
3. To understand the need of a particular type of composite materials and its manufacturing methods.

SYLLABUS

Unit-I: Rapid Prototyping Method:- study of RP relevance in precision manufacturing, sterolithography ,fused deposition methods, materials, principle of prototyping and various applications . (7-Hrs)

Unit-II: Ultrasonic Machining:-elements of the process of UM, mechanics of material removal, process parameters, applications and limitations.
Abrasive water jet machining: - elements of the process of AWJM, mechanics of material removal, process parameters, applications and limitations. **(**7-Hrs)

Unit-III: Electro Chemical Process:- basic fundamentals of Electro Chemical grinding, metal removal rate in ECM,Tooling and applications**.**
Chemical Machining: - basic fundamentals of CM, principle of material removal-maskants-elements .Advantages and applications of CM. (7-Hrs)

Unit-IV: Thermal Metal Removal Process:- basic principle of spark erosion (EDM),wire cut EDM & Electric discharge grinding process ,principle of working and applications . (7-Hrs)

Unit-V: Electron Beam Machining: - generation and control of EBM for machining, theory of EBM, applications and limitations.
Laser Beam Machining: process description, mechanism of material removal in LBM, process parameters, applications and limitations**.** (7-Hrs)

Unit-VI: Composite Materials: - classification of composites.
Manufacturing methods: spray Lay-up, Wet/Hand Lay-up, Vacuum bagging, Resin transfer moulding (RTM) ,Resin Film infusion and applications of composites**.** (7-Hrs)

BOOKS RECOMMENDED:

Text Books:
1. Advanced machining process ,V.K.Jai, Allied publishers.
2. Modern machining process, Pande P.C. & Shah H.S.Tata Mc-Graw Hills.
3. Manufacturing Technology, Volume-II, Rao P.N., Tata Mc-Graw Hills.

Reference Books:
1. Principles of Modern Manufacturing, Mikell P.Groover, SI version, Wiley India Edition.
2. Manufactring Technology, Kalpakzian, Pearson.
3. Production Technology, Volume-II, Khanna O.P., Dhanpat Rai Publisher, New Delhi.
4. Non-Conventional Machining , Mishra P.K.,Narosa Publisher, New Delhi.
5. Composite Materials ï production, properties, testing and applications, K.Shrivasan, Narosa Pubications,

SEMESTER SIXTH

6 ME04 PROF. ELECT. – I (i) NON-CONVENTIONAL ENERGY SOURCES

Course Learning Objectives (CLOs):
1. To study the introduction to renewable and non-renewable resources of energy.
2. To study the radiation transmission through covers & Solar Energy collections.
3. To study the solar energy utilization and solar energy storage.
4. To study energy from ocean and energy from wind.
5. To study biomass energy resources like biomass and biodiesel.
6. To study photo voltaic cell, fuel cell and geothermal energy.

Course Outcomes (COs):
Upon completion of the course, students will be able to:
1. Able to study the concept of renewable and non-renewable sources.
2. Apply the basic concept of solar energy utilization and storage.
3. Apply the concept of energy from ocean and wind.
4. Study the concept of bio-mass energy resources.

SECTION–A

UNIT I:

1. **Introduction:-** Renewable & Non-renewable sources. Need of renewable energy sources, Overview of Global and Indian Energy Scenario.
2. **Solar Radiation:** Solar constant, Definitions of basic earth-sun angles. Types of Solar radiation, Measurement of solar radiation using Pyrheliometer, Pyranometer and Sunshine Recorder, estimation of solar radiation intensity. (8 Hrs.)

UNIT II:

1. **Solar Collectors:-**classifications of collectors- concentrating, non-concentrating collectors and Evacuated tube solar collectors, its construction, and working.
2. **Solar Energy Storage & Utilization:-**Methods of storage such as Mechanical, Thermal, Electrical, Thermo-chemical and Electromagnetic storage. Properties of storage materials and different arrangements of storages. Applications of solar energy in heating, cooling, pumping, power production, distillation, drying, etc. (7 Hrs.)

UNIT III: Direct Energy Conversion:

1. **Solar Photovoltaic cells:** Principle, Construction and Working, Conversion efficiency. Power output and performance.
2. **Fuel Cells:** working principle, types of fuel cells, applications.
3. **Geothermal Energy Resources:** Hot Dry Rock system, Vapour dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. (8Hrs)

SECTION - B

UNIT IV: Energy from Ocean:

1. **Tidal Power:-**Types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant.
2. **Ocean thermal energy conversion system:-** Construction and working of open cycle and closed cycle OTEC systems. (7 Hrs)

UNIT V: Wind Power:- Introduction, Principles of wind energy conversion, Operation, maintenance and economics. Wind patterns and Wind speed data, Types of wind mills, application for pumping and power generation. Conversion efficiency, Site selection. (8Hrs)

UNITVI: Biomass Energy Resources: Mechanism of green plant photosynthesis. Efficiency of conversion, solar energy plantation, Bio-gas – Types of biogas plants, factors affecting production rates. Types of gasifiers, Introduction to bio-diesel and ethanol as alternative fuels, properties of bio-fuel. (7 Hrs)

BOOKS RECOMMENDED:

Text Books:

1. Solar Energy; S.P. Sukhatme; TMH
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications
3. Non-Conventional Energy Sources; B. H. Khan.

Reference Books:

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI.

6ME04 PROF. ELECT. – I (ii) PROJECT MANAGEMENT

Course Learning Objectives:

This course focuses on project management methodology that will allow students to learn how to initiate and manage projects efficiently and effectively. The overall learning shall resolve project identification evaluating its technical and economic feasibility and developing skills for its planning, and establishing controls. Relevant techniques, writing skills and monitoring methods shall be dealt with in details.

Course Outcomes:

Upon completion of the course, students will be able to:

- Apply project selection methods to evaluate the feasibility of projects.
- Use appropriate project management practices, tools, and methodologies.
- Define, analyze, refine, and document project requirements, assumptions, and constraints.
- Analyze and refine project time and cost estimates to define project baseline, schedule and budget.
- Organize and manage critical resources for effective project implementation
- Identify, analyze, quantify and mitigate risks in implementing project

SECTION – A

Unit I: Project Identification considering objectives and SWOT analysis, Screening of Project Ideas, Technical, Market, Financial, Socioeconomic and Ecological Appraisal of a project demand forecasting, secondary data, accuracy, confidence level, uncertainty. (7 hrs.)

Unit II: Technical feasibility: Process selection, Level of automation, plant capacity, acquiring technology, Appropriate technology plant location, Equipment selection & procurement, Govt. policies. Value analysis and project evaluation. (8 hrs.)

Unit III: Economic feasibility: Cost of Project, working capital analysis, fixed cost, means of finance, estimation of sales & production price analysis, Breakeven point, Projected cash flow statements, projected balance sheet, projected profit & loss statement, projected cash flow, rate of return, Discounted payback period, cost benefit analysis, return after taxes. (9 hrs.)

SECTION – B

Unit IV: Project Planning and Control: Work break down structure and network development. Basic Scheduling, Critical Path and four kinds of floats. Scheduling under probabilistic durations, Time Cost tradeoffs, CPM, PERT, Optimum project duration, Integrated resource Management. (9 hrs.)

Unit V: Project report: Preparation of project report, risk analysis, sensitivity analysis, methods of raising capital. (7 hrs.)

Unit VI: Initial review, performance analysis, ratio analysis, sickness, project revival, Project Monitoring with PERT/Cost, Organizational aspects, Computer packages and Project Completion environ-mental & social aspects. (8 hrs.)

BOOKS RECOMMENDED:

Text Books:

1. Prasanna Chandra,ñProjects: Planning, Analysis, Selection, Financing, Implementation, and Reviewò, 9th Edition, McGraw Hill Education (India) Pvt. Ltd. 2019.
2. Choudhry S., Project Management, Tata McGraw-Hill, 1988.
3. P. Gopalakrishnan and V. E. Ramamoorthy, Textbook of Project Management, Laxmi Publications; Laxmi Publications Pvt Ltd., First edition 2014.
4. L.S. Srinath, PERT and CPM: Principles and Applications, Affiliated East-West Press (Pvt.) Ltd. 3rd Edition, 2001.
5. M. Y. Khan, P. K. Jain, Financial Management: Text, Problems and Cases,McGraw Hill Education; Eighth edition, 2018.

Reference Books:

1. Harold Kerzner, Project Management: A Systems Approach to Planning, Scheduling, and Controlling**,** Wiley; 13th edition, 2022.
2. A Guide to the Project Management Body of knowledge PMBOK Guide, 6th Edition, Project Management Institute 2017.
3. John M. Nicholas, Herman Steyn, Project Management for Business, Engineering, and Technology, A Butterworth-Heinemann Title; 3rd edition, 2008.

6ME04 PROF. ELECT. - I (ii) LEAN MANUFACTURING

Course Learning Objectives:

- To introduce basics of Lean Manufacturing System& Its Applications.
- To illustrate Different Concept & Elements of lean manufacturing
- To interpret different approaches for lean manufacturing implementation.
- To introduce concept of Six Sigma and its applications.

Course Outcomes (CO): After completion of course student will be able to:

- Explain the concept, history and applications of lean manufacturing
- Interpret different element of lean manufacturing
- Interpret different tools of lean manufacturing
- Apply lean manufacturing in real life situation.
- Identify the barriers in implementation of Lean Manufacturing
- Explain the concept of Six Sigma

Unit I: Introduction to lean manufacturing:
Historical evolution of lean manufacturing, objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing, 10 steps to lean production, necessity of lean manufacturing systems, limitations and applications of lean manufacturing. (7 Hrs)

Unit II: Concepts in lean manufacturing: Overview of Toyota Production System (TPS), Concept of value in lean, concept of waste in lean, the 7 wastes, their causes and effects. (6 Hrs.)

Unit III: Lean Tools and Methodology:
Primary tools of lean manufacturing such as 5S, Total productive maintenance (TPM), Pillars of TPM, Work Place Organization, Work Cell (6 Hrs)

Unit IV: Secondary Tools of Lean Manufacturing: Introduction and applications of: Just-In-Time (JIT), Kaizen, Poke Yoke, Kanban system , single minute exchange of die (SMED). (7 Hrs)

Unit V: Implementation of Lean Manufacturing : Different approaches for lean manufacturing implementation, important factors in lean implementation, barriers and limitation in lean implementation. (6 Hrs)

Unit VI: Introduction to Six Sigma : Meaning of Six Sigma, Why Six Sigma?, Six Sigma improvement model, building Six Sigma organization and culture, applications of Six Sigma. (7 Hrs)

Text Books :
1. Lean Thinking by James Womack and Danial Jones, Free press.
2. The Toyota way of Field Book by Jeffery Liker and David Meier, Mcgraw ï Hill.
3. The Kaizen Blitz by Laraia, Moody and Hall, Weily.

Reference Books:
1. Lean Production Simplified by Pascal Dennies, Productivity Press.
2. Statistical Quality Control, M. Mahajan, Dhanpatrai and Co. Pvt. Ltd.

6ME05 OPEN ELECTIVE – II (i) RENEWABLE ENERGY TECHNOLOGIES

Course Learning Objectives (CLOs):

1. To study the introduction to renewable and non-renewable resources of energy.
2. To study the radiation transmission through covers & Solar Energy collections.
3. To study the solar energy utilization and solar energy storage.
4. To study energy from ocean and energy from wind.
5. To study biomass energy resources like biomass and biodiesel.
6. To study photo voltaic cell, fuel cell and geothermal energy.

Course Outcomes (COs):
Upon completion of the course, students will be able to:

1. Understand concept of renewable energy sources and its importance.
2. Understand the basic concept of radiation transmission through covers and solar energy collections, the basic concept of Solar energy utilization and storage.
3. Demonstrate, concept of energy from ocean and wind.
4. Understand the concept of bio-mass energy resources, concept of direct energy conversion and fuel cell.

SYLLABUS

UNIT I: Introduction:- Renewable &Non-renewable sources. Need of renewable energy sources, Overview of Global and Indian Energy Scenario.
Solar Radiation: Solar constant, Definitions of basic earth-sun angles. Types of Solar radiation, Measurement of solar radiation using Pyrheliometer, Pyranometer and Sunshine Recorder. (7Hrs)

UNIT II: Solar Collectors:-classifications of collectors- concentrating,non-concentrating collectors and Evacuated tube solar collectors, itôs construction, and working.
Solar Energy Storage & Utilization: Methods of storage such as Mechanical, Thermal, Electrical, Thermo-chemical and Electromagnetic storage. Applications of solar energy in heating, cooling, pumping, power production, distillation, drying, etc. (7Hrs)

UNIT III: Direct Energy Conversion:

1. **Solar Photo voltaic cells:** Principle, Construction and Working, Conversion efficiency.
2. **Fuel Cells:** working principle, types of fuel cells, applications.
3. **Geothermal Energy Resources:** Hot Dry Rock system, Vapour dominated, liquid dominated, flash steam, binary fluid and total flow concept of power generation. (7 Hrs)

UNIT IV: Energy from Ocean:

Tidal Power:-Types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. **Ocean thermal energy conversion system:-** Construction and working of open cycle and closed cycle OTEC systems. (7Hrs)

UNIT V: Wind Power: Introduction, Principles of wind energy conversion, Operation, maintenance and economics. Wind patterns and Wind speed data, Types of wind mills, application for pumping and power generation. Conversion efficiency, Site selection. (No derivations and numericals). (7 Hrs)

UNITVI: Biomass Energy Resources: Mechanism of green plant photosynthesis. Efficiency of conversion, solar energy plantation, Biogas-**Ty**pes of biogas plants, factors affecting production rates. Types of gasifiers, Introduction to bio-diesel and ethanol as alternative fuels, properties of bio-fuel. (7Hrs)

BOOKS RECOMMENDED:

Text Books:
1. Solar Energy; S.P. Sukhatme; TMH.
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications.
3. Non-Conventional Energy Sources; B. H. Khan.

Reference Books:
1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication.
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai.
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, Rakesh Ranjan; PHI.

6ME05 OPEN ELECTIVE –II (ii) AUTOMOBILE ENGINEERING AND ELECTRIC VEHICLES

Course Learning Objectives (CLOs):
1. To study the Introduction of automobiles, engine types and working of SI and CI engines.
2. To study the fuel feed systems, their types and to understand the basics of cooling system.
3. To study the electrical system, Battery capacity and its ratings, starter motor drive and to understand the basics of lubrication system.
4. To study the basics of transmission system, clutches, gear boxes and suspension system.
5. To study the braking system, steering system, wheel balancing and alignment and to study the introduction of power steering.
6. To study the basics of Electric vehicle and to study the working of electric vehicles.

Course Outcomes (COs):
1. Understand the basics of automobile engineering and its components.
2. Analyze &develop about the cooling system and its function.
3. Understand basic concept of transmission system and types of gears box, basic concept of electrical system and ignition system.
4. Apply the knowledge of suspension and lubrication.
5. Understand the concept of Electric vehicle.

SYLLABUS

UNIT I: Introduction, Classification of automobiles, chassis layout, basic working of SI and CI engines, engine parts, Multiple cylinder engines. (7 Hrs)

UNIT II: Fuel feed systems- fuel feed systems for petrol and diesel engines, Basic principles of Multipoint Fuel Injection Systems (MPFI) and Common Rail Diesel Injection Systems (CRDI). **Cooling system:** purpose, Air cooling and water cooling system, antifreeze mixtures. (7 Hrs)

UNIT III: The electrical system:-. Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive. Introduction to Ignition system. Introduction of charging unit for electric vehicle.
Lubrication: Types of lubricants and their applications in automobile. (7 Hrs)

UNIT IV: Transmission system:- Layout, Working principle of clutch, working of Gear Box:- Sliding mesh, Propeller shaft, Principle of differential.
Suspensions system: shock absorbers and independent suspension system. (8 Hrs)

UNIT V: Braking system: Working of Mechanical and hydraulic brakes.
Steering system:- Function, types of linkages, wheel balancing, wheel alignment, Introduction of camber, castor, king pin inclination, toe-in& toe-out & their effects. Introduction to power steering. (7 Hrs)

UNIT VI: Introduction to Electric Vehicle, need, Types of Electric vehicle, components, working, advantages, limitations. (6Hrs)

BOOKS RECOMMENDED:
Text Books:-
1. Automobile Engineering- Vol. I & II; Kirpal Singh; Standard Publishers Distributors
2. Automobile Engineering; R.K. Rajput; Laxmi Publications, New Delhi .
3. Electric and Hybrid Vehicles; Husain, I. CRC Press.

Reference Books:-

1. Automotive Mechanics; Crouse & Anglin; TMH.
2. Automotive Mechanics; J. Heitner; East West Press.
3. Automotive Mechanics; S. Srinivasan; TMH.
4. James Larminie, ñElectric Vehicle Technology Explainedò, John Wiley & Sons, 2003.

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6ME08 COMPUTER AIDED DESIGN & SIMULATION -LAB. [Only Practical]

Course Learning Objectives (CLOs):

1. To understand fundamentals of CAD.
2. To study the solid modeling techniques.
3. To study the geometric transformation techniques.
4. To demonstrate Simulation of Mechanical Systems.

Course Outcomes (COs):

1. Understand the concept of CAD and simulation.
2. Apply knowledge using CAD modeling for component design
3. Apply the knowledge of geometric transformation.
4. Analyse the Mechanical & Manufacturing systems through simulation.

Practicals:- Any six practicals from the list should be performed.

1. Creation of 2D drawing (Sketching Module) of any mechanical machine component using any modeling/drawing software.
2. Creation of isometric view from given orthographic view of any mechanical machine part using any modeling software.
3. Creation of 3D drawing of any mechanical machine part using any modeling software.
4. Creation of assembly of Knuckle joint/ Cotter joint using any modeling software.
5. Creation of sheet metal component using any modeling software.
6. Simulation of Four bar chain mechanism using any modeling software.
7. Simulation of Slider crank chain mechanism using any modeling software.
8. Simulation of Cam and Follower mechanism.
9. Simulation of Spring-mass system.
10. Thermal Analysis of a 2D component
11. Stress analysis of plate with circular hole
12. Stress analysis of beams(cantilever or simply supported)

Practical Examination:-The practical examination shall consist of oral on the term work and syllabus.

Text Books:

1) P. N. Rao; CAD/CAM Principles and Applications; Mc-Graw Hills Publications.
2) Mikel P. Groover and Emory W. Zimmers: Computer Aided Design and Manufacturing, Prentice hall.
3) Ibrahim Zeid: Mastering in CAD- CAM, Tata McGraw Hill Publication.
4) Geoffrey Gordon, System Simulation; Prentice Hall.

Reference Books:

1) Mikell P. Groover: ñAutomation, Production systems & Computer Integrated Manufacturingò, Prentice Hall.
2) Robert E. Shannon; ñSystem Simulation: The Art and Scienceò; Prentice Hall.
3) J. Schwarzenbach and K.F. Gill Edward Arnold; óSystem Modelling and Controlô
4) P. Radhakrishnan and Subramaniam: ñCAD/CAM/CIMò, wiley Eastern Ltd.

SEMESTER VII

7ME09 TECHNICAL SEMINAR AND PROJECT

Course Learning Objectives (CLOs):

1. To collect information on novel and latest development in core and allied area of the subject.
2. To encourage the process of independent thinking and working together in a group.
3. To implement innovative ideas for social benefit
4. To develop the ability to describe, interpret and analyze technical issues.

Course Outcomes (COs): After completion of course, student will be able to:

1. Prepare a well-organized report employing elements of technical writing and critical thinking.
2. Demonstrate the ability to describe, interpret and analyze technical issues.
3. Apply principles of ethics and standards, skill of presentation and communication techniques.
4. Work in a group to develop the leadership/interpersonal skills for finishing task within timeframe.