



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

B. Tech. in Mechanical Engineering
VII 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-IV | ME107201ME | Fluid Mechanics-II-Fluid Machinery | T | 3 | 0 | 0 | 20 | 0 | 30 | 0 | 50 | 0 | 100 | 3 | | |
| 2. | Program Elective-IV | ME107202ME | Solar Energy Utilization | | | | | | | | | | | | | | |
| 3. | Program Elective-V | ME107211ME | Energy Conversion System | T | 3 | 0 | 0 | 20 | 0 | 30 | 0 | 50 | 0 | 100 | 3 | | |
| 4. | Program Elective-V | ME107212ME | Power Plant Engineering | | | | | | | | | | | | | | |
| 5. | Program Elective-V | ME107213ME | Tribology | T | 3 | 0 | 0 | 20 | 0 | 30 | 0 | 50 | 0 | 100 | 3 | | |
| 6. | Open Elective-III | ME107301ME | Air Pollution Control | | | | | | | | | | | | | | |
| 7. | Open Elective-III | ME107302ME | Integrated Product Development | | | | | | | | | | | | | | |
| 8. | Open Elective-III | ME107303ME | Optimization Techniques | T | 3 | 0 | 0 | 20 | 0 | 30 | 0 | 50 | 0 | 100 | 3 | | |
| 9. | Program Core | ME107101ME | Production Management | | | | | T | 3 | 1 | 0 | 20 | 0 | 30 | 0 | 50 | 0 |
| 10. | Laboratory | ME107401ME | Mechanical Lab – 9 | P | 0 | 0 | 2 | 40 | 0 | 20 | 0 | 40 | 0 | 100 | 1 | | |
| 11. | Internship | ME107701ME | Summer Internship II | P | 0 | 0 | 2 | 50 | 0 | 0 | 0 | 50 | 0 | 100 | 2 | | |
| 12. | Laboratory | ME107801ME | Project Work | P | 0 | 0 | 8 | 40 | 0 | 20 | 0 | 40 | 0 | 100 | 4 | | |
| Total | | | | | | 12 | 1 | 12 | | | | | | 700 | 20 | | |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Fluid Mechanics-II-Fluid Machinery |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107201ME |
| 6. | Status (Core/Elective) | Program Elective-IV |
| 7. | Pre-requisites (course no./title) | Nil |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives (CO): At the end of the course, the student will be able to <ol style="list-style-type: none">Understand the concept of relative velocity and velocity diagrams of Jets and calculate the Vane angles, power transfer and efficiency.Understand the concept of axial, tangential and radial flow in turbomachineryUnderstand the concept of different type of Turbines.Understand the concept of different type of Pumps | |
| 10. | Course Syllabus UNIT I IMPACT OF JETS: Impulse momentum principle, force exerted by the jet on stationary and moving plate. Concept of relative velocity and velocity diagrams. Vane angles, power transfer and efficiency. INTRODUCTION TO TURBO MACHINERY: positive displacement and rotodynamic or turbomachines, types of turbomachines, axial, tangential and radial flow, impulse and reaction types, degree of reaction, velocity diagrams, Eulers equation. UNIT II INTRODUCTION TO TURBINES: Hydroelectric power plant, location, major components, surge tank, classification of turbines, specific speed, PELTON TURBINE: major components and their function, specific speed, nozzles, force, power, losses of power, different efficiencies, bar diagram. UNIT III REACTION TURBINES: Francis turbine, construction, major parts, working, work done, efficiency, cavitation, role of draft tube, advantages and disadvantages. Kaplan and propeller turbine working and comparison, model analysis. UNIT IV CENTIFUGAL PUMP: Construction, working, velocity diagram, work done, power, | |

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| | efficiency, pumps in series and parallel, cavitation, specific speed RECIPROCATING PUMP: classification and working, single acting and double acting, slip, indicator diagram, work done and power, air vessel, use, cavitation. |
| 11. | Text Books- <ol style="list-style-type: none"> 1. Mechanics of fluid – Massey B S – English Language Book Society (U K) 2. Fluid Mechanics –Yunus A. Cengel and John M Cimbala – McGraw Hill |
| 12. | Reference Books- <ol style="list-style-type: none"> 1. A Text book of fluid mechanics—R K Rajput—S Chand and Co, Ltd 2. Introduction to Fluid mechanics and machines --- S K Som and G Biswas --- McGraw Hill |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Solar Energy Utilization |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107202ME |
| 6. | Status (Core/Elective) | Program Elective-IV |
| 7. | Pre-requisites (course no./title) | Thermodynamics, Heat and Mass Transfer |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: | <ol style="list-style-type: none">1. To teach the students about how to estimate the amount of solar radiation received by any surface, at any place, on any date over the globe.2. To teach the students about how to estimate, evaluate and analyse the amount of distillation of potable water by various techniques based on solar energy.3. To make students to learn the evaluating and analysing the use of various solar thermal applications that includes air heater, solar chimney, solar dryer for energy conservation as a benefit to the society and to mankind.4. To make students capable to estimate the economic feasibility of any proposed solar thermal application in the light of payback period and life cycle etc. |
| 10. | Course Outcomes (CO): At the end of the course, the student will be able to <ol style="list-style-type: none">1. Estimate the amount of solar radiation received by any surface, at any place, on any date over the globe.2. Estimate, Evaluate and analyse the amount of distillation of potable water by various techniques based on solar energy.3. Evaluate and analyse the use of various solar thermal applications that includes air heater, solar chimney, solar dryer for energy conservation as a benefit to the society and to mankind.4. Estimate the economic feasibility of any proposed solar thermal application in the light of payback period and life cycle etc. Course Syllabus UNIT I Calculation of solar radiation received: The sun, Solar Radiation: Terrestrial, Extraterrestrial, Sun Earth angles, Availability of solar radiation on inclined surface, on horizontal surface, Solar Time, Sun rising, and sun set time, day length, sunshine hours, Estimation of beam and diffused components of hourly, daily, monthly average, radiation on any surface on any day and at any place. UNIT II Solar distillation: Introduction, working principle, thermal efficiency, instantaneous | |

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| | <p>efficiency, overall thermal efficiency, heat transfer, external heat transfer, top loss coefficient, bottom and side loss coefficient, internal heat transfer, radiative loss coefficient, convective loss coefficient, evaporative loss coefficient, determination of distillate output, passive solar stills, effect of various parameters, other designs, modified internal heat transfer.</p> <p>UNIT III</p> <p>Solar thermal devices, Description and classifications, conventional heaters, double exposure heaters, air heater with flow above and both side of the absorber, two pass solar air heater, heater with finned absorber, vee-corrugated absorber, reverse absorber heater, with porous absorber, testing of solar air collector, parametric studies, applications of air heater, comparison of performance of liquid and air collector. Other Solar Thermal Devices: solar cooker, solar driers, solar chimney etc.</p> <p>UNIT IV</p> <p>Economic analysis of solar equipment: Introduction, cost analysis, Cash flow diagrams, cost comparison with equal and unequal duration, Payback time with and without interest, benefit cost analysis, Effect of depreciation, cost comparison after taxes.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Solar Energy Fundamentals, Design Modelling and Applications By G.N.Tiwari, Narosa publication 2. Solar distillation practice for water desalination systems: By G.N.Tiwari and A.K.Tiwari, Anamaya Publishers. 3. Solar Energy Principles of thermal collection and storage By S P Sukhatme and J K Nayak |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Advance solar distillation systems By G N Tiwari and Lovedeep Sahota 2. Solar Engineering of Thermal Processes by Duffie and Beckman |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Energy Conversion System |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107211ME |
| 6. | Status (Core/Elective) | Program Elective-V |
| 7. | Pre-requisites (course no./title) | Physics, MOS-1, Basic Mechanical Engineering |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: <ol style="list-style-type: none">1. To understand the principle of steam generation theory and steam generators.2. To understand the different components of steam power plants.3. To estimate the performance of boilers, draft, and condensers.4. To understand the working principle of aircraft engines and rockets.5. To understand various types of non-conventional energy resources. Course Outcomes (CO): At the end of this course, the students will be able to <ol style="list-style-type: none">1. Explain the functioning of different types of high-pressure boilers.2. Apply thermodynamics principle in closed and open system.3. Differentiate various forms of non- conventional energy sources.4. Apply the principle of momentum and thrust equation for jet propulsion systems. | |
| 10. | Course Syllabus UNIT I – Boilers Classification of boilers, Boiler mountings & accessories, Draught & its classification, Chimney height & diameter calculation, Efficiency of a chimney, Draught losses. High pressure boilers – La-Mont, Benson, Velox and Super critical boiler, Fluidized bed boiler. UNIT II – Steam Condensers Function, Types of condensers, Efficiency and measurement. Analysis of condenser operation, Source of air leakage, Effect of air leakage, Air extraction, Thermodynamic analysis. UNIT III – Direct Energy Conversions Tidal energy conversion, OTEC, MHD power system, Geothermal energy, Conversion technique, Thermo-electric effects, Thermo-electric & thermionic converters. UNIT IV – Jet Propulsion | |

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| | <p>Aircraft Propulsion: Types of jet engines, Principle and operation, Thermodynamics of turbo jet, Efficiency and performance, Turbo prop, Ram jet, Pulse jet, Comparison of various propulsive devices</p> <p>Rocket Propulsion: Types of rocket engines, Basic theory, Physics equations, Classifications, Liquid propellant rockets and its advantage, Efficiency and performance, Rocket projection and escape velocity.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion – S.M. Yahya – New Age International Publishers. 2. Thermal Engineering – Mahesh M. Rathore- McGraw Hill Education. 3. Thermodynamics & Heat Engines – R. Yadav – CPH. 4. Non Conventional Energy Resources- B. H. Khan- McGraw Hill Education |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Fundamental of Compressible Fluid Dynamics – P. Balachandran – PHI. 2. Gas Turbine Theory & Jet Propulsion – J.K. Jain – Khanna Publishers. 3. High Pressure Boilers- Frederick M. Steingress, Harold J. Frost, Daryl R. Walker- American Technical Publishers. 4. Thermal Engineering (engineering Thermodynamics & Energy Conversion Techniques)- P. L. Ballaney- Khanna Publishers. |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Power Plant Engineering |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107212ME |
| 6. | Status (Core/Elective) | Program Elective-V |
| 7. | Pre-requisites (course no./title) | Strength of Materials, Fluid Mechanics, Machine Design, Engineering Mechanics, Material science and engineering mathematics |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: | <ol style="list-style-type: none">1. To know the basics of various powerplants like steam, hydroelectric, nuclear and diesel power plant.2. To understand and solve problems related to power developed.3. To understand power plant economics. |
| | Course Outcomes (CO): | At the end of this course, the students will be able to <ol style="list-style-type: none">1. The steam power plant.2. The Hydroelectric power plant.3. The Nuclear power plant.4. The Diesel power plant5. Variable load problems and power station economics. |
| 10. | Course Syllabus | <p>UNIT I</p> <p>General Sources of power, Central Power Stations, Elements of electric power systems primary and secondary distribution substations (in brief).</p> <p>Steam Power Plant: Elements of modern steams power stations, brief layout and arrangement of elements and complements, Foundation.</p> <p>Heat Balance in steam cycles, Fuels and fuel handling System and Ash handling System, Air pre-heater, Feed water pre-heaters, Steam re-heaters, Deaerators, Feed water treatment, Pumping and regulation water walls, Modern developments in steam boilers, Important instrumentation and piping of gas and water loop. Factors to be controlled from maximum efficiency and variable output.</p> <p>UNIT II</p> <p>Hydro Electric power station –Potential power with reference to rainfall and catchments area, Water storage, Equipment used in hydro-electric power stations, Characteristics of hydraulic turbines, Comparison of the factors governing the cost of</p> |

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| | <p>hydro steam and diesel power stations.</p> <p>Diesel power station -Application of Diesel in power field, Suitability of diesel engines for bulk power, Layout of Diesel Power Plant, Advantages and limitations of diesel, Power stations, Performance Characteristics.</p> <p>UNIT III</p> <p>Nuclear Power Station -Evolution of nuclear energy from atoms by fission and fusion, Chain reactions, Fission materials, Type of reactors, gas cooled, Boiling water liquid,Metal cooled and fast reactor, Arrangements of various elements in a nuclear power station, Steam cycles and boilers coolant heat exchangers, Reactor control, Reactor shielding and safety methods.</p> <p>UNIT IV</p> <p>Variable load problems: Idealized and realized load curves, Effect of variable load on plant design and operation variable load operation.</p> <p>Power station Economics: Source of income, Cost of plant and production, Elements of cost, depreciation and replacement theory of rates.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Power Plant Engineering, 2nd Edn. – P.K. Nag – Tata McGraw-Hill Pub. Com., New Delhi. 2. Fundamental of Power Plant Engineering -R. Yadav-Central Publishing House Allahabad,2011 3. Plant Engineering – G. R. Nagpal – Khanna Publishers. |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Power Plant Engineering – F. T. Morse Affiliated East – West Press Pvt. Ltd., New Delhi. 2. Power Plant Technology – M. M. E1 – Wakil – McGraw Hill, International Edition 1984 |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Tribology |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107213ME |
| 6. | Status (Core/Elective) | Program Elective-V |
| 7. | Pre-requisites (course no./title) | Strength of Materials, Fluid Mechanics, Machine Design, Engineering Mechanics, Material science and engineering mathematics |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: The main objective of the course is to explain the importance of Tribology in the context of industrial applications. Also, other objectives of this course are listed below: <ol style="list-style-type: none">1. The basic objective of the course is to deal fundamentals of friction, wear and lubrication.2. The course is useful in understanding the nature of surfaces of engineering materials.3. The course is useful in understanding the various lubricants and tribological applications (Bearings, Gears, etc.) | |
| 10. | Course Outcomes (CO): The students will be able to <ol style="list-style-type: none">1. Explain the role of friction in tribological applications. Also, discuss different wear mechanism and their remedies.2. Distinguish between different types of lubricants and their selection in different engineering applications. Summarize the importance of surface finish and condition monitoring.3. Design different bearings (hydrodynamics, anti-friction, etc)4. Discuss tribological aspects of gear applications.5. Explain the Green and Nano Tribology | |
| 10. | Course Syllabus UNIT I Tribology Introduction, Historical background, Practical Importance and subsequent use in the field. Friction: Origin, Friction Theories, measurement methods, friction of metals and non metals. | |

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| | <p>Wear: Classification and Mechanisms of Wear, Delamination theory, Testing methods, approach to wear reduction</p> <p>UNIT II</p> <p>Lubricants: Types and specific field of applications. Requisite properties of lubricants. Viscosity, its measurement, effect of temperature and pressure on viscosity, standard grades of lubricants, selection of lubricants. Lubrication Types, Basic equation of lubrication.</p> <p>Surface Roughness: Standardization, measurement with contacting and non-contacting instruments, Statistical analysis of surface, characteristics of the surface.</p> <p>Condition Monitoring: Condition monitoring & monitoring techniques for tribological systems, Lubricant monitoring, Temperature monitoring, Corrosion monitoring, Surface roughness monitoring.</p> <p>UNIT III</p> <p>Behaviour of Tribological components, Bearings, Classification, selection, effect of frictional torque, factors affecting performance, failure modes, bearing lubrication.</p> <p>Hydrodynamic Bearings: Mechanism of pressure development, classification, Idealized Journal Bearing, oil film thickness, pressure distribution, load carrying capacity.</p> <p>Elasto-hydrodynamic Lubrication: Theoretical considerations, line and point contacts, film thickness equations, different regimes in EHL contact.</p> <p>UNIT IV</p> <p>Antifriction Bearings: Ball and roller bearings, geometry of ball bearings, radial load distribution, stresses and deformations, lubrication of ball bearings.</p> <p>Gears: friction & stresses, wear, lubrication & failure. Failure Case Studies.</p> <p>Green Tribology: Basics and Applications</p> <p>Nano Tribology: Basics and Applications</p> <p>Case Studies in different areas of Engineering.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Engineering Tribology– Prasanta Sahoo – Prentice Hall of India Pvt. Ltd., New Delhi, 2005. 2. Fundamentals of Tribology – S.K. Basu, S.N. Sengupta, B.B. Ahuja – PHI Learning Pvt. Ltd., 2010. 3. Tribology in Industries – S.K. Shrivastava – S. Chand & Company Ltd., New Delhi, 2001 |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Engineering Tribology – G.W. Stachowiak, A.W. Batchelor – Elsevier India Pvt. Ltd., New Delhi. 2. Introduction to Tribology of Bearings – B.C. Majumdar – S. Chand & Company Ltd., New Delhi. 3. Rolling Bearing Analysis – T.A. Harris – John Wiley & Sons, Inc., New York |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Air Pollution Control |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107301ME |
| 6. | Status (Core/Elective) | Open Elective-III |
| 7. | Pre-requisites (course no./title) | Nil |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: | <ol style="list-style-type: none">Understand sources of air pollution and its effect, relationship between pollutant concentrations, legislation and regulation.Understand emission from I.C. engines, major industries and control measures.Understand meteorological aspects of air pollutant dispersion.Understand air pollution sampling, measurement, pollution control method and control equipment. |
| 10. | Course Outcomes (CO): At the end of the course, the student will be able to <ol style="list-style-type: none">Identify sources of air pollution and its effect, relationship between pollutant concentrations, legislation & regulation.Explain about emission from IC engine &major industries along with control measures.Discuss meteorological aspects of air pollutant dispersionDiscuss air pollution sampling& measurements, pollution control method and control Equipment. Course Syllabus | UNIT I Air Pollution: Introduction Air Pollution, sources & classification of air pollutants, aerosols, Primary & secondary air pollutants, Photochemical Air pollution, Effect of air pollution on human health, vegetation and materials, Pollutant concentration, types, relationship between different concentration Air pollution indices, determination of index, Air pollution legislation & regulations (1981 & 1986). UNIT II Air pollution: Transportation & Major Industries Air pollution due to automobiles, types of emission from IC Engines, Effect of various operating variables on exhaust emission, control of emissions from IC Engines. Air pollution from major industries: Fe & Steel Industry, Thermal Power Plants Cement |

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| | <p>Industries. Smoke, measurement of smoke and its control.</p> <p>UNIT III</p> <p>Meteorological Aspects of Air pollutant Dispersion Temperature Lapse rates & stability, wind velocity and turbulence, Plume Behaviour, Dispersion of air pollutants, the Gaussian Plume Model.</p> <p>Air Pollution Sampling & Measurement Types of pollutant sampling techniques and measurement, Ambient Air Sampling, collection of gaseous air pollutants and particulate pollutants, stack sampling techniques, analysis of air pollutants.</p> <p>UNIT IV</p> <p>Air Pollution control methods & Equipment Air pollution source correction methods: Process changes, equipment modification/machinery replacement etc. Gases/ Odour control: Combustion, Absorption, Adsorption. Control equipment's: Objectives and choice of control equipment, Settling chamber, Inertial separators, Cyclones, filters, Electrostatic Precipitator, Scrubbers.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Air Pollution- M.N. Rao, H.V.N. Rao, Tata McGraw Hill Company. 2. Environmental Pollution Control Engineering - C.S. Rao, New Age International Limited Publishers. |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Air Pollution control Theory- Martin Crawford, Tata McGraw Hill Company. |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Integrated Product Development |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107302ME |
| 6. | Status (Core/Elective) | Open Elective-III |
| 7. | Pre-requisites (course no./title) | Nil |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives: | <ol style="list-style-type: none">1. gain the knowledge of the product development process, on various product development methodologies, product management problems regarding the product development in the industries.2. understand the integration of customer requirements in product design concept generation, selection and testing for development of product.3. Understand the concept of industrial product design process, testing methods and report documentation for development of product.4. Understand and analyze on different service industries and their product development process including intellectual property rights and confidentiality, security and configuration management concept with case studies.5. launch own ideas and the ideas of others, which enables you to manage your own company as well as to work with innovation and development in large companies. |
| | Course Outcomes (CO): | <ol style="list-style-type: none">1. Analyse various global trends, product development process and product development methodologies to decide on the scope of the new product in the market & industries.2. Summarize the types of product requirements, product development methodologies and management.3. Analyse the different product design concept, and selection of developed product through real life case studies.4. Conceptualize the product of integrating hardware, software, controls, electronics and mechanical system and detailed product design and testing.5. Develop product test specifications standards, validate the product and confirm its performance as per design specifications.6. Enumerate the end product development process of trade off, IPR, security and configuration management. |
| 10. | Course Syllabus | UNIT I - Fundamentals of Product Development Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends, Technical Trends, Economic Trends, Environmental |

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| | <p>Trends, political/Policy Trends; PESTLE Analysis.</p> <p>Introduction to Product Development Methodologies and Management: Overview of Products and Services; Types of Product Development (NPD/ Re-Engineering; Overview of Product Development methodologies; Product Life Cycle; Product Development Planning and Management.</p> <p>UNIT II - Requirements and System Design</p> <p>Requirement Engineering: Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management.</p> <p>UNIT III - Design and Testing</p> <p>Conceptualization: Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation.</p> <p>Detailed Design: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing.</p> <p>Testing, Certification and Documentation: Introduction to Product verification processes and stages (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).</p> <p>UNIT IV - Business Dynamics - Engineering Services Industry</p> <p>The industry: Engineering Services Industry – overview; Product development in Industry versus Academia.</p> <p>The IPD Essentials: Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and configuration management.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Student handbook, by NASSCOM and NIT Silchar |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Product Design and Development, 4th edition, Karl T. Ulrich and Steven D. Eppinger, Irwin McGraw-Hill, 2008. 2. Quality Function Deployment, Productivity Press, Akao, Y., ed. (1990), Cambridge MA. Becker Associates Inc. 3. The Mechanical Design Process, Ullman, David G. Mc Graw-Hill, 4th edt., 2009 4. Product design techniques in reverse engineering and new product development, Kevin Otto, Kristin Wood, Pearson, India, 2001 5. Designing engineering systems for sustainability, Sandborn P, Myers J., In: Misra KB, editor. Handbook of performability engineering, Springer; 2008. |



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Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Optimization Techniques |
| 3. | L-T-P Structure | 3-0-0 |
| 4. | Credits / # of period | 3 |
| 5. | Course Number (Code) | ME107303ME |
| 6. | Status (Core/Elective) | Open Elective-III |
| 7. | Pre-requisites (course no./title) | Nil |
| 8. | Frequency of offer | Once per Academic Year |
| 9. | Course Objectives (CO): At the end of the course, the student will be able to | <ol style="list-style-type: none">1. Acquire knowledge and develop basic understanding of the concepts of optimization and mathematical modelling.2. Acquire knowledge for basic modelling techniques to formulate the real-life practical problems into a mathematical model.3. Use different direct and gradient based optimization method to solve single and multivariable un-constrained or constrained nonlinear function for minimization or maximization.4. Use non-traditional optimization methods such as Genetic Algorithms, Simulated Annealing, Global Optimization5. Application of software for optimization and develop the computer programs for different optimization algorithms6. Get aware to Goal Programming, Advanced Optimization Techniques and Dynamic Programming |
| 10. | Course Syllabus UNIT I Introduction, Single Variable Optimization, Bracketing Methods (Exhaustive Search Method, Bounding Phase Method), Region Elimination Methods (Interval halving Method, Fibonacci Search Method, Golden Section Method), Point Estimation Methods, Gradient Based Methods (Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method) | UNIT II Multivariable Optimization Techniques, Unidirectional Search Methods, Direct Search Methods (Evolutionary Optimization Method, Simplex Search Method, Hooke-Jeeves Pattern Search Method, Powell's Conjugate Direction Method), Gradient Based Methods (Cauchy's Steepest Descent Method, Newton's Method, Marquardt's Method) |

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| | <p>UNIT III</p> <p>Constrained Optimization Algorithms, Transformation Methods (Penalty Function Method, Method of Multipliers), Direct Search (Variable Elimination Method, Random Search Method).</p> |
| | <p>UNIT IV</p> <p>Introduction to Non-Traditional optimization techniques (Genetic Algorithms, Simulated Annealing), Software related to Optimization, Introduction to Goal Programming, Introduction to Advanced Optimization Techniques.</p> |
| 11. | <p>Text Books-</p> <ol style="list-style-type: none"> 1. Optimization: Theory and Applications, S. S. Rao. |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none"> 1. Optimization for Engineering Design, Kalyanmoy Deb, Mohan C Joshi & K. M. Moudgalya |



Department of Mechanical Engineering

National Institute of Technology Raipur

(Institute of National Importance)
G. E. Road, Raipur-492010 (CG)

Semester-VII

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| 1. | Department proposing the course | Mechanical Engineering |
| 2. | Course Title | Production Management |
| 3. | L-T-P Structure | 3+1+0 |
| 4. | Credits / # of period | 4 |
| 5. | Course Number (Code) | |
| 6. | Status (Core/Elective) | Program Core |
| 7. | Pre-requisites (course no./title) | Mathematics |
| 8. | Frequency of offer | Once in a Year |
| 9. | Course Objectives: | <ol style="list-style-type: none">Understand the basic concept of production management, cost analysis and forecasting techniques to identify the various demand patterns.Understand the Inventory control and learn the various inventory control techniques to solve the real-life problems.Understand the production planning and control objectives, functions, steps and leans the various sequencing and scheduling techniques.Understand the line balancing and supply chain management concept to solve the real-life industrial problems. |
| | Course Outcomes (CO): | The students will be able to: <ol style="list-style-type: none">Apply the appropriate forecasting model based on different demand pattern.Determine the level of inventory and apply the appropriate model and technique to solve the industrial problems.Apply the various concepts of production management (production planning and control, line balancing, MRP, SCM) to solve the industrial problems. |
| 10. | Course Syllabus UNIT - I: Introduction: Introduction, Objectives, Scope of Production management, Production Systems, Types of Production Systems (Job, Batch, Mass and Continues Production System, Flexible production System, Lean Production System, Push and Pull Production Control System), Product Life Cycle. Cost Analysis: Element of Costs, Break even Analysis, Incremental Costs, Make or Buy Decisions Demand Forecasting: Purpose, Types of Forecasting, Qualitative Method of Forecasting – opinion Survey Method, Market Trials, Delphi Method etc., Quantitative Models: a). Level/Constraint Model, Weightage Method, Moving Average Method, Exponential Method etc. b). Trend Model – Least Square Method, Holts Model. | |

c). seasonal Model, Basic Model, Winter Model.

UNIT - II:

Inventory Control: Objectives, Scope and Classification, Inventory Control techniques, Economic Order Quantity, Wilson Harrise Model, Inventory Model for Back Order, Discount Model, All Quantity Discount Model and Marginally, Quantity Discount Model, Inventory Model for Multiple items, Production and Consumption Model with and without Backordering, Safety Stock, General Idea regarding Inventory Control under Risk and Uncertainty.

Material Requirement Planning: Dependent Demand, Material Requirement Planning, Structure of MRP System, MRP Calculations, Planning Issues, Incrimination Issues, MRP-I vs. MRP-II.

UNIT - III:

Production Planning and Control (PPC): Introduction, Objectives and Functions of PPC, Steps in PPC, Routing, Master Production Schedule, Sequencing for Single Machine, Flow Shop Scheduling, Job Shop Scheduling, Johnson Algorithm, Modified Johnson Algorithm, Branch and Bound Method, Palmer Heuristic, Campbell Dudek Smith (CDS) Algorithm, Shifting Bottleneck Heuristic, Gantt Chart, Dispatching, Expediting.

UNIT - IV:

Line Balancing: Introduction, Objectives, Line Efficiency, Smoothness Index, Shortest Processing Time Algorithm.

Supply Chain Management: Introduction, Definitions, Objectives and Major Drivers of Supply Chain, Supply Chain Strategies, Supply Chain Integration Concept.

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| 11. | <p>Text Books-</p> <ol style="list-style-type: none">Chase, R. B., Jacobs F. R. and Aquilano N. J., "Operations Management for Competitive Advantages", 11th Edition, Tata McGraw Hill Book Company, New Delhi, 2010.Hopp W. J. and Spearman M. L., "Factory Physics: Foundations of Manufacturing Management", McGraw Hill International Edition, 3rd Edition, 2008.Chary S. N., "Production and operations Management", McGraw Hill International Edition. |
| 12. | <p>Reference Books-</p> <ol style="list-style-type: none">Richard B, Chase, Ravi Shankar, and F. Robert Jacobs, "Operations & Supply Chain Management (14th edition)", McGraw Hill Publishing Company Ltd, New Delhi.David Simchi-Levi, Philip Kaminsky, Edith Simchi-Levi and Ravi Shankar, "Designing and managing the Supply Chain: Concepts, Strategies and Case Studies (Third Edition)", McGraw Hill Publishing Company Ltd, New Delhi. |