Department of Mechanical Engineering
National Institute of Technology Raipur
(Institute of National Importance)
G. E. Road, Raipur-492010 (CG)

B. Tech. in Mechanical Engineering
VIII Semester CBCS Scheme

Sl. No	Course Title	Course Code	Course Name	Type	L	T	P	TA		MSE		ESE		Total Marks	Credits
								Max	Min	Max	Min	Max	Min		
1.	Program Elective-VI	ME108201ME	Additive Manufacturing	T	3	0	0	20	0	30	0	50	0	100	3
2.	Program Elective-VI	ME108202ME	Computer Aided Design and Manufacturing												
3.	Program Elective-VI	ME108203ME	Heat Exchangers: Fundamental & Design												
4.	Program Elective-VII	ME108211ME	Advance Refrigeration and Air Conditioning	T	3	0	0	20	0	30	0	50	0	100	3
5.	Program Elective-VII	ME108212ME	Alternative fuels and emission control in internal combustion engines												
6.	Program Elective-VII	ME108213ME	Automobile Engineering												
7.	Open Elective-IV	ME108301ME	Experimental Techniques for the Engineers	T	3	0	0	20	0	30	0	50	0	100	3
8.	Open Elective-IV	ME108302ME	Welding Technology												
9.	Open Elective-V	ME108311ME	Non-Conventional Energy Resources	T	3	1	0	20	0	30	0	50	0	100	3
10.	Open Elective-V	ME108312ME	Nature Inspired Design												
11.**	Internship	ME108701ME	Major Internship	P	0	0	2	50	0	0	0	50	0	100	6
Total					12	1	12							500	12

**The students who opt for Major Internship will have to take '2' open elective courses along with the Major Internship making a total 12 credits for VIIIth Semester.

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Additive Manufacturing**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108201ME**
6.	Status (Core/Elective)	**Program Elective-VI**
7.	Pre-requisites (course no./title)	Computer Graphics, Manufacturing Technology.
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives (CO):** 1. Understand the working principle and process parameters of Additive Manufacturing processes. 2. Explore the applications of AM processes in various fields. 3. Select the suitable material and process for fabricating a given product. 4. Understand the different post processing methods for AM. 5. Understand the basics of different tooling and its methods for AM 6. Apply the knowledge in Modeling of AM components 7. Design and develop basic model of AM Process **Course Outcomes (CO):** 1. Understand the fundamentals and process parameters of AM processes. 2. Explore the suitability of AM process for various applications. 3. Apply the suitable process for fabricating a given product considering different real-life case studies. 4. Understand the different tooling and its methods for AM 5. Develop the optimal modeling of AM components for product. 6. Design and develop a product for AM process.	
10.	**Course Syllabus** **UNIT I** **Introduction:** Overview of Additive Manufacturing (AM); AM history; Classification of AM; Merits/de-merits and applications of AM process; Outline on AM software's. Brief information on different materials used for AM. **UNIT II** **CAD Data Processing for AM: -** CAD model development; Overview on Data requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation; Design of support structure for AM;	

	Overview on slicing methods; Tool path generation for AM. **UNIT III** **Liquid, Solid & Powder Based AM Technologies:** Stereolithography; FDM; LOM; Multi-jet Modeling, SLS, Direct Metal Laser Sintering, 3-Dimensional Printing; Working Principles, products, materials, merits, drawbacks and applications –Case studies. **Direct Energy Deposition AM Process:** Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam based metal deposition: working principles, products, benefits and drawbacks, applications. Overview on new & Hybrid AM technologies. **UNIT IV** **Post Processing of AM Parts:** Overview on support material removal, Surface quality and aesthetic improvement. Applications of AM. Overview on construction of basic AM machines. **Rapid Tooling:** Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods. **AM Applications:** Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.
11.	**Text Books-** 1. **Rapid prototyping: Principles and applications**, second edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2003 2. **Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing,** Ian Gibson, David W Rosen, Brent Stucker, 2nd Edition, Springer, 2015 3. **Rapid Prototyping: Laser-based and Other Technologies,** Patri K. Venuvinod and Weiyin Ma, Springer, 2004. 4. **3D Printing and Additive Manufacturing: Principles and Applications: Fourth Edition of Rapid Prototyping,** Chee Kai Chua, Kah Fai Leong, World Scientific Publishers, 2014 5. **Rapid Tooling: Technologies and Industrial Applications,** Peter Dhillon, Hilton/Jacobs, Paul Jacobs, CRC press, 2000
12.	**Reference Books-** 1. **Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling,** D.T. Pham, S.S. Dimov, Springer 2001. 2. **Rapid Prototyping and Engineering applications: A tool box for prototype development,** Lieu W. Liou, Frank W. Liou, CRC Press, 2007. 3. **Rapid Prototyping:** Theory and practice, Ali K. Kamrani, Emad Abouel Nasr, Springer, 2006 4. **Rapid Prototyping: Principles and Applications in Manufacturing,** Rafiq Noorani, John Wiley & Sons, 2006 5. **Laser Metal Deposition Process of Metals, Alloys, and Composite Materials, Engineering Materials and Processes,** Mahamood R.M., Springer International Publishing AG 2018

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Computer Aided Design and Manufacturing**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108202ME**
6.	Status (Core/Elective)	**Program Elective-VI**
7.	Pre-requisites (course no./title)	Mathematics
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives:** 1. To convey the generic and specific ideas of CAD/CAM as well as teach various aspects of geometric transformations (specifically the graphics algorithms) and modelling of analytical and synthetic curves. 2. To teach in detail, the underpinnings of surface and solid modelling. 3. To make students conversant with the detail aspects of all types of NC systems, their compilation and part programming. 4. Demonstrate group technology as well as the vitals and applications of rapid prototyping. **Course Outcomes (CO):** At the end of this course, the students will be able to 1. Perceive the concepts of CAD/CAM and be acquainted with various geometric modeling and transformations including graphics algorithms like DDA and Bresenham and also be able to model analytic and synthetic curves. 2. Model surfaces and generate solid models of various engineering components. 3. Compile the NC system and various part programming techniques. 4. Demonstrate group technology and develop a thorough understanding of the vitals and applications of rapid prototyping.	
10.	**Course Syllabus** **UNIT I** **Introduction:** Introduction to CAD/CAM, CAD/CAM Tools based on their constituents and their implementation in a design environment, Benefits of CAD/CAM. **Geometric Modeling:** Drawing of lines, circles and ellipses using DDA and Bresenham's algorithms, 2D & 3D Transformations, Perspective and Parallel Projection, Hidden surface Removal. **Geometric Modeling of Curves:** Parametric and Non parametric, Explicit and Implicit, Representation of curves. **Analytical Curve**: Line, Circle, Conics. **Synthetic curve**: Hermite Cubic Splines, Bezier Curves, B- Spline Curves.	

	UNIT II **Representation of Surfaces:** Parametric Representation of surfaces Equation of surface, Tangent vector, Normal vector, Twist vector, Parametric patches and surfaces, Analytical surfaces: Ruled surface, surface of revolution, Tabulated cylinder. Synthetic surface: Hermit bi-cubic surface, Bezier bi-cubic surface, B-spline bi- cubic surface, Coon's surface. **Solid Modeling:** Solid modeling techniques, Geometric and Topology, Valid solid, Types of solid modeling, Algorithms, Basic set theory, Solid Representation Schemes. CSG representation, 3D base primitives, Unary Operation, Boolean's Operation, Sweeping Operation and CSG tree. **UNIT III** **Numerical Control:** Introduction to numerical control, Basic component of an NC System, The NC Procedure, NC coordinate systems, NC motion control system, Applications of NC, Introduction to Computer Control in NC, Problem with Conventional NC, Computer Numerical control, Direct Numerical control, Combined DNC/CNC System, Adaptive control system. NC Part Programming, Introduction to NC Part programming, Manual Part Programming, Computer assisted part programming APT language, G&M codes and examples. **UNIT IV** **Group Technology and Rapid Prototyping:** Introduction to group technology, Part families, Part and classification, Three Parts Classification & Codes system, Group technology Machine cell design, Benefits and Limitation of Group technology. Introduction to Rapid Prototyping: applications, merits and demerits.
11.	**Text Books-** 1. **CAD/CAM Theory and Practice**-Ibrahim Zeid-McGraw Hill Publications. 2. **CAD/CAM Principles & Applications**-P.N.Rao-McGraw Hill Publications. 3. **CAD/CAM Principles and Applications**-J. Srinivas-Oxford University Press.
12.	**Reference Books-** 1. **Computer Numeric Control**- T. Jeyapoovan, Robert Quesada-Pearson Education. 2. **CAD/CAM**-Milkell P. Groover, Emory W. Zimmers-Pearson Education.

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Heat Exchangers: Fundamentals & Design**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108203ME**
6.	Status (Core/Elective)	**Program Elective-VI**
7.	Pre-requisites (course no./title)	Thermodynamics, Fluid Mechanics, Heat Transfer
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives (CO):** At the end of this course, the students will be able to 1. To develop a familiarity with various types of heat exchangers, their construction, and applications. 2. To analyze the sizing and rating of the heat exchangers for various applications 3. Understand the procedure of Designing Heat Exchangers 4. Apply the mathematical knowledge for thermal analysis on various parts of the heat exchangers components.	
10.	**Course Syllabus** **UNIT I – Introduction** Background, Introduction to Thermal and hydraulic aspects, pressure drop and heat transfer, sizing, and rating. Construction Details and Heat Transfer –Types, Shell and Tube Heat Exchangers, Regenerators and Recuperators, Industrial applications. Temperature distribution and its implications, LMTD and NTU method, Effectiveness. **UNIT II – Non-Contacting Type of Heat Exchanger** Tubular Heat Exchangers: different designs, brief description of Shell and Tube Heat Exchangers, Special types. Compact heat exchangers, enhancement of heat transfer, extended surface or Fin, fundamental of extended surface heat transfer, Fin tube heat exchanger. Plate Fin Heat Exchangers (PFHE), types, construction, fabrication, design. **UNIT III- Direct contact heat exchangers, Regenerators and Heat Pipes** Direct contact heat exchangers, types, application, simple analysis. Regenerators, types of regenerators, construction, application. Theory of Regenerator, NTU and method. Heat pipes, construction, working principle, application, analysis. Special heat pipes. **UNIT IV – Phase Change Heat Exchanger & Micro Heat Exchanger** Phase change HEX; phase change heat transfer, introduction to evaporators and condensers. Phase change HEX; phase change heat transfer, introduction to evaporators	

	and condensers Microscale Heat Exchangers and heat sinks; heat transfer and Fuid Fow through narrow conduits, special design.
11.	**Text Books-** 1. **Fundamentals of Heat Exchanger Design**, John Wiley & Sons., R. K. Shah and D. P. Sekulic, 2003.
12.	**Reference Books-** 1. **Process Heat Transfer,** CRC Press, G. F. Hewuttm G L Shires and T R Bott,1994. 2. **Heat Exchangers**, CRC Press, A. Kakac, H. Liu, 2002. 3. **Handbook for Heat Exchangers and Tube Banks Design**, D. Annaratone, Springer Verlag, 2010. 4. **Compact Heat Exchangers**, Pergamon, J. E. Hesselgreaves, 2001. 5. **Advances in Thermal Design of Heat Exchangers**, Eric M. Smith, John Wiley & Sons, Ltd., 2005.

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Advanced Refrigeration and Air Conditioning**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108211ME**
6.	Status (Core/Elective)	**Program Elective-VII**
7.	Pre-requisites (course no./title)	Thermodynamics, Heat and Mass Transfer, Refrigeration and Air Conditioning
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives:** 1. To make students capable to understand and estimate the ozone depletion potential and global warming potential of refrigerants involved and the world's concern about the same. 2. To make students capable to understand and design various efficiency improving techniques in refrigeration and air conditioning. 3. To make students capable to estimate, design, and understand Vapor absorbtion refrigeration system than can work on alternative energy, like solar energy. 4. To make students capable to estimate, design, and understand desiccant based solar air conditioning system being that a recent technique. **Course Outcomes (CO):** At the end of this course, the students will be able to 1. Understand and estimate the ozone depletion potential and global warming potential of refrigerants involved and the world's concern about the same. 2. Understand and design various efficiency improving techniques in refrigeration and Air Conditioning. 3. Estimate, design, and understand vapour absorption refrigeration system that can work on alternative, like solar energy. 4. Estimate, design, and understand desiccant based solar air conditioning system being that a recent technique.	
10.	**Course Syllabus** **UNIT I** **Review of conventional vapour compression systems and alternative refrigerants:** Review of conventional vapour compression systems: VCR systems single stage, multistage and cascade systems. Refrigerants and its types, ODP and GWP of important refrigerants, Montreal & Kyoto Protocol, Alternatives to important CFCs, HCFCs and HFCs, Modern trends in Refrigeration and Air conditioning industry. Retrofitting, Recovery, Recycling and Reclaim **UNIT II** **Novel Trends for efficiency improvement in VCR systems and Novel cycles**: Performance	

	enhancement of VCR system using novel methods of subcooling: Integrated and dedicated subcooling VCR cycles, Ejector Refrigeration system, Trans-critical vapour compression system. Integration of Vortex tube in Trans-critical vapour system, Morar and Keller Models. Waste Heat recovery from refrigeration systems. Methods of improving efficiency at component level. **UNIT III** **Vapour absorption refrigeration systems**: Vapor absorption systems single, double, and triple effect, GAX Vapour Absorption systems. New trends in vapour absorption systems. Use of **Solar energy in Vapour Absorption systems:** Solar operation of refrigeration systems, Rankine and sterling cycle based solar cooling systems. **UNIT IV** **Solar Airconditioning systems:** Solar desiccant cooling systems, Open cycle absorption/desorption solar cooling alternatives, Advanced solar cooling systems, Computer simulation of refrigeration and air-conditioning systems including solar systems.
11.	**Text Books-** 1. **Refrigeration and Air Conditioning** by C. P. Arora, TMH Publication. 2. **Refrigeration and Air Conditioning** by R.K. Rajput Katson Publication. 3. **Refrigeration and Air Conditioning** by Arora & Domkundwar, Dhanpat Rai and Sons. 4. **Solar Energy Fundamentals** by G N Tiwari 5. **Alternatives in Refrigeration and Air Conditioning** by S.C. Kaushik, A. Arora, P.S. Bilga
12.	**Reference Books-** 1. **Solar Refrigeration and space conditioning** By S.C.Kaushik, Divyajyoti Publications. 2. **Refrigeration and Air Conditioning** by Stooker W.F. 3. **Refrigeration and Air Conditioning** by Ahmadul Ameen, PHI Publication 4. **Handbook of Air Conditioning and Refrigeration** by Shan K. Wang, Tata McGraw Hill Publications. 5. **Solar Engineering of Thermal Processes** by Duffie and Beckman

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Alternative fuels and emission control in internal combustion engines**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108212ME**
6.	Status (Core/Elective)	**Program Elective-VII**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives:** 1. To understand combustion process in internal combustion engines. 2. To understand emissions formation in internal combustion engines. 3. To know about emission control technology in internal combustion engines **Course Outcomes (CO):** At the end of this course, the students will be able to 1. Combustion process in IC Engines, 2. Emissions formation in IC Engines, 3. Emission control technology in IC Engines,	
10.	**Course Syllabus** **UNIT I** Petroleum based liquid fuels and refining, Combustion of fuel, Combustion in SI Engines, Combustion in CI Engines. **UNIT II** Alternative fuels: Alcohols, Natural gas, Liquefied petroleum gas, Gas-to-Liquid fuels, Hydrogen, Vegetable oils, Biodiesel etc., Potential, Advantages and Problems associated with these fuels. **UNIT III** Engines emissions: Formation of major pollutants CO, HC, NO_X and PM in IC Engines, Effect of SI Engine design and operating variables, Effect of CI Engine design and operating variables. **UNIT IV** Emission standard and Emission control technology	
11.	**Text Books-** 1. **IC Engines combustion and emissions** by B. P. Pundir, Narosa Publishing house, New Delhi	

12.	**Reference Books-** 1. **Internal Combustion Engine** by V. Ganeshan – McGraw Hill Education (India) Private Limited, New Delhi. 2. **Internal Combustion Engine** by M.L. Mathur and R.P. Sharma,dhanpat rai publications New Delhi.

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Automobile Engineering**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108213ME**
6.	Status (Core/Elective)	**Program Elective-VII**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives (CO):** At the end of this course, the students will be able to 1. Understand and analyze the movements of respective components through simple drawings. 2. Understand & analyze the latest trends in development of new components for automobiles. 3. Develop concepts to identify the faults of automobile by judging the area of probable fault. 4. To establish the concepts of removing the faults at reasonable time with low cost as compared with the traditional methods being followed. 5. To create awareness with the recent developments in technologies. 6. To equip the students with sound knowledge of recent instruments & equipment's used in related areas.	
10.	**Course Syllabus** **UNIT I** **Chassis & Frame:** Layout of chassis, its main components, Types of frames, Conventional frames & Unitized Chassis, Classification of Vehicles, Emission Norms. **Springs:** Purpose & Function, Types: Leaf, Coil Springs, Torsion bars, Rubber springs, Telescopic damper, Stabilizer, Air springs. **Suspension system:** Objects & principles of suspension system, Types, Rigid axle & Independent suspension for front & rear ends, Single & double arm parallel & perpendicular type of suspension system, Gas filled suspension system. **Recent advances in Automobile Engineering** **UNIT II** **Front Axle:** Live & dead axle, Stub axle. **Rear Axle:** Hotch kiss drive, Torque tube drive.	

	Drive Axles: Types of Loads acting on drive axles, Full – Floating, Three–Quarter Floating and Semi–Floating Axles. **Clutches:** Characteristics, Functions, requirements and Principles of operation of clutch, Friction clutch: Cone Clutch, Single plate, Multi plate, Centrifugal clutch, Positive clutch. Clutch lining materials. Torque transmitted and related problems. **Fluid flywheel:** Characteristics, Construction, principles of working. **Electrical System:** Battery construction, Maintenance, Testing and charging, Cutout, Lighting circuit, Horn, Signals, Ventilating system, Heating and Airconditioning Systems. **UNIT III** **Gear Box:** Object of Gear Box, Air, Rolling & Gradient resistance, Necessity of Gear Box: Tractive effort variation with speed, Types of Gear Boxes: Sliding mesh, Constant mesh, Synchromesh. Selector Mechanism. Lubrication of gear box, Transfer case/box. Automatic transmission/s, Overdrive. **Torque converter:** Principles of working, characteristics, Torque converter with direct drive, Testing of automobiles. **Drive Line:** Universal Joints, Propeller Shaft. **Final Drive, Differential:** Functions, Single & double reduction differential, Limited slip differential. **Wheels:** Types **Tyres:** Types, specifications/ designations, factors affecting tyre life. **UNIT IV** **Brakes & Braking system:** Purpose, Principles, Layout of braking system. Classification: Drum & Disc brakes, Mechanical Brakes, Hydraulic brakes: Master cylinder, Tandem master cylinder, wheel cylinder. Self-adjusting brakes, Self-energizing brakes, Power assisted brakes, Anti–Lock Brakes/ Antiskid brakes. **Steering system:** Types of steering gears, Steering Ratio, Reversibility of steering, Center point steering, Steering Geometry: Castor, Camber, King Pin Inclination, Combined Angle, Toe-in, Toe-out. Cornering power, Under & Over Steer; Power steering, effect of shimmy, Condition of true rolling, calculation of turning radius. Correct steering equation and related problems.
11.	**Text Books-** 1. **Automobile Engineering** – Vol. I & II - Kripal Singh, Standard Publishers 2. **Automotive Mechanics** – J Heitner, EWP 3. **Automobile Engineering** – G. B. S. Narang, Khanna Publishers 4. **Motor Vehicle** – Newton & Steeds, Life & Sons Limited.
12.	**Reference Books-** 1. **Automotive Mechanics** – W. H. Crouse & D. L. Anglin, Tata McGraw Hill 2. **Automobile Engineering** - Dr. N. K. Giri – Khanna Publishers 3. **Automobile Engineering** – K. R. Govindan – Anuradha Agencies

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Experimental Techniques for the Engineers**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108301ME**
6.	Status (Core/Elective)	**Open Elective-IV**
7.	Pre-requisites (course no./title)	Basic mechanical and electrical engineering, Linear regression, and statistics
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives:** 1. To acquire basic concepts of measurement systems and its conversion (analogue to digital and vice-versa) 2. To characterize the material properties (mechanical, thermal, electrical, etc.) for basic and advanced engineering applications. 3. To understand the statistical analysis of static and dynamics experimental data and its significance. 4. To get acquainted with various types of transducers (actuator and sensor) for different applications. 5. To completely understand develop the working principle of sensors and actuators. **Course Outcomes (CO):** At the end of this course, the students will be able to 1. Understand the basic concept of engineering experimentation. 2. Ability to plan experiments and present the experimental data meaningfully. 3. Acknowledge, access and analysis various experimental techniques. 4. Carry out Error and uncertainty analysis of mechanical system. 5. Ability to apply theoretical concepts for data analysis and interpretation. 6. Capability to visualize and understand materials and its characterization	
10.	**Course Syllabus** **UNIT I** **Measurement System and data acquisition:** Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, Static and dynamic performance characteristics of measurement devices, general data acquisition system, Signal conditioning, data transmission, Analog-to-Digital and Digital-to-Analog Conversion, Data Storage and Display, Calibration, Analysis of experimental data (Concept of error, Sources of error, Statistical analysis of errors)	

	UNIT II **Mechanical Design Characterization techniques:** Introduction (Force, torque and strain measurements), Mass Balance measurements, Elastic Element for force measurement, Torque Measurement, Stress and Strain, Strain measurements, Electrical-Resistance strain Gages Basic Characteristics of a Strain Gauge, Types of Strain Gauge, Grid Method of Strain Analysis, Factors Influencing Strain sensitivity, Gauge Construction, Factors-Influencing Gauge Section, Gauge Sensitivity and Gauge Factor, Correction for transverse Strain Effects, Rosette Analysis, Universal Testing Machine. **UNIT III** **Sensors & transducers:** Sensors and Transducers – Types of sensors, Type of transducers and their characteristics, Performance Terminology, (Displacement, Position & Proximity Sensors), (Velocity & Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature & Light Sensors), Selection of Sensors, The Variable-Resistance transducer, Capacitive Transducer, The Differential Transformer (LVDT), Piezoelectric Transducers, Comparison of Analog and Digital Instruments. Mechanical Actuation Systems, Hydraulic & Pneumatic Actuation Systems, Electrical Actuation Systems. **UNIT IV** **Thermal and transport characterization techniques:** Introduction, Thermal-Conductivity Measurement, Measurement of Viscosity, Calorimetry, Thermo Gravimetric Analysis (TGA), Instrumentation, Applications, Differential Thermal analysis (DTA), Apparatus, Methodology, Applications, Differential Scanning Calorimeter (DSC), Applications, instrumentation, data acquisition and interpretation of analytical results.
11.	**Text Books-** 1. **Experimental methods for the engineers,** J. P. Holman, 2nd Ed. TMH 2. **Experimental Stress Analysis,** J.W. Dally and W.F. Riley, 2nd Ed. MGH. 3. **An Introduction to Experimental Stress and Strain Analysis,** Dureli. 4. **Mechatronics**, W. Bolton, Pearson Education Asia, N. Delhi 5. **Microstructural Characterization of Materials;** D. Brandon & W.D. Kaplan, John Wiley & Sons Publ., 1999.
12.	**Reference Books-** 1. **Metallurgical Thermochemistry,** O. Kubashewski, E. Vans & C. B. Alcock, Pergamon Press, 1967. 2. **Physical Examinations of Metals,** B. Chalmers & A. G. Quarell, Edward Arnold, 1960. 3. **Metal Experiments in Material Science,** E. C. Subba Rao; T.M.H. 1973.

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Welding Technology**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108302ME**
6.	Status (Core/Elective)	**Open Elective-IV**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives (CO):** Upon successful completion of this course, you should be able to: 1. To understand the various manual and automated welding processes available. 2. Learn the various types of stresses & distortions induced in a component as a result of welding Weld joints, weld symbols, and joint design principles. 3. To understand the concepts on materials failure and fracture analysis of materials and to design new materials that can with stand catastrophic failures at different environment.	
10.	**Course Syllabus** **UNIT I** **Introduction**: Evolution of welding; classification of welding processes; heat sources and shielding methods. **Physics of Welding Arc:** Welding arc; voltage distribution along the arc; thermionic and non-thermionic cathodes; theories of cathode and anode mechanism; arc characteristics and its relationship with power source; arc efficiency; heat generation; effect of type of shielding gas on arc; isotherms of arcs. **UNIT II** **Arc Welding Processes:** Consumable electrode welding processes. Manual metal arc (MMA) welding; Gas metal arc welding; pulsed MIG welding; Submerged arc welding, Significance of flux-metal combination; Electroslag welding: heat generation; principle; Gas tungsten arc welding; selection of polarity. **UNIT III** **Design of weld joints**: Introduction to design; engineering properties of steels; Type of welds and weld joints; description of welds: terminology, definitions and weld symbols; edge preparation; sizing of welds in structure; Design for Static loading, Weld Calculations in lap, butt and fillet welds; design for fatigue loading,	

	UNIT IV **Testing and inspection of weld joints:** Chemical tests; Metallographic tests; Hardness tests; Mechanical test for groove and fillet welds-full section, reduced section and all-weld- metal tensile tests, root, face and side bend tests, fillet weld break tests, creep & fatigue testing. Non-Destructive Testing of Weldments; Visual inspection; Dye-penetrant inspection; Magnetic particle inspection; Ultrasonic inspection, principle of ultrasonic testing, Radiographic inspection –principle of radiography, X-ray tubes, gamma-ray sources, defect discernibility; Eddy current inspection.
11.	**Text Books-** 1. **Welding Process and Technology,** Vol. 1 and Vol.2 , R. S. Parmar, Khanna Publisher. 2. **Welding Principles and Practices,** E. R. Bohnart, Mc Graw Hill Publisher.
12.	**Reference Books-** 1. **The Metallurgy of Welding,** 6th Edition , Lancaster, William Andrew Publishing, NY. 2. **Principles of Welding (Processes, Physics, Chemistry and Metallurgy),** Robert and Messler, Wiley Interscience Publishers. 3. **Welding Hand Book**, Vol. 5; 7th edition, AWS, 1984. 4. **Welding Metallurgy**, S Kou, John Wiley, USA, 2003

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Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Nature Inspired Design**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108311ME**
6.	Status (Core/Elective)	**Open Elective-V**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives (CO):** • This course will introduce the interdisciplinary field of nature inspired design and biomimicry. Essential concepts will be taught using multiple perspectives including biology, design, business and engineering. Biomimicry is the process of learning about and from nature in order to transfer that knowledge and propose innovative solutions to human-related problems. That same process also helps advance knowledge creation in biology and the other supporting fields. • Knowledge obtained in the course can be used as a framework for students interested in pursuing deeper study in biomimicry as well as a foundation for application to other fields of interest. Familiarity with basic concepts in Biology, Art/Design, Business, or Engineering are helpful, but deep knowledge of any single discipline is not required to complete or benefit from taking this course. **Course Outcomes** Upon successful completion of this course, you should be able to: 1. Describe the theory and methods behind nature inspired design and biomimicry 2. Provide diverse examples of biomimetic applications and how they work 3. Use tools introduced in class to further your own ideas for nature inspired design 4. Apply tools introduced in the class to advance your studies in fields such as biology, design, business or engineering.	
10.	**Course Syllabus** **UNIT I** Introduction, fundamental definitions, historical development, technological Aspects, Biomimicry. **UNIT II** Nature as a Model, Nature as a Measure, Nature as a Mentor, Iconic Case Studies, Natural mechanisms and their applications.	

	UNIT III Biomimetic surfaces, Biomaterials, biocompatible materials, biologically inspired smart materials, sensors, robots. **UNIT IV** Nature inspired Engineering Design and Architecture, Tools and Concepts. Team Design Projects.
11.	**Text Books-** 1. **Engineered Biomimicry**, Akhlesh Lakhtakia (Editor), Raúl José Martín-Palma (Editor), Elsevier, 2013. 2. **Inspired by Biology,** National Research Council, The National Academies Press, 2008
12.	**Reference Books-** 1. **Biomimicry: Innovation Inspired by Nature**, Morrow, Janine M. Benyus, New York, 2009, 1997. 2. **Biomimetics: Nature-Inspired Design and Innovation**, Sandy B. Primrose, Wiley Blackwell, 2020.

Department of Mechanical Engineering

National Institute of Technology Raipur

(Institute of National Importance)

G. E. Road, Raipur-492010 (CG)

Semester-VIII

1.	Department proposing the course	**Mechanical Engineering**
2.	Course Title	**Non-Conventional Energy Sources**
3.	L-T-P Structure	**3-0-0**
4.	Credits / # of period	3
5.	Course Number (Code)	**ME108312ME**
6.	Status (Core/Elective)	**Open Elective-V**
7.	Pre-requisites (course no./title)	Nil
8.	Frequency of offer	Once per Academic Year
9.	**Course Objectives:** 1. To understand the need of non-conventional energy resources. 2. To identify the application of non-conventional energy technologies. 3. To understand the principles involved in conversion of solar energy, wind energy, biomass and geothermal energy to electricity generation. 4. To understand the principle of working of fuel cell and its environmental effects. **Course Outcomes (CO):** Upon successful completion of this course, you should be able to: 1. Understand the need and role of non- conventional energy sources and power generation techniques to generate electrical. 2. Evaluate the performance of the various non-conventional and renewable energy sources.	
10.	**Course Syllabus** **UNIT I - Introduction of non-conventional energy sources** Classification of energy sources, Impact of current energy usage, Conventional sources of energy, Importance of non-conventional energy sources, Advantages and disadvantages of non-conventional energy sources, World energy status, Energy scenario in India, Energy storage, Necessity of energy storage, Energy storage methods. **UNIT II - Solar Energy** Solar energy incident on earth, Solar spectrum, Measurement of solar radiation, Overview of solar energy technologies, Solar thermal systems, Solar photovoltaic systems, Performance and durability of solar devices. **UNIT III - Wind Energy and Biomass** **Wind Energy**: Introduction, Technology and geographical aspects, Estimation of wind energy at a site, Wind energy conversion systems, Wind turbine aerodynamics, Wind turbine types, Wind energy storage, Environmental aspects, Wind energy in India. **Biomass**: Overview, Photosynthesis process, Biomass resources, Biomass conversion	

	technology, Biomass gasification, Biomass liquefaction, Biogas plant. **UNIT IV - Geothermal energy and Fuel Cell** **Geothermal energy**: Introduction, Origin, application and distribution of geothermal energy, Types of geothermal resources, Analysis of geothermal resources, Exploration and development of geothermal resources, Environmental consideration, and Geothermal energy in India. **Fuel Cell:** Introduction, Application, Classification, Performance of fuel cell, Fuel cell power plant, Present status, Environment effect.
11.	**Text Books-** 1. **Non- Conventional Sources of Energy**- G.D. Rai- Khanna Publisher. 2. **Non-Conventional Energy Resources**- B. H. Khan- Tata Mc Graw Hill Education Pvt Ltd. 3. **Renewable Energy Resource: Basic Principles and Applications**- G. N. Tiwari and M. K. Ghosal- Narosa Publishing House.
12.	**Reference Books-** 1. **Renewable Energy Sources: Their Impact on Global Warming and Pollution**- Tasneem Abbasi, S. A. Abbasi- PHI Learning Pvt. Ltd. 2. **Solar Energy: Principles of Thermal Collection and Storage:** S. P. Sukhatme- Tata McGraw Hill. 3. **Solar Energy Thermal processes-** Duffie and Beckman- John Wiley. 4. **Fuel Cell Problems and Solutions-** V. S. Bagotsky- John Wiley & Sons. 5. **Wind Energy Engineering-** Pramod Jain- McGraw-Hill Companies, Inc